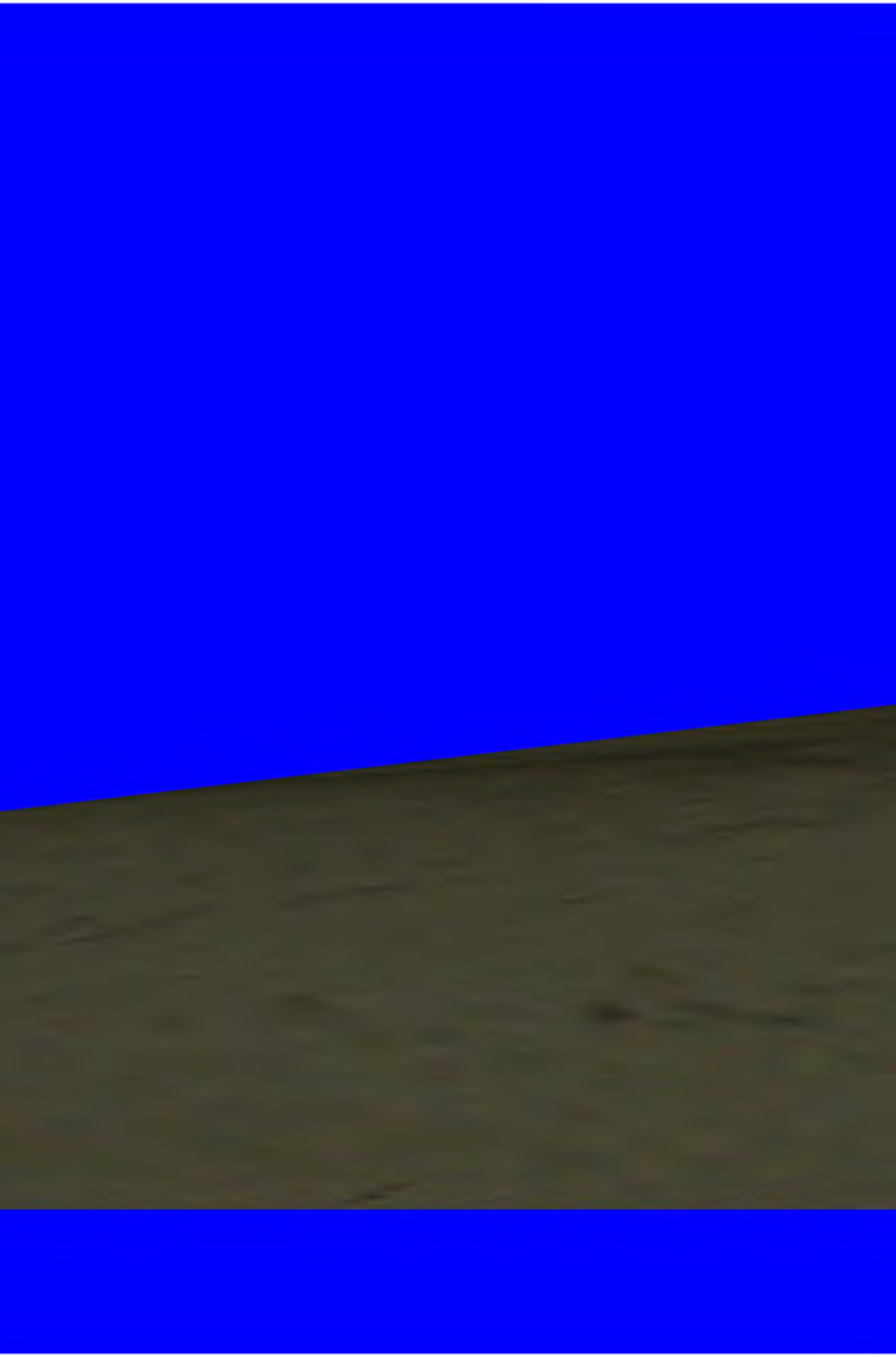

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FOR THE YEAR

1899.

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Vol. I.

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THIRTY-FIRST ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
1900.

MEMBERS OF THE BOARD.

1899–1900.

HENRY P. WALCOTT, M.D., *Chairman*, ...	of Cambridge.
GERARD C. TOBEY, Esq., ...	of Wareham.
JAMES W. HULL, ...	of Pittsfield.
CHARLES H. PORTER, ...	of Quincy.
JULIAN A. MEAD, M.D., ...	of Watertown.
HIRAM F. MILLS, C.E., ...	of Lawrence.
FRANK W. DRAPER, M.D., ...	of Boston.

Secretary.

SAMUEL W. ABBOTT, M.D.

Engineer.

X. H. GOODNOUGH, C.E.

Pathologist.

THEOBALD SMITH, M.D.

Chemist.

H. W. CLARK.

Consulting Chemist.

THOMAS M. DROWN, M.D.

CONTENTS.

GENERAL REPORT.

The following report of the State Board of Health comprises the general work of the Board during the year ending Sept. 30, 1899, and of the special work relating to food and drug inspection during the same period, also of that which relates to water supply and sewerage for the calendar year 1899.

The first portion of the volume, paged in Roman numerals, contains a condensed account of the work done under the provisions of the laws defining the duties of the Board.

The regular work of the Board is performed mainly under the provisions of three separate acts and the necessary appropriations for their execution,—an organic act of 1869, establishing the Board; an act for the inspection of food and drugs, of 1882; and an act for the protection of the purity of inland waters, of 1886, with the amendments to these acts.

The second part of the report, paged in Arabic figures, contains the fuller details of the work of the Board, under the acts relating to water supply and sewerage, food and drug inspection and the general acts relating to the work of the Board.

The following members comprised the Board in 1899: —

HENRY P. WALCOTT, *Chairman.*

FRANK W. DRAPER.	GERARD C. TOBEY.
HIRAM F. MILLS.	CHARLES H. PORTER.
JAMES W. HULL.	JULIAN A. MEAD.

No changes have taken place in the membership of the Board during the year.

INFECTIOUS DISEASES.

One of the prominent topics of general interest in all civilized countries is the decline in the mortality from infectious diseases.

As a general rule, most of the destructive infectious diseases — typhoid fever, small-pox, dysentery, scarlet fever, measles, whooping-cough, diphtheria, puerperal fever and, most prominent of all, consumption — have shown a diminishing death-rate, comparing the past ten years with a similar period fifty years ago. To this rule the population of Massachusetts has formed no exception.

The mortality from the diseases usually known as local diseases (diseases of the brain, heart, lungs, kidneys, etc.) has generally increased in recent years, but the decline in the mortality from infectious diseases has more than counterbalanced this increase, so that the result has been a diminution in the general death-rate of the State. This death-rate has for the past fifty years averaged about 19.5 per 1,000 of the living population, but the death-rate of the past four years has been considerably less than 19.5.

The year 1898 was remarkable for the absence of serious epidemics throughout the State, the death-rate having been lower than that of any previous year, with one or two exceptions, for a half-century.

The year 1899 also, so far as can be learned from the mortality returns of the year, was, like its predecessor, a year of more than average healthfulness. The death-rate of the State was slightly less than that of the previous year, allowing for an average growth of population, such as had prevailed between the two census enumerations of 1890 and 1895. The death-rate from the principal infectious diseases was slightly but not very much greater than that of 1898.

The following figures are worthy of note in this connection: —

Deaths and General Death-rates, Massachusetts, 1891–99.

Year.	Deaths.	Death-rates.	Year.	Deaths.	Death-rates.
1891,	45,185	19.7	1896,	49,381	19.3
1892,	48,762	20.8	1897,	47,419	18.1
1893,	49,084	20.5	1898,	46,761	17.5
1894,	46,791	19.1	1899,	47,710	17.4
1895,	47,540	19.0			

The following figures are also suggestive, as showing the mortality from the principal infectious diseases during the two years 1898 and 1899: —

Deaths from Principal Infectious Diseases, Massachusetts, 1898–99.

	1898.	1899.		1898.	1899.
Small-pox, . .	–	14	Dysentery, ...	293	268
Diphtheria and croup,	706	1,047	Whooping-cough, . .	337	338
Scarlet fever, . .	141	235	Pneumonia, . . .	4,206	4,993
Typhoid fever, . .	663	612	Cancer, ...	1,907	1,838
Measles, . . .	82	241	Cerebro-spinal meningitis,	259	240
Cholera infantum, .	2,320	1,964			
Consumption, . .	5,288	5,221		16,202	17,011

By the foregoing table it appears that there was an increase in the mortality from small-pox, diphtheria, scarlet fever, measles, whooping-cough and pneumonia, amounting to 1,396 deaths, and a decrease of 587 deaths in the mortality from typhoid fever, cholera infantum, consumption, dysentery, cancer and cerebro-spinal meningitis, comparing the figures of 1899 with those of 1898.

Small-pox.

During the year 1899 small-pox has occurred in Massachusetts to a greater extent than in any year since 1894. The number of places in which outbreaks have occurred was, however, quite small, and were all in the eastern portion of the State. No case was reported from any town in which rags were used for the manufacture of paper.

The reported cases occurred in the following cities and towns: Fall River, 37; Boston, 29; Everett, 6; Chelsea, 27; Swampscott, 3; Lowell, 2; Melrose, 1; total, 105 cases.

Sex. — Of the whole number, 53 were males and 52 were females.

Season. — Contrary to the usual history of small-pox the principal outbreaks in 1899 occurred in the latter part of spring and in summer, 69 cases having been reported between April 1 and October 1.

Of the foregoing number it is worthy of note that the circumstances in certain cases revealed a gross violation of certain specific laws relating to vaccination, since 11 cases occurred among unvaccinated mill operatives at Fall River, in violation of chapter 515 of the Acts of 1894, while there were also 4 cases among unvaccinated scholars in the public schools, in violation of chapter 496 of the Acts of 1898, section 11.

Record of Cases of Small-pox reported to the State Board of Health during the Year 1899, under the Provisions of Chapter 302 of the Acts of 1893.

Number.	Date of Report.	Place of Occurrence.	Nationality of Patient.	Occupation.	Age.	Sex.	Previously Vaccinated.	Number of Scars.	Number of Deaths.
1[1]	April 11,	Boston, .	Ireland, .	Laborer, .	42 years.	M.	Yes.	1	–
2	April 11,	Boston, .	United States,	– –	–[2]	F.	No.	–	–
3	April 11,	Boston, .	United States,	– –	10 years.	M.	–	–	–
4	April 12,	Boston, .	Ireland, .	Housewife, .	32 years.	F.	Yes.	2	–
5[1]	April 13,	Boston, .	Scotland, .	Mill operative, .	42 years.	F.	Yes.	1	–
6	April 21,	Boston, .	United States,	Baker, .	31 years.	F.	Yes.	–	1
7[1]	April 23,	Boston, .	Ireland, .	Housewife, .	28 years.	F.	Yes.	1	–
8	April 25,	Boston, .	Ireland, .	– –	3 years.	F.	Yes.	–	–
9[1]	April 25,	Boston, .	Ireland, .	Laborer, .	24 years.	M.	Yes.	1	–
10[1]	May 19,	Swampscott, .	United States,	Shoemaker, .	42 years.	M.	Yes.	–	1
11	May 29,	Fall River, .	French Canadian.	Mill operative, .	17 years.	M.	No.	–	–
12	May 29,	Fall River, .	French Canadian.	– –	4 years.	F.	No.	–	–
13	Mny 29,	Fall River, .	French Canadian.	Scholar, .	9 years.	F.	No.	–	–
14[3]	May 29,	Fall River, .	French Canadian.	Mill operative, .	19 years.	F.	Yes.	1	–
15	May 29,	Fall River, .	French Canadian.	Housewife, .	38 years.	F.	No.	–	–
16[4]	May 29,	Fall River, .	French Canadian.	Scholar, .	11 years.	M.	Yes.	1	–
17[5]	May 29,	Fall River, .	French Canadian.	Scholar, .	14 years.	F.	Yes.	1	–
18	May 29,	Fall River, .	French Canadian.	Scholar, .	7 years.	M.	No.	–	–
19[5]	May 29,	Fall River, .	French Canadian.	Scholar, .	12 years.	M.	Yes.	1	–
20	May 29,	Fall River, .	French Canadian.	Mill operative, .	18 years.	F.	No.	–	–
21[6]	May 29,	Fall River, .	United States,	– –	11 mos.	M.	No.	–	–
22	May 29,	Fall River, .	French Canadian.	– –	2¼ years.	M.	No.	–	–
23	May 29,	Fall River, .	French Canadian.	Scholar, .	10 years.	F.	Yes.	–	–
24	May 29,	Fall River, .	French Canadian.	Mill operative, .	28 years.	M.	No.	–	–
25	May 29,	Fall River, .	French Canadian.	Mill operative, .	23 years.	M.	No.	–	–
26[6]	May 29,	Fall River, .	United States,	– –	2 years.	F.	No.	–	–
27[7]	May 29,	Fall River, .	French Canadian.	Mill operative, .	34 years.	M.	Yes.	1	–
28[8]	May 29,	Fall River, .	French Canadian.	Housewife, .	54 years.	F.	Yes.	2	–
29[6,9]	May 29,	Fall River, .	United States.	– –	2¼ mos.	F.	No.	–	–
30	May 29,	Fall River, .	French Canadian.	Mill operative, .	21 years.	F.	No.	–	–
31	May 29,	Fall River, .	French Canadian.	Laborer, .	29 years.	M.	No.	–	–

1 Vaccinated in infancy.
2 One year four months.
3 Vaccinated ten years ago.
4 Vaccinated two years before date.
5 Vaccinated one year ago.
6 Parents French Canadians.
7 Twenty-three years before date.
8 Vaccinated thirty years ago.
9 Not vaccinated till May 27.

Record of Cases of Small-pox reported to the State Board of Health during the Year 1899, under the Provisions of Chapter 302 of the Acts of 1893 — Continued.

Number.	Date of Report.	Place of Occurrence.	Nationality of Patient.	Occupation.	Age.	Sex.	Previously Vaccinated	Number of Scars.	Number of Deaths.
32[1]	May 29,	Fall River, .	French Canadian.	Mill operative, .	16 years.	M.	Yes.	1	-
33	May 29,	Fall River, .	French Canadian.	Mill operative, .	22 years.	M.	No.	-	-
34	May 29,	Fall River, .	French Canadian.	Mill operative, .	24 years.	M.	No.	-	-
35	May 29,	Fall River, .	French Canadian.	Mill operative, .	29 years.	M.	-	-	-
36	May 29,	Fall River, .	French Canadian.	Mill operative, .	24 years.	M.	No.	-	-
37	May 29,	Fall River, .	French Canadian.	Mill operative, .	19 years.	F.	No.	-	-
38	May 29,	Fall River, .	French Canadian.	Mill operative, .	28 years.	M.	No.	-	-
39[2]	May 29,	Fall River, .	French Canadian.	Mill operative, .	28 years.	M.	Yes.	1	-
40	May 29,	Fall River, .	United States,	- -	2 years.	F.	No.	-	-
41	May 29,	Fall River, .	French Canadian.	Laborer, . .	40 years.	M.	No.	-	-
42[3]	May 29,	Fall River, .	French Canadian.	Mill operative, .	18 years.	F.	Yes.	-	-
43[3]	May 29,	Fall River, .	French Canadian.	Mill operative, .	22 years.	F.	Yes.	Slight.	-
44[4]	June 5,	Swampscott, .	United States,	Railroad employee,	50 years.	M.	Yes.	8	-
45[5]	June 5,	Swampscott, .	United States,	Scholar, . . .	15 years.	F.	Yes.	Slight.	-
46	June 7,	Boston, . .	United States,	- -	10 years.	M.	-	1	-
47	June 7,	Boston, . .	United States,	- -	4 years.	M.	No.	-	1
48[6]	June 10,	Boston, . .	United States,	Housewife, . .	35 years.	F.	Yes.	1	-
49	June 17,	Fall River, .	United States,	Mill operative, .	15 years.	F.	No.	-	-
50	June 19,	Boston, . .	United States,	- -	1 year.	F.	No.	-	1
51	June 21,	Boston, . .	Ireland, . .	Domestic, . .	30 years.	F.	Yes.	1	-
52[7]	June 23,	Boston, . .	Ireland, . .	Laborer, . .	60 years.	M.	Yes.	-	-
53[8]	June 27,	Boston, . .	British Provinces.	- -	54 years.	M.	Yes.	-	1
54	June 28,	Fall River, .	French Canadian	- -	16 years.	M.	No.	-	-
55[8]	June 30,	Boston, . .	United States,	- -	32 years.	F.	No.	-	-
56[8]	July 6,	Boston, . .	Ireland, . .	Housewife, . .	54 years.	F.	Yes.	-	-
57	July 11,	Boston, . .	British Provinces.	Carpenter, . .	26 years.	M.	No.	-	-
58	Aug. 4,	Boston, . .	United States,	Domestic, . .	45 years.	F.	-	-	-
59[8]	Aug. 12,	Boston, . .	Ireland, . .	Insurance agent, .	46 years.	M.	Yes.	1	-
60[8]	Aug. 16,	Boston, . .	Ireland, . .	Car inspector, .	35 years.	M.	Yes.	1	1
61	Aug. 21,	Fall River, .	French Canadian.	Laborer, . .	28 years.	M.	No.	-	-
62	Aug. 27,	Boston, . .	United States,	- -	5 years	M.	No.	-	-
63[8]	Aug. 27,	Boston, . .	England, .	- -	31 years.	M.	Yes.	1	-

[1] Vaccinated ten years ago.
[2] Thirteen years before date.
[3] Several years before date.
[4] Vaccinated thirty-five years ago and ten days ago.
[5] Ten years ago and ten days ago.
[6] Vaccinated thirty years ago.
[7] Vaccinated forty years ago.
[8] Vaccinated in infancy.

Record of Cases of Small-pox reported to the State Board of Health during the Year 1899, under the Provisions of Chapter 302 of the Acts of 1893 — Continued.

Number.	Date of Report.	Place of Occurrence.	Nationality of Patient.	Occupation.	Age.	Sex.	Previously Vaccinated.	Number of Scars.	Number of Deaths.
64	Sept. 1,	Fall River, .	French Canadian.	- -	4 years.	F.	No.	-	-
65	Sept. 23,	Everett, .	United States,	- -	4½ years.	M.	-	-	-
66[1]	Sept. 26,	Everett, .	United States,	Housewife, . .	29 years.	F.	Yes.	1	-
67	Sept. 26,	Chelsea, .	United States,	Barber, . . .	25 years.	M.	No.	-	-
68[2]	Sept. 26,	Chelsea, .	German, . .	Watchmaker, .	28 years.	M.	Yes.	-	-
69[3]	Sept. 26,	Chelsea, .	United States,	Clerk, . . .	25 years.	M.	Yes.	1	-
70[3]	Sept. 26,	Chelsea, .	United States,	Electrician, . .	23 years.	M.	Yes.	1	-
71	Oct. 5,	Lowell, . .	United States,	Mill operative, .	20 years.	M.	No.	-	-
72	Oct. 7,	Everett, .	United States,	- -	23 years.	F.	No.	-	1
73[4]	Oct. 7,	Everett, .	United States,	Nurse, . . .	55 years.	F.	Yes.	2	1
74	Oct. 9,	Chelsea, .	United States,	Housewife, . .	53 years.	F.	Yes.	-	-
75[3]	Oct. 10,	Everett, .	United States,	Journalist, . .	81 years.	M.	Yes.	-	-
76[2]	Oct. 11,	Chelsea, .	United States,	Clerk, . . .	23 years.	M.	Yes.	1	-
77[5]	Oct. 11,	Chelsea, .	United States,	Housewife, . .	53 years.	F.	Yes.	1	1
78	Oct. 11,	Chelsea, .	United States,	- -	5 years.	M.	No.	-	-
79[6]	Oct. 16,	Melrose, .	United States,	Boiler inspector, .	36 years.	M.	Yes.	5	-
80[4]	Oct. 20,	Everett, .	United States,	Book-keeper, .	45 years.	M.	Yes.	Slight.	-
81	Oct. 25,	Chelsea, .	United States,	Housewife, . .	19 years.	F.	No.	-	1
82	Oct. 26,	Chelsea, .	British Provinces.	Domestic, . .	22 years.	F.	No.	-	1
83[7]	Oct. 27,	Chelsea, .	United States,	Housewife, . .	40 years.	F.	Yes.	1	-
84[5]	Oct. 27,	Chelsea, .	United States,	Mill operative, .	25 years.	M.	Yes.	-	1
85	Oct. 27,	Chelsea, .	United States,	Teamster, . .	30 years.	M.	Yes.	1	-
86	Oct. 29,	Chelsea, .	United States (colored).	Housewife, . .	25 years.	F.	No.	-	-
87[8]	Nov. 5,	Chelsea, .	United States,	Housewife, . .	58 years.	F.	Yes.	-	-
88[5]	Nov. 6,	Chelsea, .	United States,	Domestic, . .	22 years.	F.	Yes.	1	-
89	Nov. 18,	Chelsea, .	United States (colored).	- -	1 year.	F.	No.	-	-
90[2]	Nov. 18,	Chelsea, .	United States (colored).	Housewife, . .	35 years.	F.	Yes.	1	-
91	Nov. 18,	Chelsea, .	United States (colored).	- -	2 years.	F.	No.	-	-
92	Nov. 19,	Chelsea, .	United States (colored).	Barber, . . .	25 years.	M.	No.	-	-
93	Dec. 1,	Chelsea, .	United States,	- -	5 years.	M.	No.	-	-
94[9]	Dec. 1,	Chelsea, .	United States,	- -	7 years.	F.	Yes.	1	-
95[10]	Dec. 2,	Chelsea, .	Russia, . .	- -	5 years.	M.	Yes.	2	-

1 Vaccinated in August.
2 Vaccinated ten years ago.
3 Vaccinated fifteen years ago.
4 Vaccinated forty years ago.
5 Twenty years ago.
6 Vaccinated four years before present date.
7 Thirty-five years ago.
8 Thirty-eight years ago.
9 Three months ago.
10 Two years ago.

Record of Cases of Small-pox reported to the State Board of Health during the Year 1899, under the Provisions of Chapter 302 of the Acts of 1893 — Concluded.

Number.	Date of Report.	Place of Occurrence.	Nationality of Patient.	Occupation.	Age.	Sex.	Previously Vaccinated.	Number of Scars.	Number of Deaths.
96[1]	Dec. 4,	Chelsea, .	United States,	- -	4 mos.	M.	Yes.	1	-
97[1]	Dec. 4,	Chelsea, .	United States,	- -	-[2]	F.	Yes.	1	-
98	Dec. 7,	Chelsea, .	United States,	- -	3 years.	M.	No.	-	-
99	Dec. 15,	Boston, . .	British Provinces.	- -	25 years.	F.	No.	-	-
100[3]	Dec. 16,	Boston, . .	Denmark, .	- -	39 years.	F.	Yes.	1	-
101	Dec. 18,	Lowell, . .	United States,	Paper-hanger, .	32 years.	M.	No.	-	1
102	Dec. 19,	Boston, . .	United States,	- -	4 years.	F.	No.	-	-
103[4]	Dec. 19,	Chelsea, .	United States,	Book-keeper, .	23 years.	F.	Yes.	-	1
104[3]	Dec. 29,	Boston, . .	United States,	- -	50 years.	F.	Yes.	1	-
105[3]	Dec. 31,	Boston, . .	British Provinces.	- -	36 years.	F.	Yes.	1	-

[1] Three months ago.
[2] One year nine months.
[3] Vaccinated in infancy.
[4] Seventeen years ago.

General Summary. — The following general summary is presented in consequence of an unusual prevalence of small-pox in 1899.

Since 1883 records have been kept of each case of small-pox reported in the State, from which it is possible to gain fairly accurate information as to the protection afforded by vaccination, as well as the effect of the age of the individual upon the fatality of the disease in the vaccinated and the unvaccinated.

The following table presents the numbers of cases reported to the State Board of Health, together with the number of deaths in each year since and including 1883: —

Cases and Deaths from Small-pox reported to the State Board of Health, 1883-1899.

Years.	Cases.	Deaths.	Years.	Cases.	Deaths.
1883, ...	21	5	1888, ...	32	9
1884, ...	9	3	1889, ...	15	6
1885, ...	32	19	1890, ...	6	1
1886, ...	2	-	1891, ...	5	3
1887, ...	13	3	1892, ...	19	2

Cases and Deaths from Small-pox reported to the State Board of Health, 1883-1899 — Concluded.

Years.	Cases.	Deaths.	Years.	Cases.	Deaths.
1893,	45	9	1897,	18	4
1894,	185	33	1898,	12	-
1895,	1	-	1899,	105	14
1896,	5	-	Total,	525	111

From 1885 down to the present time records have also been kept of the fact of vaccination among those attacked with small-pox, so far as it was possible to gather this information from the official notices received at the office of the Board. From these records the following table has been compiled: —

Small-pox in Massachusetts (1885-99). Comparative Fatality of the Vaccinated and Unvaccinated.

Years.	Totals.			Vaccinated.			Unvaccinated.			Unknown.		
	Cases.	Deaths.	Per Cent.	Cases.	Deaths.	Per Cent.	Cases.	Deaths.	Per Cent.	Cases.	Deaths.	Per Cent.
1885,	32	11	-	7	-	-	13	9	-	12	2	-
1886,	3	1	-	1	-	-	1	1	-	1	-	-
1887,	12	3	-	6	-	-	5	2	-	1	1	-
1888,	32	5	-	15	1	-	13	3	-	4	1	-
1889,	16	4	-	11	1	-	3	1	-	2	2	-
1890,	6	1	-	2	-	-	2	-	-	2	1	-
1891,	5	1	-	1	-	-	3	1	-	1	-	-
1892,	19	2	-	7	-	-	10	1	-	2	1	-
1893,	47	9	-	11	-	-	29	8	-	7	1	-
1894,	185	33	-	84	6	-	86	22	-	15	5	-
1895,	1	-	-	1	-	-	-	-	-	-	-	-
1896,	5	-	-	4	-	-	-	-	-	1	-	-
1897,	18	3	-	9	2	-	3	1	-	6	-	-
1898,	12	-	-	11	-	-	1	-	-	-	-	-
1899,	105	14	-	54	7	-	46	7	-	5	-	-
	498	87	17.5	224	17	7.6	215	56	26.0	59	14	23.7

From this table it appears that the fatality of small-pox among the vaccinated was 7.6 per cent., while that of the unvaccinated was 26.0 per cent., or more than three times as great.

These cases reported in the fifteen years ending with 1899 occurred in the following cities and towns: —

Boston,	177	Milton,	2
Holyoke,	43	Methuen,	2
Fall River,	43	Dalton,	2
Chelsea,	36	Holden,	2
Chicopee,	31	Melrose,	2
Worcester,	24	Adams,	1
New Bedford,	18	Andover,	1
Lowell,	14	Attleborough,	1
Springfield,	10	Belchertown,	1
Westfield,	10	Blackstone,	1
Huntington,	7	Chester,	1
Everett,	6	Granville,	1
Russell,	5	Lanesborough,	1
Pepperell,	4	Lawrence,	1
Sherborn,	4	Lynn,	1
Greenfield,	4	Marlborough,	1
State Almshouse,	4	Maynard,	1
Waltham,	3	Medway,	1
Somerville,	3	Natick,	1
Cambridge,	3	Northborough,	1
Swampscott,	3	Pittsfield,	1
Haverhill,	2	Randolph,	1
Quincy,	2	Spencer,	1
North Adams,	2	Stoneham,	1
Brookline,	2	West Springfield,	1
Great Barrington,	2	Williamstown,	1
Lenox,	2	Gloucester,	1

Thirteen of these cities and towns were places in which paper mills using rags are located, but the actual number of paper mill operatives attacked with small-pox was only 20, or 4 per cent., a smaller ratio than that which prevailed in earlier epidemics. Several other persons were attacked who were probably indirectly exposed to infection from rags, being persons of other occupations living in the same families or tenements with paper mill operatives. Outbreaks in Chicopee have occasionally been traced to the neighboring city of Holyoke.

Outbreaks involving one or more cases in each occurred in Boston in eleven years out of the fifteen-year period; in Holyoke in eight years; in Springfield in four years; in Lowell in four years; in Chelsea in four years; in Huntington in three years; in Westfield in three years; in Pepperell in three years; in New Bedford in three years.

Sex. — Of the cases, wherein the sex was stated, 242 were males and 207 were females, or in the ratio of 117 males to each 100 females.

Nationality. — The nationality of the reported cases was as follows, so far as it was stated in the returns: —

United States,	190	France,	7
British Provinces,	129*	Germany,	5
Ireland,	69	Sweden,	3
England,	13	Russia,	2
Portugal,	13	Belgium,	1
Italy,	10	Finland,	1
Scotland,	10	Denmark,	1

Occupations. — The occupation of the persons attacked was as follows, so far as was stated in the returns: —

Operatives in paper mills,	20	Cigar makers,	4
Operatives in other mills,	44	Laundry operatives,	3
Housewives,	48	Harness makers,	3
Laborers,	28	Tramps,	3
House servants,	17	Painters,	2
School children,	25	Weavers,	2
Carpenters,	6	Car cleaners,	2
Clerks,	7	Night watchmen,	2
Nurses,	5	Railroad employes,	2
Physicians,	3	Bakers,	2
Seamen,	5	Shoemakers,	2
Waiters,	5	Engineers,	2
Barbers,	4	Mechanics,	2
Book-keepers,	4	Salesmen,	2

and 1 each of 31 other occupations, including a disinfecter of a local board of health.

Small-pox by Ages, and the Influence of Vaccination. — The following table contains the statistics by ages of the cases and deaths from small-pox in the vaccinated and the unvaccinated, and among those in which the facts as to vaccination were unknown or doubtful. These relate to those cases and deaths which occurred in the twelve years 1888–99.

* Including 65 French Canadians.

Fatality of the Vaccinated and Unvaccinated in Massachusetts (1888–99). Twelve Years. By Ages.

Ages.	Vaccinated.		Unvaccinated.		Doubtful.		Total.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
0 to 1 year,	1	-	23	11	1	-	25	11
1 to 5 years,	9	-	47	7	1	-	57	7
5 to 10 years,	6	-	19	-	3	-	28	-
10 to 15 years,	19	-	7	-	2	-	28	-
15 to 20 years,	23	1	25	6	6	2	54	9
20 to 30 years,	76	5	51	12	16	4	143	21
30 to 40 years,	31	5	19	6	3	1	53	12
40 to 50 years,	24	3	3	3	4	-	31	6
Over 50 years,	17	2	-	-	3	1	20	3
Unknown,	3	-	1	-	4	-	8	-
	209	16	195	45	43	8	447	69

This table contains very valuable information relative to the protective power of vaccination at different age periods. Only 1 vaccinated infant under one year of age was attacked with small-pox, and this child survived, while there were 23 attacks of unvaccinated infants under one year of age, and of these, 11 died, or 47.8 per cent. Among vaccinated persons under fifteen years of age there were 35 attacks, and *no deaths*. Among unvaccinated persons under fifteen years old there were 96 attacks and 18 deaths, or 18.7 per cent. Among vaccinated adults over fifteen years of age there were 171 attacks and 16 deaths, or 9.4 per cent. Among unvaccinated adults over fifteen years old there were 98 attacks and 27 deaths, or 27.5 per cent.

It is also worthy of note that 51 school children or children of school ages (five to fifteen years) were attacked, and of this number 26, or more than one-half, were unvaccinated. Out of this whole number (51) there were no deaths, this being the age period in which the specific intensity of life is greatest, *i.e.*, the power to resist fatal attacks of illness.

Out of the 209 who were recorded as having been vaccinated it was stated in the returns that 115, or 55 per cent., had been vaccinated in infancy only, and judging from the carefully recorded statistics of other countries, it is safe to presume that the 16 deaths of vaccinated adults occurred among this class exclusively.

The occurrence of small-pox in the State in a greater degree than usual in 1899 was due primarily to a corresponding increased incidence of the disease in other States, with all of which our own State has unrestricted freedom of intercourse by railway lines in many directions. The serious outbreak in Fall River was confined almost exclusively to persons of French Canadian origin. Another cause is to be found in the neglect of vaccination and revaccination, the latter being almost of equal importance with the former.

Outbreaks in Other States. — Under the provisions of the Interstate and Intercolonial resolutions which were drawn up at a meeting of the American Public Health Association at Toronto, in 1886, reports of outbreaks of small-pox were received at the office of the Board during 1899 from Connecticut, Florida, Illinois, Indiana, Kansas, Louisiana, Maine, Michigan, Minnesota, Missouri, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, West Virginia, Wisconsin and the provinces of Ontario and Quebec. The greater number of cases were reported from Pennsylvania, Ohio, Louisiana and the provinces of Ontario and Quebec. The total number of cases reported from these States and provinces was 2,399.

On account of the increased prevalence of small-pox in the State in 1899 the Board issued the following circular in June: —

Small-pox and Vaccination.

[A Circular from the State Board of Health. — June, 1899.]

In view of the unusual prevalence of small-pox in other neighboring States at the present time the State Board of Health desires to urge upon the local health authorities throughout the State the importance of general vaccination of the inhabitants for the prevention of small-pox. The facilities for intercourse between Massachusetts and other States make the introduction of the disease an easy matter among populations which are partially unprotected by vaccination.

In the State of Ohio there have been 1,757 reported cases since April, 1898, and 328 have been reported within the past seven weeks, mostly in the larger cities of Cincinnati, Cleveland and Columbus. The existence of this unusual number of cases threatens the population of neighboring States to such a degree that special vigilance becomes necessary on the part of all local health authorities to provide the necessary facilities for a general vaccination of the people.

Five limited outbreaks of the disease have occurred in Massachusetts within the past month, and others are liable to occur if special pains are not taken to prevent them.

It is quite certain that a considerable portion of the population is still without protection, in consequence of neglect to be vaccinated or because vaccination has been improperly performed.

Vaccination gives a protection which is more complete than can be obtained by any other means, and even when this protection is not absolute, it has been thoroughly demonstrated that vaccination renders the individual much less liable to an attack of small-pox, and if the attack does occur, the severity of the disease is greatly modified.

The objections once urged against the use of humanized lymph are now obviated by the almost universal use of lymph obtained from the calf. The Board recommends the use of glycerinated lymph as likely to produce the most uniformly favorable results.

In view, therefore, of the possible appearance of small-pox, it is earnestly recommended that a general vaccination of all unprotected persons be made, and that the local authorities of cities and towns be requested to carry out this recommendation.

Examination of the pupils in the public schools should be made before the usual summer closing of the schools and such examination should be made by a competent physician.

Your attention is called to the following extracts from the existing statutes relating to small-pox and vaccination: —

[P. S., 80, § 78; Acts of 1884, 98, § 1; Acts of 1890, 102.]

When a householder knows that a person within his family or house is sick of small-pox, diphtheria, scarlet fever or any other infectious or contagious disease dangerous to the public health, he shall immediately give notice thereof to the board of health of the city or town in which he dwells, and upon the death, recovery or removal of such person, such of the rooms of said house and such of the articles therein as, in the opinion of the board of health, have been subjected to infection or contagion shall be disinfected by such householder to the satisfaction of said board of health. Any person neglecting or refusing to comply with either of the above provisions shall be punished by a fine not exceeding one hundred dollars.

[P. S., 80, § 79; Acts of 1884, 98, § 2; Acts of 1891, 188.]

When a physician knows that a person whom he is called to visit is infected with small-pox, diphtheria, scarlet fever or any other disease dangerous to public health, he shall immediately give notice thereof in writing over his own signature to the selectmen or board of health of the town; and if he refuses or neglects to give such notice he shall forfeit for each offence not less than fifty nor more than two hundred dollars.

[Acts of 1884, 98, § 3.]

The boards of health in the several cities and towns shall cause a record to be kept of all reports received in pursuance of the preceding sections, and such record shall contain the names of all persons who are sick, the localities in which they live, the diseases with which they are affected, together with the date and the names of the persons reporting any such cases. The boards of health shall give the school committee immediate information of all cases of contagious diseases reported to them according to the provisions of this act.

[ACTS OF 1884, 98, § 4.]

The secretary of the Commonwealth shall furnish the boards of health with blank books for the record of cases of contagious diseases as above provided.

[ACTS OF 1883, 138, § 1; ACTS OF 1886, 101, § 4.]

When the board of health of any city or town has had notice of the occurrence of a case of small-pox in such city or town, such board of health shall, within twenty-four hours after the receipt of such notice, notify the state board of health of the same, and the secretary of said state board shall forthwith transmit a copy of the notice so received to the state board of lunacy and charity.

[ACTS OF 1893, 302, § 1.]

When the board of health of any city or town has had notice of the occurrence of a case of small-pox or of any other disease dangerous to the public health in such city or town, such board of health shall, within twenty-four hours after the receipt of such notice, notify the state board of health of the same.

[ACTS OF 1883, 138, § 2; ACTS OF 1893, 302, § 2.]

If the board of health of the city or town, in which a case of small-pox or of any other disease dangerous to the public health has occurred, refuses or neglects to send a notice as required in section one [of chapter 302 of the Acts of 1893], such city or town shall forfeit its claim upon the Commonwealth for the payment of any expenses which may be incurred, as provided in section eighty-three of chapter eighty of the Public Statutes.

Vaccination.

[ACTS OF 1894, 515, § 1.]

Parents and guardians shall cause their children and wards to be duly vaccinated before they attain the age of two years, except as provided in section two of this act. For every year's neglect the party offending shall forfeit the sum of five dollars.

[ACTS OF 1894, 515, § 3.]

The board of health in any city or town shall require and enforce the vaccination and re-vaccination of all the inhabitants thereof whenever in the opinion of said board the public health or safety requires such action. Every person over twenty-one years of age, not under guardianship, who neglects to comply with such requirement shall forfeit the sum of five dollars.

[ACTS OF 1894, 515, § 4.]

The board of health in any city or town shall furnish the means of free vaccination or re-vaccination to all the inhabitants thereof whenever in the opinion of said board the public safety requires it.

[ACTS OF 1894, 515, § 5.]

Incorporated manufacturing companies, superintendents of almshouses, state reform schools, industrial schools, lunatic hospitals, and other places where the poor or sick are received, masters of houses of correction, jailers, keepers of prisons, the warden of the state prison, and superintendents or officers of all other institutions supported or aided by the state, shall, at the expense of their respective establishments or institutions, cause all the inmates thereof to be vaccinated or re-vaccinated whenever in the opinion of the board of health, in the city or town in which such establishments or institutions are situated, the health of the inmates thereof or the public safety require such action.

[P. S., 47, § 9.]

The school committee shall not allow a child who has not been duly vaccinated to be admitted to or connected with the public schools. [But see 1894, 515, § 2, page 37, and 1898, chapter 496, section 11.]

[Acts of 1894, 355.]

All vaccine institutions in the Commonwealth shall be under the supervision of the state board of health.

[Acts of 1898, 496, § 11.]

PROVIDING FOR THE EXCLUSION OF CERTAIN CHILDREN FROM THE PUBLIC SCHOOLS.

No child who has not been duly vaccinated shall be admitted to a public school except upon presentation of a certificate signed by a regular practising physician that such child is an unfit subject for vaccination. No child who is a member of a household in which a person is sick with small-pox, diphtheria, scarlet fever or measles, or of a household exposed to contagion from a household as aforesaid, shall attend any public school during such sickness or until the teacher of the school has been furnished with a certificate from the board of health of the town or city, or from the attending physician of such sick person, stating, in a case of small-pox, diphtheria or scarlet fever, that a period of at least two weeks, and in a case of measles a period of at least three days, has elapsed since the recovery, removal or death of such person, and that danger of the conveying of such disease by such child has passed.

By the provisions of section 34 of chapter 496 of the Acts of 1898, the truant officers of cities and towns are required to "inquire into all cases arising under section 11 of the same chapter and are authorized to make complaints, serve legal processes and carry into execution judgments thereunder."

Typhoid Fever.

The death-rate from typhoid fever is very properly taken as an index of the sanitary condition of any community for a series of years, special reference being had to the purity of the public water supply as a matter of the highest importance. One of the most notable points in the sanitary history of the State is the almost uniform decline in the mortality from this disease, in proportion as measures have been taken to introduce better water supplies and to improve those which already exist.

The following tables, continued from those which have been published in previous reports, present the deaths and death-rates in the cities of the State for the successive five-year periods which have elapsed since 1870, together with the four-year period 1896 to

1899. For all of these years except 1898 and 1899 the figures are taken from the Registration Reports. For 1898 and 1899 the figures are from the official returns sent by local boards of health to the State Board, under the provisions of chapter 218 of the Acts of 1894.

The figures presented in these tables show a marked improvement when the later years of the series are compared with the former. In the first five-year period (1871–75) the death-rate from typhoid fever in the cities as well as in the State at large was 8.2 per 10,000 living, and this has gradually been reduced to 2.6, or less than one-third, in the four-year period 1896–99. There has also been a progressive decrease in these four years from 3.1 in 1896 to 2.4 in 1899.

While in the period 1871–75 there was not one city having a lower death-rate from typhoid fever than 2.7 per 10,000, there were in the period 1896–99 twenty-two cities having a lower death-rate from this cause than 2.7, or just two-thirds of the whole number of cities, and in 1899 there were twenty-four such cities.

North Adams maintained the highest typhoid death-rate during each of these last four years, except in 1899. Beverly, Newburyport, Haverhill, Chicopee, Boston and Quincy also had average typhoid death-rates of more than 3 per 10,000 for the four years. Worcester, Fitchburg, Woburn and Marlborough had mean death-rates in this latter period of less than 1.5 per 10,000. In Woburn the total number of deaths from this cause was only 2 in each of the four years, and in Marlborough there were no deaths from typhoid fever in 1898 and 1899.

The most notable improvement was that of Lawrence, where the typhoid death-rate fell from a mean of 11.2 per 10,000 in 1886–90, and 7.7 in 1891–95, to 2.5 in the four years 1896–99, following the introduction of filtration of the city water supply in the autumn of 1893. The coincidence in the decline of the typhoid fever death-rate with the introduction of public water supplies throughout the State was shown in a carefully prepared table which was published in the twenty-eighth annual report of the Board (1896), pages 779–782.

In consequence of the intimate relation of this disease to the sanitary condition of communities, local boards of health are brought into closer contact with it than with other infectious diseases. Hence the State Board has often been called upon to give such assistance as was necessary in the investigation of the causes of the prevalence of typhoid fever. A brief statement of the results of such investigations may be found in that portion of the report which is entitled "Health of Towns."

Deaths and Death-rates per 10,000 Inhabitants from Typhoid Fever in Massachusetts Cities, 1871–99.

Cities.	1871-1875. Deaths from Typhoid Fever.	1871-1875. Death-rate from Typhoid Fever per 10,000.	Cities.	1876-1880. Deaths from Typhoid Fever.	1876-1880. Death-rate from Typhoid Fever per 10,000.	Cities.	1881-1885. Deaths from Typhoid Fever.	1881-1885. Death-rate from Typhoid Fever per 10,000.
Holyoke,	157	23.3	Holyoke,	77	8.1	Holyoke,	159	12.8
Springfield,	214	14.8	Lawrence,	122	6.6	Chicopee,	48	8.4
Chicopee,	63	12.6	Chicopee,	35	6.5	Lowell,	243	7.9
Lawrence,	190	11.9	Fall River,	152	6.4	North Adams,	48	7.6
Lowell,	221	9.8	Malden,	31	5.4	Lawrence,	144	7.4
Fall River,	176	9.8	Springfield,	86	5.3	Fall River,	174	6.6
Pittsfield,	56	9.6	Worcester,	131	4.9	Springfield,	117	6.6
Brockton	43	9.2	Haverhill,	40	4.8	Taunton,	59	5.3
Chelsea,	86	8.7	Salem,	61	4.6	Lynn,	109	5.2
Northampton,	46	8.7	Newburyport,	31	4.6	Haverhill,	52	5.2
New Bedford,	90	8.4	Pittsfield,	29	4.5	Boston,	952	5.1
Worcester,	176	7.8	Lowell,	117	4.3	Pittsfield,	34	4.9
Lynn,	118	7.8	Quincy,	21	4.3	Brockton,	41	4.8
Boston,	1,145	7.7	Marlborough,	20	4.3	Quincy,	27	4.8
Somerville,	60	7.6	North Adams,*	16	4.3	Salem,	66	4.7
Salem,	87	6.9	Lynn,	72	1	Northampton,	29	4.6
Taunton,	65	6.7	Boston,	690	3.9	New Bedford,	62	4.1
Haverhill,	46	6.6	New Bedford,	50	3.8	Marlborough,	20	3.8
Marlborough,	27	6.4	Gloucester,	34	3.8	Cambridge,	108	3.7
Gloucester,	51	6.3	Chelsea,	36	3.4	Gloucester,	38	3.7
Cambridge,	124	5.7	Medford,	12	3.4	Everett,	9	3.6
Woburn,	26	5.7	Taunton,	34	3.3	Newton,	31	3.4
Malden,	25	5.5	Northampton,	19	3.3	Worcester,	106	3.3
Fitchburg,	32	5.4	Beverly,	13	3.3	Somerville,	45	3.3
Beverly,	18	5.2	Newton,	25	3.0	Newburyport,	22	3.2
Quincy,	19	4.6	Somerville,	33	2.8	Chelsea,	37	3.1
Newburyport,	29	4.5	Fitchburg,	17	2.8	Malden,	21	3.0
Everett,	6	4.1	Brockton,	14	2.3	Waltham,	20	3.0
Medford,	11	3.6	Cambridge,	55	2.2	Fitchburg,	18	2.6
Newton	20	2.8	Woburn,	10	2.0	Medford,	11	2.6
Waltham,	13	2.7	Waltham,	8	1.5	Woburn,	14	2.5
			Everett,	2	1.0	Beverly,	10	2.3
Total,	3,458	-	....	2,093	-	....	2,864	-
Means for the cities,	-	8.2	....	-	4.2	....	-	5.1
The State,	-	8.2	....	-	4.5	....	-	5.0

* North Adams not incorporated till 1878.

Deaths and Death-rates per 10,000 Inhabitants from Typhoid Fever in Massachusetts Cities, 1871–99 — Concluded.

Cities.	1886-1890. Deaths from Typhoid Fever.	1886-1890. Death-rate from Typhoid Fever per 10,000.	Cities.	1891-1895. Deaths from Typhoid Fever.	1891-1895. Death-rate from Typhoid Fever per 10,000.	Cities.	1896-1899. Deaths from Typhoid Fever.	1896-1899. Death-rate from Typhoid Fever per 10,000.
Lowell,	306	11.2	North Adams,	74	8.4	North Adams,	37	4.5
Lawrence,	233	11.2	Lawrence,	187	7.7	Beverly,	19	3.9
North Adams,	64	8.9	Lowell,	294	7.3	Newburyport,	21	3.5
Chicopee,	43	6.7	Chicopee,	50	6.6	Haverhill,	46	3.4
Fall River,	209	6.4	Woburn,	33	4.8	Chicopee,	23	3.3
Holyoke,	105	6.6	Newburyport,	29	4.1	Boston,	679	3.2
Marlborough,	32	5.2	Springfield,	97	4.1	Quincy,	30	3.2
Quincy,	37	5.1	Quincy,	37	4.0	New Bedford,	76	3.0
Pittsfield,	40	5.0	Salem,	68	3.9	Lynn,	75	2.9
Haverhill,	59	4.8	Fall River,	154	3.8	Lowell,	96	2.7
Taunton,	58	4.7	Holyoke,	72	3.8	Somerville,	64	2.7
Springfield,	88	4.3	Haverhill,	49	3.4	Springfield,	59	2.6
Salem,	59	4.0	Marlborough,	24	3.3	Taunton,	30	2.6
Newton,	44	4.0	New Bedford,	77	3.2	Fall River,	99	2.6
Boston,	818	3.9	Boston,	722	3.1	Lawrence,	57	2.5
New Bedford,	71	3.8	Somerville,	65	2.8	Everett,	23	2.4
Brockton,	46	3.8	Brockton,	41	2.7	Pittsfield,	20	2.3
Woburn,	24	3.8	Malden,	36	2.7	Waltham,	20	2.3
Cambridge,	116	3.6	Medford,	17	2.7	Cambridge,	79	2.2
Malden,	33	3.3	Worcester,	120	2.6	Northampton,	16	2.2
Fitchburg,	31	3.3	Cambridge,	91	2.4	Chelsea,	28	2.1
Everett,	14	3.3	Chelsea,	35	2.4	Melrose,*	11	2.0
Northampton,	22	3.2	Everett,	18	2.4	Brockton,	28	1.9
Worcester,	109	2.8	Lynn,	64	2.2	Holyoke,	33	1.9
Somerville,	49	2.8	Taunton,	29	2.2	Salem,	28	1.9
Chelsea,	35	2.6	Newton,	28	2.2	Newton,	22	1.9
Newburyport,	17	2.5	Northampton,	17	2.1	Medford,	12	1.8
Lynn,	56	2.2	Beverly,	11	1.9	Gloucester,	21	1.7
Gloucester,	25	2.2	Fitchburg,	22	1.8	Malden,	21	1.6
Medford,	11	2.2	Waltham,	18	1.8	Worcester,	63	1.5
Waltham,	17	2.0	Gloucester,	18	1.8	Fitchburg,	17	1.5
Beverly,	10	2.0	Pittsfield,	25	1.8	Woburn,	8	1.4
						Marlborough,	3	0.5
Total,	2,971	-	....	2,617	-	....	1,864	-
Means for the cities,	-	4.6	....	-	3.4	....	-	2.6
The State,	-	4.1	....	-	3.2	....	-	2.5

* Melrose incorporated 1898.

Consumption.

The decline in the mortality from this destructive disease has continued with a fairly steady and uniform rate throughout the past fifty years, the death-rate by five-year periods being as follows since 1850: —

Deaths from Consumption per 10,000 living.

1851-55,	41.1	1876-80,	31.0
1856-60,	38.9	1881-85,	31.4
1861-65,	36.5	1886-90,	27.3
1866-70,	33.4	1891-95,	23.1
1871-75,	34.5		

Estimated.

1896,	21.7	1898,	19.4
1897,	20.8	1899,	18.7

The most encouraging feature in this very marked diminution of the death-rate from consumption is the fact that the saving of life is greatest at the wage-earning period of life (15 to 60 years), since it is at this age that consumption is most fatal. Out of 1,000 deaths from all causes in Massachusetts at the age period 15 to 60 years in 1894 and 1895, 288 were from tuberculosis. (In Paris for the same period of life the figures were still higher — 400 — and in Vienna, 459, or nearly one-half of all the deaths at that age of life.)

Reasonable measures, therefore, intended for the control and prevention of a disease so destructive to human life at its most useful period, are commendable and should be generally adopted. Cleanliness, the destruction of sputum and the prevention of its distribution in places where it can prove harmful, the circulation of tracts and literature describing the disease and the methods of its prevention in clear and simple language, the establishment of hospitals or sanitaria where the sick can be removed from places where the patient is likely to be a danger to his friends, — all these measures tend to diminish the death-rate from this cause.

Diphtheria and Croup.

The death-rate from these combined causes in Massachusetts during the past forty years has fluctuated considerably, reaching a high rate of 18.2 per 10,000 in 1863, then dropping to a minimum of 4.5 in 1867, and continuing at nearly the same rate for about ten years, then rising to a maximum of 19.6 per 10,000 in 1876 and continuing at a high rate for six years, in none of which it fell below 10 per 10,000. From 1882 to 1895 it continued at about an average of 7 or 8 per 10,000, with a slight rise to 10.2 in 1889. From 1895 to 1898 there was a decided fall in the death-rate, but so far as can be learned from the returns received in 1899 there was again a slight rise in the death-rate for that year. There should, however, be a distinction made between the death-rate or mortality of this disease and the fatality or ratio of deaths to cases.

In the following table both of these facts are presented for the years 1891 to 1899: —

Death-rate and Fatality of Diphtheria and Croup in Massachusetts, 1891-99.

Years.	Death-rate.	Fatality. Ratio of Deaths to Cases.	Years.	Death-rate.	Fatality. Ratio of Deaths to Cases.
1891, . . .	5.3	23.5	1896, . . .	6.6	15.1
1892, . . .	6.2	29.2	1897, . . .	5.5	14.1
1893, . . .	5.8	31.7	1898, . . .	2.6	13.2
1894, . . .	7.4	27.9	1899, . . .	3.7*	11.5
1895, . . .	7.1	18.9			

* Approximate.

In this table the first column entitled "death-rate" shows the fluctuation of the disease in its incidence upon the population during the period of nine years, while the column of fatality shows the percentage of deaths out of the whole number of reported cases and answers the question: Out of a certain number who are attacked, how many die? The most notable point in this last column is the steady and continuous decline since 1894, a fact which can only be explained by the liberal provisions made for the general use of antitoxin for the treatment of diphtheria throughout the State. For further information on this point reference may be made to the later portion of the report, "Statistical Summaries No. 2" and "Report on Antitoxin."

Isolation Hospitals for Infectious Diseases.

Closely related to the foregoing subject of infectious diseases and their proper management and control is the question of providing means for their separate treatment under careful medical supervision in hospitals isolated from the general population. In the twenty-fifth annual report of the Board (1893) an article was published having reference to this subject, in which the advantages of such institutions were shown, together with some of the measures which have been taken in other countries for their establishment and maintenance. At the date of that report scarcely any city or town in the State had made hospital provision for the separate treatment of this class of diseases. But the continued prevalence of infectious diseases, together with the rapid increase of population, and of its consequent density in the cities and large towns has brought the importance of the subject more and more forcibly to the local sanitary authorities.

In order to ascertain definitely the provision already existing in the State for hospital treatment of this class of diseases, the following circular was issued: —

OFFICE OF THE STATE BOARD OF HEALTH, BOSTON, July, 1900.

HOSPITAL PROVISION FOR THOSE WHO ARE SICK WITH INFECTIOUS DISEASES.

The State Board of Health is desirous of obtaining information as to the use which is now being made in the cities and large towns of Massachusetts of hospitals established for the special purpose of isolation and treatment of persons sick with certain infectious diseases. For this purpose a reply is requested to the inquiries which follow.

Please to return this blank, the replies being made in the spaces after the questions.

1. Is there at present, or in course of erection, a hospital in your city or town for the isolation and treatment of infectious diseases?

2. Is such hospital maintained by means of public, or private funds, or both?

3. When was the hospital established?

4. What diseases have been treated in it?

5. What number of cases of each disease were treated during the past year in the isolation hospital?

6. How many patients will the hospital accommodate?

7. Is provision made for the treatment of different infectious diseases in separate wards?

8. What was the (approximate) cost of establishing the hospital? What were the expenses of maintenance in 1899?

9. How is the hospital situated in respect to the population? Is it in the densely settled district, or in a more remote place, apart from the houses of the population?

10. Have you a separate hospital, house or establishment for the isolation and treatment of persons sick with small-pox?

S. W. ABBOTT, *Secretary*.

To the Board of Health, _______________, *Mass.*

Replies were received to this circular from the 33 cities and from the town of Brookline as follows: —

Isolation Hospitals for Infectious Diseases in Massachusetts, 1899.

[The following abbreviations are used in this summary: D., Diphtheria; S. F., Scarlet Fever; M., Measles; E., Erysipelas; W. C., Whooping-cough; T., Typhus Fever.]

Name of City or Town.	Estimated Population in 1899.	1	2	3	4	5	6	7	8	9	10
Boston,	539,416	Yes.	Public.[1]	1895	D., S. F. and M.,	D., 1,760; S. F., 657; M., 188; mixed, 314.	250	Yes.	$500,000 00 71,687 34	In the city,	Two.[2]
Worcester,	111,732	Yes.	Public.	1896	D. and S. F.,	D., 97; S. F., 91; mixed 11,	40	Yes.	40,000 00	Isolated,	Yes.
Fall River,	108,142	-	-	-	-	-	-	-	-	-	Yes.[3]
Cambridge,	92,520	Yes.[4]	Private.	-	-	-	-	-	-	-	-
Lowell,	90,114	Yes.	Private.	-	D. and S. F.,	-	-	-	-	Centrally located,	Yes.[5]
New Bedford,	70,511	No.	-	-	-	-	-	-	-	-	Yes.
Lynn,	68,218	Yes.	Public.	1895	D. and S. F.,	D., 53; S. F., 17,	18	Yes.	10,000 00 4,500 00	Isolated,	Yes.
Somerville,	64,394	No.	-	-	-	-	-	-	-	-	Yes.[6]
Lawrence,	59,072	No.	-	-	-	-	-	-	-	-	Yes.[7]
Springfield,	58,266	Yes.	Both.	1899	D., S. F., E. and M.,	D., 38; S. F., 2; E., 5,	24	Yes.	12,000 00 1,800 00	Isolated,	es.
Holyoke,	44,510	No.	-	-	-	-	-	-	-	-	Yes.
Brockton,	38,759	No.	-	-	-	-	-	-	-	-	Yes.
Salem,	37,723	No.	-	-	-	-	-	-	-	-	Yes.
Malden,	36,421	No.	-	-	-	-	-	-	-	-	-
Chelsea,	34,235	Yes.	Both.	1893	D., S. F., M., W. C., E. and T.	D., 48; S. F., 4; M., 4; W. C., 3; E., 3; T., 1.	12	Yes.	4,000 00 3,074 00	In densely settled district.	Yes.
Haverhill,	32,651	No.	-	-	-	-	-	-	-	-	-
Gloucester,	31,426	-	-	-	-	-	-	-	-	-	-
Fitchburg,	30,533	Yes.[8]	-	-	-	-	-	-	-	-	-
Newton,	30,461	Yes.	Both.	1891	D., S. F. and M.,	D., 115; S. F., 35; M., 19,	12	Yes.	18,000 00	Isolated,[9]	Yes.[10]
Taunton,	28,527	No.	-	-	-	-	-	-	-	-	Yes.[11]

Everett, . . .	28,102	No.	-	-	-	-	-	-	-	-	No.
Quincy, . . .	24,578	No.	-	-	-	-	-	-	-	-	Yes.
Pittsfield, . . .	23,421	No.	-	-	-	-	-	-	-	-	Yes.
Waltham, . . .	22,791	Yes.	Private.	1893	D. and S. F., . .	D., 27; S. F., 33, . . .	24	Yes.	-[12]	Isolated, . .	Yes.
North Adams, . .	21,583	No.	-	-	-	-	-	-	-	-	Yes.
Brookline, . .	19,412	Yes.	Public.	1894	D. and S. F., . .	D., 68; S. F., 21, . . .	18-24	Yes.	7,000 00[13] 3,886 00	Isolated, . .	Yes.
Chicopee, . . .	18,816	No.	-	-	-	-	-	-	-	-	Yes.
Northampton, . .	18,160	No.	-	-	-	-	-	-	-	-	No.
Medford, . . .	17,190	No.	-	-	-	-	-	-	-	-	Yes.[14]
Marlborough, . .	15,914	No.	-	-	-	-	-	-	-	-	No.
Newburyport, . .	15,036	No.	-	-	-	-	-	-	-	-	Yes.
Woburn, . . .	14,721	-[15]	-	-	-	-	-	-	-	-	No.
Melrose, . . .	14,721	No.	-	-	-	-	-	-	-	-	No.
Beverly, . . .	12,594	-	-	-	-	-	-	-	-	-	-

[1] Boston: a few private patients are treated.

[2] Boston: one in city and one at Gallop's Island.

[3] Fall River: small-pox hospital built in 1899, four miles from town; 37 patients treated in it in that year. Cost, $5,000. Accommodates 24.

[4] Cambridge: permanent hospital built by private funds, and a temporary hospital in use in 1899 by public funds; 69 cases treated in latter. Cost of repairs, alterations and furnishing, $2,099.24. Maintenance, $4,473.30.

[5] Lowell: small-pox hospital; accommodates 25.

[6] Somerville: not used in past year.

[7] Lawrence: not in condition for use.

[8] Fitchburg: new hospital being built; old one will probably be used for infectious diseases.

[9] Newton: on same land with general hospital; plans for a new building are also drawn.

[10] Newton: accommodates 6 patients.

[11] Taunton: pest-house, 3 miles from city, accommodates 15 to 16, — crowded; an old almshouse.

[12] Waltham: $15 per week charged for city cases.

[13] Brookline: less reimbursements, which were $525. Plans are drawn for new hospital, all to accommodate 60.

[14] Medford: "a so-called pest-house"

[15] Woburn: pest-house used for treatment of D. and S. F. patients; accommodates 3 patients.

From this table it appears that in the 33 cities of Massachusetts and in the town of Brookline there is at present provision for the reception of persons sick with infectious diseases (except small-pox) in 11 of these places, or about one-third of the whole number. Nine of these were in cities having a population of over 30,000 in each. Four of these hospitals are supported by public funds, three by private funds and three by both sources.

All of these institutions have been established since 1890. The principal diseases treated in them are diphtheria and scarlet fever. In a few instances patients ill with measles and other infectious diseases are admitted.

The entire number of patients treated in them in 1899 was 3,618, of which 2,206 were cases of diphtheria, 860 of scarlet fever, 329 mixed infections, 211 of measles and 12 of other diseases (erysipelas, whooping-cough and typhus fever).

There is provision in these hospitals for 404 beds. All have provision for the treatment of different diseases in separate wards, and in five cities in separate buildings.

The cost of building these hospitals was $588,099.24, and the cost of maintenance in 1899 was $89,420.64.

In two instances the hospitals are situated in densely settled districts, and in the remainder in isolated, or comparatively isolated, locations.

In 22 cities, or two-thirds of the whole number, provision is made in some sort of separate structure for the reception of persons suffering with small-pox.

Thus it appears that twice as many cities have provision for small-pox as for other infectious diseases, and yet in several of these cities there has not been a case of small-pox for more than twenty years, while cases of diphtheria and scarlet fever occur every year in greater or less numbers.

The occurrence of a case of infectious disease often brings hardship and expense upon the family, and the patient becomes a menace to those around him. The rigid rules of quarantine often entail serious loss to the family, both of wages and of the education of the children. For these evils the isolation hospital provides a remedy, in the isolation of the patient where he will have better care and will not endanger the lives of others. The pecuniary saving to the community in the wages and education fully offset the cost of maintenance.

Each city in the State, or at least those which have a population of more than 20,000 in each, should make some adequate provision for this class of patients.

In three of the larger cities of the State in which no public provision has yet been made for this class of diseases, the Board of Health has officially addressed the mayors under the provisions of chapter 511 of the Acts of 1894, stating the opinion of the Board that such provision is necessary for the safety of the inhabitants; but thus far the city government has neglected to order the erection of such hospitals. The act to which reference is here made reads as follows: —

[Acts of 1894, Chapter 511.]

Section 1. In any city in which no suitable hospital accommodations have been provided for the care and treatment of persons suffering from contagious diseases dangerous to the public health, the board of health of such city may address a communication to the mayor thereof, stating that in the opinion of said board the safety of the inhabitants of the city demands that suitable hospitable accommodations should be provided for the reception and treatment of persons suffering from such diseases, other than small-pox and those of a venereal nature. The mayor shall forthwith transmit such communication to the city council, and the city council shall forthwith order such hospital accommodations to be provided, and shall make the necessary appropriations therefor.

Section 2. Every city in which hospital accommodations have been provided in accordance with the provisions of this act shall make an annual appropriation for the maintenance of such hospital accommodations, and said appropriation shall be expended under the direction of the board of health, unless otherwise ordered by the city government.

Lead Poisoning.

The subject of lead poisoning has attracted special attention in Massachusetts during the past few years in consequence of the occurrence of an unusual number of cases from this cause in different cities and towns. It was therefore deemed proper to test the effect of the public water supplies of different cities and towns upon lead pipes, and in cases where it had a decided solvent action, to visit such places and ascertain whether cases of lead poisoning had occurred in them.

With this subject in view Dr. Morse, inspector of the Board, visited such cities and towns in 1899 and has presented the following report. The majority of the cases, including two deaths, occurred in 1898 and 1899.

During the early part of 1899 it became apparent to the Board that cases of lead poisoning might exist in certain cities and towns in the State where experimentally it was shown that the public water, supplied to the people, had a solvent effect upon lead in its passage through lead or lead-lined pipes. With this indication at hand, a list of cities and towns was obtained from the chemist of the Board where such conditions existed, and visits were made to 19 of them and many of the practising physicians interviewed relating to the presence of such cases, with the following results: —

Chicopee.

At Chicopee Centre four physicians were interviewed, three of whom had seen no cases of the disease present. The fourth had three cases in one family twelve years ago, but a private water supply was used and the water brought to the house through a lead pipe for a long distance.

At Chicopee Falls three physicians were interviewed, two of whom had had no cases. The third reported one case five years ago in a female aged fifty, which was a well-marked case, and was undoubtedly contracted from the water supplied by the corporation to their houses through lead pipes. Since the new supply has been introduced no cases have been observed.

Palmer.

At this town two physicians were interviewed, one of whom had no cases. The other one had two cases three years ago, in which the water supply for the house was obtained from a spring some distance away and brought to the house through a lead pipe.

Springfield.

Eleven physicians were interviewed, two of whom had cases of lead poisoning to report, but both of the cases were from a private spring water supply, which was brought to the houses through a lead pipe. No cases were traced to the use of the public water supply.

Millbury.

Two physicians were interviewed, one of whom had two cases of the disease. One was a painter and the other came to Millbury ill with the disease.

Milford.

Nine physicians were visited, five of whom reported sixteen cases of the disease present in Milford and Hopedale, both towns receiving the same water supply. In addition, six other cases were reported, three of whom used a private supply coming from Bear's Hill through a lead pipe. A sample of this water taken at the house and analyzed for lead showed .2210 grain per gallon present, an amount considered to be six times greater than what has been known to produce serious symptoms of lead poisoning. Another case, also using well water which was pumped to the house, was reported and the analysis of the water showed .1700 grain per gallon. A third under the same conditions showed .0238 grain per gallon, but in this case the lead pipe had been removed six months previously by the advice of the doctor and only a short piece of lead pipe remained in the house. Another case at Spindleville, a suburb of Hopedale, was not investigated. Samples of water were also taken at eleven houses where cases were reported as using the public supply, with the following results: —

Grain per gallon,	.0306	Grain per gallon,	.1020
Grain per gallon,	.0136	Grain per gallon,	.1530
Grain per gallon,	.0850	Grain per gallon,	.0680
Grain per gallon,	.1190	Grain per gallon,	.1190
Grain per gallon,	.0171	Lead pipe removed by advice of physician one year ago,	.0102
Grain per gallon,	.0255		

The samples taken were obtained from the faucets in the houses, as the water was in ordinary daily use. Most of the cases were rather of a milder character than were present in other places, which fact was undoubtedly due to the warning which this Board gave the Milford board of health in January, 1897, when cases of lead poisoning were found there, and as a result of which both physicians and inhabitants were on the lookout for the disease, and once it appeared, suitable treatment was commenced to control it.

New Bedford.

Fourteen physicians were interviewed in this city and no evidence of any case of lead poisoning could be obtained.

West Brookfield.

No cases present.

North Brookfield.

One physician reported two cases appearing in the past two years in which the water supply was obtained from a well and brought to the house through a lead pipe. Three others had seen no cases whatsoever.

East Brookfield and Brookfield.

No cases present.

Lawrence.

No cases present.

Ashburnham.

Three physicians reported thirteen cases among the inhabitants of the town, but in all of the cases a private water supply was used and the water brought to the houses through lead pipes. No cases appeared among those using the public supply.

South Hadley Falls.

No cases were reported in this town.

Stoughton.

One case was reported in this town, but the patient used a well water which was brought to the house through a lead pipe.

North Easton.

Two cases were reported, both using well water.

Kingston.

On account of the existence of cases here in previous years a visit was made to learn of any new cases. It was found that none had appeared during the past year and all of the old ones had shown improvement under treatment. In addition, about 200 feet of a lead pipe main had been removed and replaced by an iron pipe in order to further protect the inhabitants from the disease.

Fairhaven.

A number of cases of the disease had formerly appeared here, and in May, 1897, this Board notified the board of health of Fairhaven of the danger in using their public water supply after having passed through lead pipes. It was found upon investigation that no new cases had developed during the past year and many of the old ones had recovered. It was the custom of the people to let the water run for some time before using it and therefore lessen the danger of contracting the disease.

Rockland.

No cases reported.

Norwood.

No cases reported.

Lowell.

By far the greater amount of work was performed at Lowell, where it was evident that many cases of the disease existed. During May, 1899, a visit was made to twenty-five of the practising physicians of the city, seven of whom reported forty cases of the disease present, occurring in their practice. Twelve of these cases were considered of a very serious nature, and visits were made at their homes, their conditions investigated, and a more detailed report of each case is appended. The situation apparently becoming serious, a communication was sent to the mayor of the city of Lowell on June 29, advising him of the existing danger and recommending that measures be taken to prevent the further development of the disease. It was stated in the communication that the investigation was not yet complete, and during September, as the local authorities had done little or nothing to remedy the existing condition, a second canvass was made, at which time about one-fourth of the total number of physicians were interviewed, twelve of whom reported the disease present in their practice. From these physicians thirty-three new cases were obtained, and most of them were visited at their homes, and a detailed description of the cases follows. In addition to these cases, which are considered as the severer type of the disease, many others, somewhat milder in character, were reported, which were successfully treated with appropriate remedies, and also by discontinuing the use of the city water.

Case No. 1. Female adult. Married. Case one year standing. Symptoms: wrist drop; multiple neuritis; lead line on gums; lead present in urine. Analysis of drinking water shows .0850 grain of lead per gallon.

Case No. 2. Female adult. Married. Symptoms for past two and one-half years. Symptoms: abdominal colic; loss of power in hands and arms and did not dare to drive a horse on account of weakness. Under treatment, improvement in symptoms; and upon leaving home at various times complete recovery, followed by a recurrence on her return. Lead present in urine. Analysis of drinking water shows .2333 grain of lead per gallon.

Case No. 3. Male adult. Married. Policeman. Symptoms: abdominal colic; lassitude; headache; constipation, and loss of strength. Under treatment, and with a change in drinking water, marked improvement in condition. Lead present in urine. Analysis of drinking water at home shows .1530 grain per gallon. At police station .1445 grain per gallon when water remained in pipes five hours and .0425 grain per gallon after being drawn off.

Case No. 4. Another policeman, with same symptoms.

Case No. 5. Female adult. Married. Symptoms of constipation and abdominal colic; also considerable neuralgia all over body. Lead in urine. Analysis of drinking water shows .0083 grain of lead per gallon.

Case No. 6. Male adult. Unable to work at present time. Marked debility, with considerable loss of weight and strength, and is only able to get about by the use of a cane. Lead in urine. Analysis of drinking water shows .7653 grain of lead per gallon.

Case No. 7. Female adult. Married. Symptoms of colic and constipation. Lead present in urine. Analysis of drinking water shows .1530 grain of lead per gallon.

Case No. 8. Male adult. Worked in cotton mill until necessary to give up work on account of ill health. Loss of weight and strength, particularly in upper extremities, with wrist drop. Lead in urine. Analysis of drinking water shows .0153 grain of lead per gallon.

Case No. 9. Male adult. Pattern maker. Marked abdominal colic, with loss of weight and strength. Went away from home for one week, with some improvement in health, and upon returning to Lowell had an attack of colic in two days. Previous to treatment had an attack almost every night. Lead in urine. Analysis of drinking water shows .0267 grain per gallon.

Case No. 10. Male adult. Symptoms date back two years, appearing three weeks after moving into present house, which had just been built and was plumbed with lead pipe. Patient helpless in bed and is unable to get up without assistance. Marked emaciation of body and loss of strength in hands and arms. Suspicious lead line on left side of lower jaw. Constipation; colic; headache, and a sweetish metallic taste in mouth, especially in the morning. Analysis of drinking water shows .1067 grain of lead per gallon. Analysis of urine shows no lead present, but after taking ten grains of potassium iodide three times a day for ten days it contained .0183 grain of lead per gallon.

Cases No. 11 and 12. Both adult females. First, with symptoms of debility, colic and constipation, and helplessness in bed. Lead pipes introduced into houses two years ago, since which time symptoms have developed. Second case was the nurse who came to take care of first patient. Shortly after coming to the house she had several attacks of intestinal colic, each one increasing in severity. At the end of five weeks she stopped drinking city water and has had only one attack since. Both have improved since then and first case is able to be up and around. Analysis of drinking water shows .2166 grain of lead per gallon after standing in pipes eleven hours and .0600 grain in ordinary daily use.

Case No. 13. Female adult. Symptoms for past four years of pains all over the body, with constipation, pain in the back and complete loss of power in both legs. Patient cannot walk and gets about with a wheel chair. Lead in urine. Analysis of drinking water shows .0067 grain of lead per gallon.

Case No. 14. Female adult. Patient is a marked invalid. Fingers contracted on hands and hands on arms. Great headache, constipation and abdominal colic, and is unable to get about except with assistance. Patient died suddenly in June from a cerebral hemorrhage. Analysis of drinking water shows .2891 grain of lead per gallon.

Case No. 15. Male adult. Symptoms of loss of weight and strength and marked wrist drop present. Lead in urine. Analysis of drinking water shows .2210 grain of lead per gallon.

Case No. 16. Female adult. Symptoms appeared about one year ago, with wrist drop, blue line on gums, constipation and headache. Analysis of drinking water shows .2721 grain of lead per gallon.

Case No. 17. Female adult. Symptoms for past two years, with wrist drop, loss of power in arms and legs; colic, constipation and headache. Died soon after being seen. Analysis of drinking water shows 1.1903 grains of lead per gallon.

Case No. 18. Boy, two years of age. Symptoms of paralysis of lower extremities; wrist drop and general debility. Recovered under treatment and change of residence. Analysis of drinking water shows .0306 grain of lead per gallon.

Case No. 19. Female adult. Symptoms of multiple neuritis, with marked lead line on gums and wrist drop. Upon the advice of her physician the patient left Lowell, went to a suburban town, and has completely recovered from the disease. Analysis of drinking water shows .1162 grain of lead per gallon.

Case No. 20. Female adult. Symptoms of loss of strength in upper extremities, with suspicion of a wrist drop. Analysis of drinking water shows .0083 grain of lead per gallon.

Case No. 21. Male adult. Symptoms of loss of strength, headache and constipation; marked lead line on gums and wrist drop. Under treatment and with a change of drinking water there was marked improvement. Other members of the family were mildly affected. The house was a new one and plumbed with lead pipe.

Cases Nos. 22 and 23. Female adults. Symptoms of constipation, headache and pains all over the body. Under treatment and discontinuing the city water complete recovery occurred. Analysis of drinking water shows .0467 grain of lead per gallon.

Case No. 24. Female adult. Symptoms for past four years, when pains appeared in left side and gradually extended over whole body. Marked emaciation, joints thickened, and on account of trouble in left hip she is unable to come down stairs only one step at a time. Has been a confirmed invalid for past two years. Analysis of drinking water shows .1351 grain of lead per gallon.

Case No. 25. Female adult. Symptoms similar to rheumatism in hands and knees, and at one time could not walk about the house on account of trouble in knees. Better under treatment. Analysis of drinking water shows .2533 grain of lead per gallon.

Case No. 26. Male adult. Symptoms of colic, constipation and headache; marked lead line on gums. Had lead pipe removed from house, and under treatment has improved. Analysis of drinking water through lead pipe shows .2700 grain of lead per gallon.

Case No. 27. Male adult. Symptoms of intestinal colic, with constipation. Marked improvement under treatment. Analysis of drinking water shows .1950 grain of lead per gallon.

Case No. 28. Female adult. Symptoms of constipation and colic, with marked improvement with iodide of potash. Analysis of drinking water shows .0309 grain of lead per gallon. Lead also present in urine.

Cases Nos. 28 and 29. Female adult. Symptoms of headache, constipation and colic; marked wrist drop, with loss of power in legs, and typical blue line on gums. Was in bed three months, but is better now under suitable treatment.

Father also had intestinal colic and constipation. Both stopped using city water, with marked improvement. Analysis of drinking water shows .2667 grain of lead per gallon.

Case No. 30. Female adult. Abdominal symptoms for six months, with colic and constipation. Under proper treatment immediate improvement resulted. Analysis of drinking water shows .0333 grain of lead per gallon.

Case No. 31. Female adult. Characteristic case, with a typical wrist drop. Moved from Lowell to North Billerica, with complete recovery following.

Case No. 32. Female adult. Marked abdominal colic, with typical wrist drop. Analysis of drinking water shows .1866 grain of lead per gallon.

Cases Nos. 33 to 37. Five cases in one family, with marked intestinal colic. Analysis of drinking water shows .0133 grain of lead per gallon.

Case No. 38. School girl, with symptoms of abdominal colic. Analysis of drinking water shows .0075 grain of lead per gallon.

Case No. 39. Female adult. Marked intestinal colic. Analysis of drinking water shows .0856 grain of lead per gallon.

Case No. 40. Female adult. Symptoms for past two years of marked neuritis, involving arms and chest; some headache and constipation. Analysis of drinking water shows .0417 grain of lead per gallon.

Case No. 41. Male adult. Symptoms of past three years becoming aggravated in the last two years, referable to loss of power in lower extremities. Improves upon leaving Lowell for a time, followed by a reappearance of symptoms upon his return. Analysis of drinking water shows .0075 grain of lead per gallon.

Case No. 42. Male adult. Almost complete paralysis of legs. Is unable to get around except by crutches. Analysis of drinking water shows .0019 grain of lead per gallon.

Case No. 43. Male adult. Loss of strength and weight in past year, and legs partially paralyzed. Analysis of drinking water shows .0136 grain of lead per gallon.

Case No. 44. Female adult. Marked abdominal colic, constipation, loss of strength and cephalalgia. Analysis of drinking water shows .0039 grain of lead per gallon.

Case No. 45. Female adult. Symptoms of marked loss of strength in legs. Lead pipes have been removed from house and iron ones substituted. Analysis of water shows no lead present.

Case No. 46. Female adult. Symptoms of weakness of wrists and legs, with pains all over the body; headache and constipation present. Lead in urine. Analysis of drinking water shows .0019 grain of lead per gallon.

Case No. 47. Male adult. Marked cephalalgia and general loss of strength. Lead present in urine. Analysis of drinking water shows .0156 grain of lead per gallon.

Case No. 48. Male adult. Continuous loss of weight and strength for past year, with constipation and colic. Analysis of drinking water shows .0078 grain of lead per gallon.

Case No. 49. Male adult. Symptoms of constipation and colic in past nine months, with some loss of weight and strength. Analysis of drinking water shows .0029 grain of lead per gallon.

Case No. 50. Marked symptoms of colic and constipation, with some headache. Moved from house, with considerable improvement in symptoms. Analysis of drinking water shows .0097 grain of lead per gallon.

The last few cases are included in this report in order to complete it to June 1, 1900, when the last work was accomplished. It will be noticed that the results of the analyses of the water for lead show a decided diminution in these cases and the symptoms present were also less severe in character. This can be accounted for by the following explanation: —

The water supply for the city of Lowell is obtained from two systems of driven wells, — the Boulevard system, located to the west of the city and adjacent to the Merrimac River, and the Cook system, located to the south of the city and adjoining River Meadow Brook, a tributary of the Concord River. From the chemical analyses of the two waters it is apparent that the solvent properties of the water drawn from the Cook system are much in excess of the water obtained from the Boulevard supply, when they come in contact with lead pipe. With this knowledge the water board of the city were advised to use the Boulevard supply to its full capacity and the Cook system as little as possible, with the result that probably four-fifths of the entire population of the city were supplied with Boulevard water, and with this arrangement the health of the city has considerably improved in this particular respect. In addition, the water board are also having driven another set of wells in the Boulevard district, which will be connected to the general supply as soon as completed, which supply, it is expected will be sufficient for the whole city.

F. L. Morse, M.D.,
Medical Inspector.

The Increase of Cancer.

In the twenty-seventh annual report of the Board for 1896 it was shown that the number of deaths registered as from cancer had very largely increased since the beginning of registration.* The death-rate from this cause for the five-year period, 1856–60, was 2.3 per 10,000 living, and that of the five-year period, 1891–95, was 6.4 per 10,000, or nearly three times as great.

It was further stated in the report of 1896 that, if the deaths from cancer in which the location of the disease is not specified be con-

* Report of 1896, p. 802.

sidered separately, the increase in the death-rate of this class is not very great. The report further states: —

It is plain that the increase in the death-rate from cancer is partially due to more accurate methods of diagnosis. For example, the deaths from cancer in 1876 were 659, of which 565 were from cancer (part not stated), 92 from cancer of the stomach and 2 from epithelioma; while in 1895 the deaths from cancer were 1,749, which were specified as 903 from cancer (part not stated), 201 from cancer of the liver, 1 from cancer of the pancreas, 305 from cancer of the stomach, 193 of the uterus, 108 of the breast, 19 of the kidneys, 2 of the bowels, 2 of the spleen and 14 from epithelioma.

The increase in the deaths registered as cancer simply, without stating its location, during the twenty years, 1876–95, was only from 3.4 to 3.6 per 10,000 of the population, while the increase in the deaths from cancer in which the part or organ affected was stated was nearly six-fold, or from .56 to 3.4 per 10,000 living. It is needless to add that the changes due to improved diagnosis would naturally become manifest mainly in this latter class, although a transfer of some deaths from the indefinite to the definite class might also occur.

Sex. — The following table shows the death-rates of the two sexes from cancer for the two twenty-year periods.

The deaths of males in the first period were 2,627 and of females 5,592, and the death-rates 2.02 and 4.00 per 10,000; and in the latter period the deaths were respectively 7,256 and 15,665, and the death-rates 3.70 and 7.47.

Death-rates from Cancer per 10,000 Living, Massachusetts, 1856-95.

	Males.	Females.		Males.	Females.		Males.	Females.		Males.	Females.
1856, .	1.29	2.45	1866, .	1.75	4.50	1876, .	2.53	5.23	1886, .	3.47	7.43
1857, .	1.87	2.89	1867, .	2.12	3.70	1877, .	2.15	5.32	1887, .	3.60	7.68
1858, .	1.70	3.12	1868, .	2.21	4.17	1878, .	3.12	6.10	1888, .	4.02	7.91
1859, .	1.69	3.82	1869, .	2.14	4.71	1879, .	3.25	6.45	1889, .	3.92	8.13
1860, .	1.74	3.64	1870, .	2.61	4.41	1880, .	3.56	6.73	1890, .	3.81	8.45
1861, .	1.67	3.69	1871, .	2.30	4.98	1881, .	3.85	6.47	1891, .	3.93	8.14
1862, .	1.72	3.84	1872, .	2.46	4.54	1882, .	3.41	7.16	1892, .	4.10	7.78
1863, .	1.78	3.33	1873, .	2.62	5.07	1883, .	3.60	7.19	1893, .	4.82	8.38
1864, .	1.86	3.31	1874, .	2.45	4.73	1884, .	3.83	7.15	1894, .	4.37	8.34
1865, .	2.06	3.33	1875, .	2.18	4.90	1885, .	3.56	6.91	1895, .	4.40	9.44

In view of these facts, the Board has deemed it advisable that an investigation should be made with reference to the causes and conditions prevailing throughout the State in connection with the existence of cancer among the population, and has entrusted the matter to competent physicians, who will report upon it in a future report of the Board.

FOOD AND DRUG INSPECTION.

The details of this important part of the work of the Board may be found in the special report upon the subject. With the exception of a small portion of the work conducted at Amherst and at Lowell, the examination of articles of food and of drugs is carried on at the laboratory of the Board at Room 501, State House. This laboratory is open each week day for the reception of samples which are brought in by the inspectors or which may be deposited with the secretary for examination.

The total number of samples examined during the year ended Sept. 30, 1899, was 9,802, and the total number examined since the beginning of work in 1883 was 107,392.

The expense of collection and analysis has been reduced from $2.26 per sample in 1883 to $1.15 in 1899.

The number of prosecutions of offenders in 1899 was 47, of which number 45 resulted in conviction.

The present report contains a comparative statement with reference to the percentage of adulteration found in different classes of food in the early and the later periods of the work of the Board in this direction. In nearly every instance it appears that marked improvement has taken place since the food and drug laws were first enacted and have been regularly and systematically enforced.

The statement made in previous reports, to the effect that the amount expended in the enforcement of the food and drug statutes is counterbalanced many times over by the gain to the consumer, is fully substantiated by the figures shown in the table on page 581.

Considerable new matter relative to methods of analysis of special articles of food appears in the analyst's report.

THE PARIS EXPOSITION OF 1900.

Early in the year the Board was invited to contribute an exhibit to the Exposition to be held at Paris in 1900. Later in the season the secretary was requested by the director of the Department of Social Economy, Education and Hygiene of the United States Commission to undertake the following projects: —

1. To prepare a monograph representing the progress of public hygiene in the United States.

2. To collect an exhibit of subjects pertaining to public health in Massachusetts.

3. To collect a similar exhibit for the United States.

The amount of space assigned for this purpose was extremely limited, being much less than that which was assigned to Massachusetts alone at the Columbian Exposition of 1893. On this account, with slight exceptions, only flat material and books could be exhibited, and nearly the entire space was devoted to the display of maps, charts, diagrams, plans, photographs and books. In the centre of the exhibit was a small case containing a display of the means adopted by States and cities for affording opportunity for the examination of material suspected of containing the germs of different infectious diseases, especially diphtheria, typhoid and malarial fever and tuberculosis.

There were also exhibits of antitoxin and vaccine lymph from different producers.

The exhibit of the State Board of Health of Massachusetts consisted of the following articles: —

Catalogue of Massachusetts Exhibit, State Board of Health.

1 full set of reports, 30 volumes.
10 or more special documents.
40 wing frame cards (vital statistics).
1 chlorine map.
1 map illustrating antitoxin distribution.
1 map illustrating distribution of appliances for diagnosis.
8 maps illustrating disease distribution.
20 photographs (sewage disposal).
5 photographs (experiment station at Lawrence and laboratories at State House).
5 photographs (other laboratories).
7 photographs (food laboratory at State House).
5 small photographs of fraudulent labels.
32 small photographs of spices and adulterants.
1 set of appliances for diagnosis.
1 set antitoxin samples.

A few copies of Dr. Councilman's report on cerebro-spinal meningitis and other pamphlets were sent for distribution.

The following sanitary and other authorities in Massachusetts also contributed to the exhibit: —

City of Boston: Board of Health, 17 annual reports, 23 photographs, a set of appliances for diagnosis, 1 set of circulars of Board; Street Department, 13 photographs; Bath Department, 40 photographs; trustees of City Hospital, hospital for infectious diseases, 2 photographs.

City of Worcester: Board of Health, 10 photographs, set of annual reports.

Trustees of Cambridge Hospital: 1 photograph of hospital for infectious diseases; Board of Health, annual reports.

Town of Brookline: Bath House Committee, 11 photographs; Board of Health, 2 photographs; set of appliances for diagnosis.

Board of Registration of Physicians, 5 reports.

Trustees of Massachusetts Hospital for Consumptives, 6 photographs.

Sharon Sanitarium, 11 photographs.

Consumptives' Home, Dorchester, 2 photographs.

Free Home for Consumptives, Quincy Street, Boston, 1 photograph.

Massachusetts Crematory, Boston, 2 photographs.

Journal of Massachusetts Association of Boards of Health, 4 bound volumes.

Five bound volumes American Kitchen Magazine.

The foregoing exhibit was prepared and forwarded to Paris, Feb. 16, 1900. A letter has been received by the secretary, dated at Paris, Aug. 4, 1900, from Mr. H. J. Rogers, Director of the Department of Education and Social Economy, in which the exhibit of hygiene was placed, saying: "Your exhibit is attracting a great deal of favorable comment. It will please you to know that the exhibit as a whole has received a 'Grand Prix.'"

The contribution from the State Board of Health of Massachusetts formed an important and instructive part of this exhibit.

In addition to the foregoing exhibit, the engineering department of the Board contributed, to a separate exhibit in the Engineering Building, 60 photographs illustrating the different sewage-dipsosal plants in operation in Massachusetts where intermittent filtration of sewage has been adopted.

These excellent views showed the general features of the filtration beds, pumping stations and other essentials of the plants now in operation, together with views of the experiment station at Lawrence.

The Pathological Department of the Board.

A most notable feature in the progress of sanitary work during the past ten years has been the growth of the laboratory. At the present time many of the State boards of health, as well as the local boards of nearly all of the large cities, have established laboratories not only for chemical analysis but also for bacteriological investigation, experiment and observation with reference to the natural history of infectious diseases. The laboratory of the Board for such bacteriological work was established in 1894 at the Bussey Institute at Forest Hills, and was soon afterward placed under the charge of Dr. Theobald Smith, who has directed the work of the Board in this direction since that time.

The different lines of work conducted in this department during the year 1899 have been the following: —

1. The production of antitoxin, which has comprised the preparation of 44,298 vials of antitoxin during the year ended March 31, 1900.*

2. The examination of 3,258 cultures of matter suspected of containing the germs of diphtheria.

3. The examination of 571 specimens of material suspected of containing germs of tuberculosis.

4. The examination of specimens of blood of persons living in malarial districts.

5. Examination of the blood of typhoid patients.

The production of tetanus antitoxin was discontinued during the year, in consequence of the very small and irregular demand for this serum, as well as the fact that its administration has usually been delayed until the patient was past recovery.

The following brief table shows the number of specimens examined for the presence of the germs of diphtheria and tuberculosis since the organization of the department: —

	Diphtheria.	Tuberculosis.
1896,	1,469	124
1897,	2,204	236
1898,	1,591	414
1899,	3,258	571
Totals,	8,522	1,345

* Since the vials or packages issued by the Board have been of variable size and strength, the standard of 1,000 units in a 5 cubic centimeter vial has been employed in making up the foregoing statement. Two sizes of vials are now employed, one containing 5 cubic centimeters and another 20 cubic centimeters.

WATER SUPPLY AND SEWERAGE.

During the year 1899 seventy-nine applications were officially made to the Board for its advice, under the provisions of chapter 375 of the Acts of 1888, entitled "An Act to protect the purity of inland waters and require consultation with the State Board of Health regarding the establishment of systems of water supply, drainage and sewerage."

The work done by the Board under the provisions of this act and other acts of the Legislature requiring special action of the Board relative to the approval of plans for systems of water supply, drainage and sewerage, together with the acts of the Board under the provisions of the general law of 1890, chapter 124, upon petitions for the taking of land for the purification and disposal of sewage, have been reported to the Legislature in Senate Document No. 4, and abstracts of the replies of the Board are given on pages 1 to 121. Public hearings have been given by the Board in connection with several of these matters.

Chemical and microscopical examinations of the various water supplies of the State have been continued as in previous years, and samples of water from 212 different sources of water supply in use in the various cities and towns having public water supplies have been examined from time to time by the Board. At the end of the year all of the cities and 132 out of a total of 321 towns were provided with public water supplies. The total population in the cities and towns supplied, according to the census of 1895, is about 90.5 per cent. of the total population of the State. Only 2 towns having a population in excess of 3,500, by the census of 1895, are now unprovided with public water supplies.

There are in the State many small systems of water works, owned by corporations or individuals, which supply water to villages or small sections in the larger cities and towns, and in many factories and mills water from some readily available source is supplied for various purposes and is often used to a large extent by the operatives for drinking. While in most such cases care is probably taken to ascertain whether the water supplied is suitable for drinking before furnishing it for use, it sometimes happens that little or no care is exercised in selecting the source of water supply or protecting it from pollution. The use of a private source, subject to direct pollution by sewage, for the supply of a factory village in Dracut, was the cause of a very serious epidemic of typhoid fever in that village early in the year, a brief statement of which will be found in a subsequent portion of this report.

Under the provisions of chapter 510 of the Acts of 1897, entitled "An act relative to the pollution of sources of water supply," the Board is given authority to make rules, regulations and orders for the purpose of preventing the pollution and securing the sanitary protection of all streams and ponds used by a city, town or water or ice company in this Commonwealth as sources of water supply, together with all springs, streams and water courses tributary thereto; and in response to a petition from the city of Cambridge this Board has provided such rules and regulations as appear to be required to protect the waters of Stony Brook and its tributaries used for supplying the inhabitants of the city of Cambridge. A copy of these rules will be found on pages 116–121 in this report. Requests for the establishment of rules and regulations for the protection of water supplies in other places have been presented to the Board. The act referred to also provides that the Board shall appoint agents to enforce the provisions of this act, and that their compensation shall be paid by the city or town, water or ice company making the application to the Board in the manner following: —

> Such compensation shall in the first instance be paid by the treasurer of the Commonwealth, upon written requisition signed by said board of health, and approved by the governor and council; but at the end of each calendar year the amount so paid shall be apportioned by said board, in such manner as it may deem just and equitable, among such cities, towns, water or ice companies, as shall have made application as aforesaid during such year; and if any such applicant shall fail, upon demand by the treasurer of the Commonwealth, to pay its proportional part so ascertained, as aforesaid, the treasurer may recover the amount thereof from such applicant, with interest from the date of the demand, in an action of contract in the superior court for the county of Suffolk.

Since it appears that the auditor has no authority to approve the payment by the treasurer of the Commonwealth of bills incurred under the provisions of this act, in the absence of a definite appropriation made for this purpose by the Legislature, there seems to be no practicable way by which the Board can enforce rules and regulations under the authority of the present statute.

At the present time a very large proportion of the water furnished by public supplies throughout the State is drawn from surface sources, such as ponds and reservoirs, and used without filtration. To describe the cases in which polluted water supplies have been proved to be the medium through which typhoid fever has been communicated to large numbers of people would be to repeat what is already well known. Wherever water drawn directly from surface sources is used for drinking, it is in the highest degree important for the protection of the public health that the pollution of the sources by sewage or other filth be prevented.

By the provisions of chapter 488 of the Acts of 1895 the State Board of Health is authorized and required to make rules and regulations for the sanitary protection of all waters used by the Metropolitan Water Board for the water supply of any city, town or water company; and in response to an application from the Metropolitan Water Board this Board has provided such rules and regulations as appeared to be required for the protection of the waters described in the act, a copy of which will be found on pages 110–116.

The average rainfall in Massachusetts for the year 1899 was nearly six inches less than the normal, a considerable excess occurring in the months of January, February and March, and a great deficiency in the aggregate during the remainder of the year. The effect of the low rainfall and its unequal distribution was to produce a stream flow much in excess of the normal during the first four months of the year and much less than the normal during the remainder of the year. Judging from the measured flow of the Sudbury River, the flow of streams was less in 1899 than it has been for a number of years, though it was probably higher in some portions of the State than in the region of the Sudbury River. The effect of this low flow was to make the pollution of streams more evident than for several years, and special attention was given to an examination of the various rivers, and numerous samples of water from various points on the more important streams have been analyzed, the results of which may be found in the chapter on the examination of rivers.

The water of the Blackstone River has been examined since June, 1887, by means of samples of water collected monthly at four places along the stream. The points selected for examination were as follows: (1) the river between the outlet of Mill Brook channel and the sewage precipitation works of the city of Worcester; (2) a point at a sufficient distance below the Worcester sewage precipitation works to allow the effluent from these works to become thoroughly mixed with the river water; (3) a point in the village of Uxbridge about seventeen miles below the precipitation works; (4) a point in the village of Millville about five miles below Uxbridge. Previous to 1890 nearly all of the sewage of the city of Worcester was discharged without treatment into the channel of Mill Brook, through which it flowed to the Blackstone River at Quinsigamond Village. On June 25, 1890, a portion of the sewage was diverted to chemical precipitation works located near the river about one mile south of Quinsigamond Village. These works were designed to treat about 4,500,000 gallons per day. Works of much larger capacity were completed and put in operation on July 15, 1893. These works have a nominal capacity of 15,000,000 gallons per day and have apparently been capable of treating a somewhat larger quantity, but the works are not of sufficient capacity to take the whole flow of the brook in all ordinary conditions.

Comparing the average of the analyses of all of the samples collected during 1899 from the river between the Mill Brook channel and the sewage precipitation works of the city of Worcester with the averages of analyses of samples collected at this place in previous years, it is seen that the stream in this portion of its course, as indicated by these analyses, was in worse condition during 1899 than it has been in any previous year since 1892. Below the precipitation works the average quantity of free ammonia shown by the analyses of samples collected during 1899 was greater than in any year since the examinations were begun, with the exception of the years 1891 and 1894, and the quantity of albuminoid ammonia present in 1899 was exceeded only in the years 1892 and 1893.

At Uxbridge the average quantity of both the free ammonia and albuminoid ammonia found in the river water in 1899 was greater than was found in any previous year since the investigations were begun; and at Millville the evidences of pollution, taken as a whole, were also greater than in any previous year, though the albuminoid ammonia was slightly less than in two of the earlier years.

Averages of the analyses of samples collected during the drier six months of the year 1899, from June to November inclusive, when compared with averages for similar months in previous years, show practically the same result as the averages for the whole year; and the results of these examinations indicate that the condition of the Blackstone River during 1899 was worse than it has been for many years, and probably in the lower portion of its course worse than it has ever been before.

The Neponset River, the pollution of which is largely caused by manufacturing waste, was also much worse than in previous years, and during the summer and fall was exceedingly foul throughout its entire length below East Walpole, giving off a very offensive odor, noticeable for a long distance from its banks. The condition of this river and the extensive meadows through which it flows in the middle portion of its course was investigated by the Board under the direction of the Legislature of 1895, and a report made in 1897, presenting a plan for the improvement of the stream, but thus far no action in the matter has been taken.

The provisions of the Pittsfield sewerage act and of the approval of the plans of sewerage by the Board under that act require the removal of the sewage of Pittsfield from the Housatonic River in June of next year (1900). The diversion of the sewage of Pittsfield from the Housatonic River will remove the chief source of pollution of that stream and very greatly improve its condition.

The condition of the Hoosac River at North Adams and of the North Branch of the Nashua River below Fitchburg has been noticeably foul, and measures for the purification of these streams are necessary.

Plans for the purification of the sewage of Middleborough were approved by the Board during the year, and when carried out will provide a remedy for the filthy and unhealthful conditions existing in the Nemasket River at that place.

The usual tables of water supply statistics are given, showing the number of towns supplied with water, the quantity of water used and a summary of the records of rainfall and flow of streams, to which reference has already been made.

Experiments upon the purification of sewage and water have been carried on at the Lawrence Experiment Station as in previous years, and the results are presented by the chemist in charge. Several of the large experimental filters for the purification of sewage have now been in operation for a period of twelve years, and the information obtained from these filters has been of the greatest value in furnishing reliable data with regard to the means of purifying sewage and preventing the pollution of streams. Much attention has been given to the purification of sewage by rapid methods, especially by the method of subjecting the sewage to decomposition and putrefaction in a tank before applying it to filters, thereby causing a large portion of the organic matter in suspension to be broken up, so that it is either dissolved in the sewage or escapes in the form of gas. Much of the remainder becomes very finely divided, and the sewage can be purified subsequently by filtration at much greater rates than in cases where fresh sewage is applied to filters. This process, known as the septic tank process, has furnished very interesting results, and, taken in connection with the bacterial or contact filters, so-called, gives promise of furnishing a means of purifying sewage in places where suitable land for the purpose is not available.

Investigations upon the purification of water by sand filtration have been carried on as usual, and the operations of the Lawrence city filter have been followed as in previous years. The results of the studies of the past year bring out very clearly the importance of a careful study of bacterial results, especially with reference to the character of the bacteria passing through a filter, and indicate that determinations of numbers of bacteria only may fail to give reliable information as to the efficiency of a filter.

The results of many investigations made in recent years upon the purification of waters containing iron in various forms are summarized in a paper by Mr. H. W. Clark, chemist of the Board, in which the results of several of these investigations are presented in detail.

Offensive Trades.

By the provisions of chapter 80, section 93, Public Statutes, certain powers and duties were given to the State Board of Health with reference to the suspension of the business of slaughtering cattle, sheep and other animals, or melting and rendering, or other noxious or offensive trades; but within the past five years no petitions have been made to the Board requesting its action under this statute.

By certain acts of 1894 and 1895 (chapters 491, section 17, of 1894, and 496, section 3, of 1895) additional measures were provided, imposing upon the local authorities certain duties in addition to those which already existed. By these provisions it was required that the proprietors of slaughter houses and other similar establishments should apply for licenses to carry on business annually in April, such application to be made to the mayor and aldermen of cities and to the boards of health of towns.

Health of Towns.

During the past few years it has been customary to insert at the latter end of the report of the Board a brief digest of matters relating to the health of towns, selected from the printed reports of local boards of health. Similar material is introduced in the present report, with the addition of several reports of inspections made in different cities and towns by Dr. Morse, medical inspector of the Board, at the request of local boards of health. Most of these have reference to the prevalence of typhoid fever. In several instances conditions were found which were sufficiently serious to account for the prevalence of disease which existed.

Summer Resorts.

Within the past few years, and especially since the rapid introduction of electric railways, the popular demand for places of outdoor recreation outside the limits of large centres of population has led to the establishment of many places of amusement, camp and picnic grounds and other kinds of summer resorts.

Some of these resorts are of a permanent character, where cottages have been built to be occupied for the season; while others are only temporary, and are used as picnic grounds for a portion of a day only at a time. In the latter case, however, it often happens that thousands of people visit such places at once. The places selected for such resorts are often located upon the shores of some stream, lake or pond used as a public water supply, and in some cases the collection of people in large numbers upon the water-shed of such bodies of water has led to their pollution and the consequent occurrence of epidemics of typhoid fever in a neighboring city or town dependent upon these sources for its public water supply.

Attention has already been called to this subject in the reports of the Board for 1896 and 1897 (pp. xix and xx). An inspection of these places was made in 1896, and it was found that at that time there were at least 130 such places distributed throughout the State. In some of them the sanitary conditions were such as needed correction, and notices to that effect were sent to the owners or proprietors.

During the past year further inspections have been made of such places as had not been visited at the time of the first inspection, and of others where the conditions were such as to require further inspection. A report upon these latter places has been prepared by Dr. Morse, the medical inspector of the Board, and appears at the end of this volume.

Routine Work of the Board.

During the year ended Sept. 30, 1899, the Board held meetings at least once in each month. Meetings of such of the standing committees as were necessary for the transaction of business were also held from time to time. Hearings were held at the office of the Board relative to the sewage disposal of Middleborough, Stockbridge, Pittsfield, Southbridge, Wakefield and Webster, and with reference to a proposed outlet for the sewage of a district in Somerville into the Miller's River. A hearing was also held at Pittsfield with reference to the sewage disposal of that city, the Board attending.

The office of the Board has been open throughout the year, as prescribed by the Public Statutes, chapter 21, section 10,* for the transaction of its authorized business.

Advice has been very frequently given at the office and by mail to local boards and to individuals in regard to sanitary matters, and many visits have been made by the inspector, the engineers and other experts to cities and towns for the purpose of making investigations and giving advice.

The bacteriological work undertaken by the Board for the benefit of such communities in the State as possessed no facilities for such methods of investigation and diagnosis, together with the production and distribution of antitoxin for the treatment and prevention of diphtheria, has very materially increased the work of the office, which acts as a general and central station for the distribution of antitoxin and of the various culture tubes, receptacles and other means employed for the diagnosis of disease.

* Office hours, 9 A.M. to 5 P.M.; Saturdays, 9 A.M. to 2 P.M.

The work of antitoxin production especially has increased over that of the previous year, as will be seen by reference to the report upon antitoxin production.

The statistics of mortality compiled from the weekly postal-card returns from the registering authorities of cities and towns have been published weekly during the year in the form of a bulletin, which also contains, once in each month, a report of the work done in the line of food and drug inspection, together with the prosecutions made under the food and drug acts, and other important information relative to the work of this department. In addition to these items there is also published in the same bulletin a weekly report of the number of cases of infectious diseases reported by the local boards to the State Board of Health, under the provisions of chapter 302 of the Acts of 1893. It is the intention of the Board to increase the usefulness of this bulletin by introducing further material relative to sanitary matters of interest to the people.

The laboratories for water analysis and for food and drug inspection are located on the fifth floor of the State House, the former at Room 502 and the latter at Room 501, each of which is open during the usual working hours.

The following table presents certain statistical data relative to the routine work of the Board: —

STATISTICAL TABLE FOR THE YEAR ENDED SEPT. 30, 1899.

Whole number of samples of foods and drugs examined during the year,	9,802
Samples of milk examined (included in the foregoing),	6,186
Whole number of samples of food and drugs examined since beginning of work in 1883,	107,392
Whole number of samples of milk examined since beginning of work in 1883,	57,384
Number of prosecutions against offenders during the year,	47
Number of convictions during the year,	45
Amount of fines imposed during the year,	$1,432 66
Number of packages of antitoxin of 1,500 units each issued to cities and towns,*	31,997
Number of bacterial cultures made for the diagnosis of diphtheria in cities and towns,*	3,258
Number of examinations made for diagnosis of tuberculosis,*	571
Number of examinations of blood made for diagnosis of malarial infection,*	76

* For the year ended March 31, 1900.

Number of notices of cases of infectious diseases received and recorded under the provisions of chapter 302, Acts of 1893,*	27,719
Number of postal-card returns of mortality for cities and towns received and recorded,*	2,015
Number of annual reports of cities and towns received under the provisions † of Acts of 1894, chapter 218,*	89
Force employed in general work of Board at central office, State House: —	
Secretary,	1
Clerks,	3
Messenger,	1
Total,	5
Force employed at central office, State House, Boston, for food and drug inspection, chemists and assistants,	2
At Amherst,	1
Inspectors,	4
Total,	7
Force employed at laboratory (Bussey Institute): —	
Pathologist,	1
Assistants,	5
Total,	6

UNDER THE PROVISIONS OF CHAPTER 375, ACTS OF 1888.

Applications for advice from cities, towns and others: —	
Relating to water supply,	39
Relating to ice supply,	3
Relating to sewerage and drainage,	30
Relating to pollution of streams,	6
Miscellaneous,	1
Total,	79
Number of samples of water examined chemically and microscopically at the laboratory, Room 502, State House,	3,513
Number of samples of sewage and effluent from sewage purification works examined chemically at the laboratory, Room 502, State House,	493
Number of samples of sewage and water examined chemically and bacterially at the Lawrence Experiment Station,	2,204
Number of samples of sand examined chemically and bacterially at the Lawrence Experiment Station,	312
Number of samples of sand examined mechanically at the Lawrence Experiment Station,	358
Additional samples examined bacterially at the Lawrence Experiment Station,	7,871
Total number of samples examined,	14,751

* For the calendar year 1899. † Towns having a population of over 5,000 inhabitants in each.

Force employed at central office: —		
Chief engineer,	1	
Assistant engineers,	4	
Stenographers and clerks,	2	
Messenger,	1	
		8
At laboratory, Room 502, State House: —		
Chemists,	1	
Assistant chemists,	5	
Biologist,	1	
		7
At Lawrence Experiment Station: —		
Chemists,	2	
Bacteriologists,	2	
Other assistants and laborers,	4	
		8
Total ordinary force employed under chapter 375, Acts of 1888,		23
Total ordinary force in all departments,		41

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	1894,	53
1887,	22	1895,	52
1888,	28	1896,	65
1889,	38	1897,	59
1890,	23	1898,	75
1891,	53	1899,	79
1892,	56		
1893,	51	Total,	662

Recommendations.

The following recommendation was made to the Legislature at the beginning of the session of 1900: —

The Board recommends the continuance of its investigations now being carried on, as authorized by the provisions of chapter 375 of the Acts of 1888.

For this purpose, and to make the necessary investigations in order to advise cities, towns, corporations and individuals in regard to the best methods of assuring the purity of intended or existing water supplies and the best method of disposing of sewage, and to carry out the other provisions of chapter 375 of the Acts of 1888, the Board estimates that the sum of $30,000 will be required.

EXPENDITURES.

The expenditures in 1899 under the foregoing appropriations were as follows: —

General Expenditures Sept. 30, 1898, to Sept. 30, 1899.

Salaries,	$8,742 00	
Travelling expenses,	739 65	
Stationery,	519 38	
Printing,	1,732 85	
Books, subscription and binding,	359 01	
Advertising,	58 00	
Express charges,	215 04	
Extra services,	107 10	
Messenger services,	18 44	
Postage and postal orders,	379 51	
Telephone and telegraph messages,	129 98	
Typewriting supplies,	7 15	
Translations,	18 00	
Sundry office supplies and incidental expenses,	199 86	
		$13,225 97

Expenditures at Pathological Laboratory at Forest Hills.

Salaries,	$3,067 04	
Travelling expenses,	46 19	
Purchase of animals,	460 62	
Board of horses,	1,681 20	
Food for animals,	74 87	
Apparatus, chemicals and laboratory supplies,	1,536 99	
Ice,	5 30	
Postage,	5 64	
Stationery,	6 25	
Rental of telephone and messages,	127 05	
		7,011 15
Total,		$20,237 12

Expenses under Chapter 375 of Acts of 1888 (Protection of Purity of Inland Waters) for Calendar Year 1899.

Salaries, including wages of laborers at Lawrence Experiment Station,	$24,128 58
Apparatus and materials,	2,630 30
Rent of Lawrence Experiment Station,	150 00
Travelling expenses,	1,486 88
Express charges,	915 33
Use of tools and office, Lawrence Experiment Station,	214 16
Amount carried forward,	$29,525 25

Amount brought forward,	$29,525 25
Books, stationery and drawing materials,	250 19
Maps and blue prints,	83 35
Postage stamps,	13 00
Printing,	104 02
Collection of samples,	8 80
Messengers, telegrams and telephone messages,	15 18
Total,	$29,999 79

For Food and Drug Inspection for Year ending Sept. 30, 1899.

Salaries of analysts,	$3,875 48
Salaries of inspectors,	4,050 00
Travelling expenses and purchase of samples,	1,803 50
Apparatus and chemicals,	1,121 72
Printing,	21 67
Express,	1 55
Special investigation,	50 00
Telegram,	42
Extra services for inspection,	188 00
Services (cleaning laboratory),	122 00
Case for samples,	7 50
Sundry small supplies,	9 99
Total,	$11,251 83

HENRY P. WALCOTT,
JULIAN A. MEAD,
HIRAM F. MILLS,
FRANK W. DRAPER,
GERARD C. TOBEY,
JAMES W. HULL,
CHARLES H. PORTER,
State Board of Health.

WATER SUPPLY AND SEWERAGE.

ADVICE TO CITIES AND TOWNS.

ADVICE TO CITIES AND TOWNS.

Under the provisions of chapter 375 of the Acts of 1888, entitled "An 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," the Board is required

"from time to time to consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply, drainage or sewerage, as to the most appropriate source of supply, the best practical method of assuring the purity thereof or of disposing of their drainage or sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. It shall also from time to time consult with and advise persons or corporations engaged or intending to engage in any manufacturing or other business, drainage or sewage from which may tend to cause the pollution of any inland water, as to the best practicable method of preventing such pollution by the interception, disposal or purification of such drainage or sewage: *provided*, that no person shall be compelled to bear the expense of such consultation or advice, or of experiments made for the purposes of this act. All such authorities, corporations, firms and individuals are hereby required to give notice to said Board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage and sewage; and all petitions to the Legislature for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of the said Board thereon."

During the year 1899 the Board has given its advice to the following cities, towns, corporations and individuals who have applied for such advice under the provisions of the general act of 1888, 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 as follows: —

Attleborough.
Blackstone.
Brookline.
Cheshire.
Dartmouth (Bay View).
Dartmouth (Salter's Point).
Falmouth.
Framingham (State Camp Ground).
Granville.
Great Barrington.
Harvard (Hildreth Bros.).
Holyoke.
Holyoke (American Thread Company).
Hyde Park.
Lawrence.
Lowell (three letters of advice).
Lowell (Lowell Bleachery and Dye Works).
Medway (Poor Farm).
Milford (two letters of advice).
Needham.
North Adams (Board of Health).
North Adams (N. L. Millard & Co.).
Northampton (Mt. Tom Sulphite Pulp Company).
Plymouth.
Provincetown.
Randolph.
Russell.
Salem (two letters of advice)
Springfield.
Stoughton.
Tyngsborough.
Ware.
Warren.
Wellesley.
Weston.
West Springfield.
Wilmington.

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

Bridgewater (State Farm).
Easthampton.
Foxborough.
Foxborough (Massachusetts Hospital for Dipsomaniacs and Inebriates).
Gardner.
Haverhill.
Hopedale (The Draper Company).
Longmeadow.
Ludlow.
Middleborough.
North Adams.
Northampton.
Pittsfield.
Somerville (three letters of advice).
Southbridge.
Stockbridge.
Wakefield.
Webster.
Westborough.
Westborough (Lyman and Industrial Schools).

Replies were made in answer to applications from the authorities of the following cities and towns for advice relative to the pollution of ponds, streams and other bodies of water: —

Dracut.
New Bedford
Uxbridge.
West Springfield.

Replies were also made during the year in answer to applications from the following authorities for advice relative to sources of ice supply: —

Holyoke.	Springfield.
North Adams.	Ware.

Rules and regulations for the sanitary protection of sources of water supply were made for the following authorities: —

Cambridge Water Board.	Metropolitan Water Board.

Water Supply.

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

Attleborough. An application was received from the water commissioners of Attleborough, Dec. 19, 1898, requesting from the Board such recommendations as it could make, as the result of the studies which have been made during the past year, with a view to eliminating the iron from the public water supply of the town. The Board replied to this request as follows: —

Jan. 24, 1899.

Since receiving your application for advice as to some method by which the rusty appearance of the water in the distributing system of the town of Attleborough might be remedied, the Board has caused an investigation to be made, to determine the condition of the water and the cause of the presence of iron therein, and, if possible, to discover some suitable method of preventing trouble from this cause. In the course of these investigations several experiments have been made, with the assistance of your Board, upon various methods of treating water.

Analyses of water supplied to the town of Attleborough from the well near Seven Mile River have been made regularly by this Board about once each month since the well was completed, and the results show that the quality remains about the same as in the beginning. The water is clear, nearly colorless and almost always odorless. It is also soft and contains but little organic matter, and as drawn from the well it is of excellent quality for drinking and other domestic uses.

It has been found, however, that the water in the pipes in various parts of the system contains an excessive amount of iron; and, since the quantity of iron present in the water of the well has always been insignificant, so far as is shown by the chemical analyses, it is evident that the water takes up iron from the pipes in its passage through them.

Further examination of the water of the well has shown that it contains carbonic acid gas in large quantity and a considerable quantity of dissolved oxygen. Our investigations of this and other water supplies and experiments conducted in the laboratory have shown that some waters in which these substances are present will attack the metal of pipes through which the water is conveyed, and it is probable that the corrosive action of the Attleborough water upon the pipes through which it is conveyed is caused by the presence of one or both of these substances. Various means of preventing the water from attacking the pipes have been tried, one of which was to remove the carbonic acid gas by aeration; but the quantity of oxygen that remained in the water was such as to cause the water to attack the pipes, and, while the quantity of iron that would be taken from the pipes in this way might be smaller than under the present conditions, the water would nevertheless be liable to continue to be objectionable for many purposes.

The effect of adding lime to the water has also been tried, but our investigations have not been carried far enough to determine definitely what results can be obtained in this way. The only recommendation that the Board can make at the present time is that the investigation be continued, since the water is of excellent quality for domestic uses and would not be objectionable in any way were it not for the presence of iron in excessive quantity in the distributing system.

Careful records of the temperature of the water in the well and in Orr's Pond, as well as in various parts of the distributing system, have been furnished by you, and several observations have been made by the Board. The results of these investigations indicate that some of the water entering the well probably comes from the rainfall percolating through the ground in its vicinity, and that other portions probably come by filtration from Seven Mile River, and still other portions from Orr's Pond.

It is possible that further investigations might show the source from which comes the carbonic acid which enters the well, and it may be practicable to neutralize its influence without affecting unfavorably the quality of the water of the well. In continuing the investigation, it appears to be of much importance to examine the condition of the water in the ground about the well; and it is suggested that, as the next step in the investigation, you cause test wells to be driven in the region about the well, in order to make it practicable to examine the water and determine if possible the source from which the carbonic acid gas comes, and whether its entrance into the well can be prevented or its effect neutralized in any way. The Board will continue to co-operate with you in these investigations, and will make all necessary analyses and will give you further advice in the matter when the results of further investigations are available.

BLACKSTONE. An application was received from the water supply committee of Blackstone, Nov. 18, 1899, for the advice of the Board relative to a proposed water supply for that town. The Board replied to this application as follows: —

JAN. 5, 1900.

The State Board of Health received from you, on Nov. 18, 1899, an application for advice with reference to a proposed water supply for the town of Blackstone, in which you refer to Ironstone Pond, Fox Brook and Emerson Brook as possible sources of supply. The Board has caused the sources referred to to be examined by one of its engineers, and samples of the water of these and other sources to be analyzed. Two of the sources referred to by you, Ironstone Pond and Emerson Brook, were examined by the Board in 1893, at the request of a number of citizens of Blackstone who proposed to form a water company at that time, and a copy of the advice of the Board with reference to the sources proposed at that time is enclosed herewith. (See Senate Document 4, 1895.) The recent examinations of the Ironstone Pond and Emerson Brook sources tend to confirm the opinion expressed in 1893; and, excepting the examinations made by the Board, it does not appear that any more thorough investigations of these sources have been made since the time of the previous application. It is not likely that it will be practicable for the town, except at large expense, to make such improvements at either source as to make it capable of furnishing a water of satisfactory quality for the town of Blackstone.

Fox Brook, the remaining source mentioned by you, at the point suggested for the location of a reservoir, has a water-shed of 4.25 square miles, which contains a population of about 62 persons per square mile. Analyses of the water of Fox Brook show that it is highly colored, and contains a large quantity of organic matter. Considering all the circumstances, this source is not, in the opinion of the Board, a satisfactory one from which to attempt to secure a water supply for Blackstone.

A good ground-water supply would be more satisfactory than either of the sources suggested. In the vicinity of a brook flowing from Ironstone Pond to the Blackstone River there are large areas of land where the soil apparently consists of coarse and porous material, which absorbs a large proportion of the water falling upon it. Much spring water discharges from this territory into the stream at various points before it reaches the Blackstone River, and you have called attention to these springs and requested advice as to the feasibility of obtaining a supply for Blackstone in this region. Analyses of samples of water from two of the springs in this region show that it is soft, colorless, and otherwise of excellent quality for the purposes of a public water supply; and, judging from the quantity flowing in the early part of December, 1899, there is a prospect of obtaining an ample supply of water for Blackstone in this region, if the porous material is deep over a considerable area. This source has the advantage of being quite near the thickly settled portion of the village of Millville, though not near enough so that the quality of the water is likely to be injured by the growth of population in this village.

Considering the circumstances, the Board would advise that an investigation be made by the town in the vicinity of the springs by means of test wells to determine the depth and extent of porous soil; and if, upon examination, favorable conditions are found, it is desirable that you cause a pumping test to be made by pumping continuously from a group of wells in this locality at a rate as great as would be necessary for the supply of the town of Blackstone. The Board will co-operate with you in further investigations by making such analyses of water as may be necessary, and will give you further advice in the matter when you have the results of additional investigations to present.

BROOKLINE. An application was received from the selectmen and water board of Brookline, Dec. 7, 1899, for the advice of the State Board of Health with reference to enlarging the yield of the present sources of water supply. The Board replied to this application as follows: —

JAN. 5, 1900.

The State Board of Health received from you, on Dec. 7, 1899, an application for advice with reference to an additional water supply for the town, in which you state: —

The present capacity of the force mains and pumps is 5,000,000 gallons in twenty-four hours. The system of driven wells and the filtering gallery will furnish the above amount of water except during the lowest stages of the river, when it is proposed to pump water from the river on to the meadows in which the wells are driven, if this can be done without injuring the quality of the water.

The town now owns land enough, in addition to the land on which the wells and filtering galleries are located, to yield from 3,000,000 to 5,000,000 gallons per day, and the system of driven wells can be easily extended if found desirable or necessary to convey the additional water to the pumps. The cost of this extension will be small. . . .

The Board has carefully considered the proposed plan and the results of analyses of the water of Charles River and of the present wells and filter-gallery, and has caused an examination to be made by its engineer of the location and surroundings of your present works.

The water obtained from your present works is of excellent appearance, being clear, nearly colorless, and otherwise of good quality, and since a covered reservoir has been provided the quality does not deteriorate in the distributing system. Much of the land in the region about the wells is subject to inundation at times of high water in the river, and is uninhabited;

and the town controls so large an area of land that it will be able to prevent serious danger of injury to the quality of its water supply that might result from the growth of population in this region, for many years.

The character of the soil over much of the area controlled by the town appears, from such examinations as have been made, to be similar to that in which the present wells are located; and it will be practicable to enlarge the tubular well system by extending it through the favorable portions of these lands, and thus increase considerably the yield of the works by drawing a larger proportion of the water stored in the ground, and increasing the area from which water will flow toward the present wells.

The main feature of the plan for increasing the yield of the works is to pump water from the river upon the meadows in which the wells are located, and the plan involves extending the tubular well system, if necessary or desirable. The water now drawn from the system of tubular wells between the two positions of the river, south-west of the pumping station, is derived from a gravel stratum found at a depth of from 30 to 95 feet beneath the surface. The water is probably supplied partly by the rainfall upon the ground in the region about the wells and partly by filtration from the river, especially at times of high water, and when the land in which the wells are situated is inundated. Much of the flat land in the region of the wells is covered with loam or peat to only a small depth, and beneath this material the soil encountered in sinking the present wells was found to be composed of sand down to the gravel stratum from which the water is drawn. If water should be pumped upon the surface of the ground about the wells in its present state, it is probable, judging from the experience with the present wells at times of high water in the river, that a considerable portion of it would sink into the ground; but the water in passing through the peat would be liable to take up organic matter and iron, and, if this method of increasing the supply should be used frequently or regularly, it might injure the quality of the water of the wells.

As already indicated, the depth of peat is not great over a large portion of the area, and it is probably feasible to remove all the peat and organic matter from large areas of the flat lands at small expense. If river water should be applied to areas prepared in this way intermittently, and only in such quantities as would allow the water to soak away and the surface of the area to remain dry for a period of several hours in each twenty-four, it is probable that the yield of the wells could be materially increased without injuring the quality of the water. The degree to which the organic matter and color of the water can be removed and its temperature lowered will probably be dependent also to a considerable extent upon the time taken by the water in passing through the ground to the wells. It is advisable to apply the river water at a considerable distance, not less than 75 feet from the wells, and not to allow the water to come in contact with any of the bodies of peat which are not removed from the field.

Considering all the circumstances, the Board is of the opinion that the proposed plan of securing an additional water supply has such advantages that it should be given a thorough trial, since it is likely that by developing this plan in the manner suggested a large additional supply of very good water can be obtained at a smaller cost to the town than from any other source.

The Board will, if you so request, give you further advice in this matter when plans for further works have been prepared.

CHESHIRE. An application was received from the Cheshire Water Company, Aug. 9, 1899, for the advice of the Board with reference to the propriety of taking Kitchen Brook in that town as an additional source of water supply. The Board replied to this application as follows: —

SEPT. 8, 1899.

The State Board of Health has considered your application for advice with reference to the use of Kitchen Brook in the town of Cheshire as a source of public water supply for that town, and has caused the water-shed to be examined by its engineer, and samples of the water to be analyzed. The results of these and the previous examinations indicate that the water of this stream is quite soft, colorless and otherwise of good quality for the purposes of a public water supply; and, so far as can be judged from the information available, the flow of the stream is sufficient to supply all of the water that the town is likely to need, excepting possibly in the very driest weather.

The water-shed of this stream contains a much smaller population than that of Thunder Brook, your present source of supply; and it appears that there is but one occupied dwelling house upon the water-shed of this stream, and this house is so situated that the danger of pollution of the stream from this place can easily be prevented. The quality of the water of Kitchen Brook is slightly better than that of Thunder Brook, judging from the limited number of analyses of these waters that have thus far been made.

The Board is of the opinion that Kitchen Brook is an appropriate source of additional water supply for Cheshire.

DARTMOUTH (Salter's Point). An application was received, July 12, 1897, from Alvin F. Waite and James T. Smith of Dartmouth, for the advice of the Board relative to the proposed water supply for Salter's Point, a small summer settlement on the shore of Buzzard's Bay in that town. The Board replied to this application as follows: —

AUG. 4, 1899.

The State Board of Health received from you, in July, 1897, an application for advice with reference to a proposed water supply for the summer settlement known as Salter's Point in South Dartmouth, in which you stated that experiments were being conducted with a view to obtaining water from the ground in the valley of a small brook west of the village, and requested the advice of the Board as to the use of water from the proposed source for the supply of the village. Subsequently a well 20 feet in diameter and about 20 feet in depth was excavated in the vicinity of the brook referred to; but it has not been practicable to obtain a sample of the water until the present summer, when the water was first used for the supply of the village.

The Board has caused the locality to be examined by one of its engineers, and a sample of the water to be analyzed.

The results of the analysis show that the water is quite hard, and there are indications that it has been previously polluted by sewage; but the water was clear, colorless and odorless, and practically free from organic matter, and an examination of the surroundings indicates that whatever polluted water may find its way to the well must pass for a long distance through the ground. Under the circumstances the well is, in the opinion of the Board, a safe source from which to take water for the supply of the village.

With regard to the quantity of water which this source will supply, it is difficult to make a definite estimate, but it appears to be sufficient for the present needs of the village.

DARTMOUTH (Bay View). An application was received, Oct. 6, 1898, from Franklyn Howland of New Bedford, for the opinion of the Board with reference to the quality of the water of a well used as a water supply for Bay View, a summer resort in Dartmouth. To this application the Board replied as follows: —

AUG. 4, 1899.

The State Board of Health has considered your application for advice with reference to a water supply for the summer resort known as Bay View, in the town of Dartmouth, and has caused the well used as a source of supply and its surroundings to be examined by one of its engineers, and samples of the water to be analyzed.

The analysis of a sample of water collected from the well in October, 1898, at a time when the well was not in use, showed that the water contained a larger amount of organic matter than is found in a good ground water, and it was also slightly turbid and colored, and had a noticeable odor on heating. It was not practicable to obtain another sample during 1898; but in July of the present year, while the well was being used, another sample was collected, which was found to be clear, colorless and odorless, and practically free from organic matter. The water of the latter sample shows evidence of having been at some time polluted and subsequently well purified in its passage through the ground, and the indications are that the water under present conditions is suitable for drinking and other domestic uses; but a tight cover should be provided over the top of the well, so that no surface water or water pumped from the well upon the ground about it can enter it.

The quantity of water which this source would yield is likely to prove too small for the supply of the inhabitants of Bay View in a very dry season; and its location is such that, if other houses are built in the region immediately about the well, and from which the well receives its supply, the quality of the water may be injuriously affected.

Under the circumstances, since an additional supply is likely to be needed, it would be best to select a source at such a distance from dwelling houses that it is likely to be free from danger of sewage pollution.

FALMOUTH (the Falmouth Water Company). An application was received, May 28, 1898, from the Falmouth Water Company, for advice, under chapter 375 of the Acts of 1888, relative to a proposed water supply for the town of Falmouth, and for the approval by the Board, under chapter 66 of the Acts of 1898, of the use of the water of Long Pond in Falmouth and of water taken from a system of tubular wells situated between Long Pond and Grew's Pond, as sources of water supply for that town. The Board replied to this application as follows: —

JUNE 2, 1899.

The State Board of Health received from you, on May 28, 1898, an application requesting the advice of the Board, under the provisions of chapter 375 of the Acts of 1888, as to a proposed source of water supply for the town of Falmouth, and requesting the approval of the Board, under the provisions of chapter 66 of the Acts of 1898, of the use of the water of Long Lake (or Pond) in Falmouth and the water taken from a system of tubular wells located between Long Pond and Grew's Pond, for the supply of the town of Falmouth for domestic use.

The application was accompanied by a description of tests which had been made by you of ground in the vicinity of Grew's Pond and the southerly end of Long Pond, and soon after the receipt of the application an examination of the region was made by the engineer of the Board.

Additional wells were afterward put in, and, beginning on March 6, 1899, a pumping test was made by pumping from fifteen wells located on the southerly shore of Long Pond and in the narrow strip of land separating Long Pond from Grew's Pond. The test was continued for a period of nearly six days, water being pumped at the rate of 250,000 gallons per day, and during the test samples of water were collected by you and sent in for analysis.

Subsequently a diagram was received, showing the location of the wells which it is proposed to use as sources of supply, and the location of the pipe through which it is proposed to draw water from Long Pond.

The Board has carefully considered the application and plans submitted, and the results of the analyses of samples of water from the wells and from Long Pond.

Samples of water collected from the fifteen wells referred to during the pumping test in March, 1899, showed that the water was clear, colorless and odorless, and that it was very soft and otherwise of excellent quality for the purposes of a public water supply. The wells are located very close to the pond, and on this account it is possible that the quality of the water may deteriorate; but no material change took place during the pumping test, and another sample collected in the latter part of May in the present year gave no indications of a material change in the quality of the water.

With regard to the quantity of water obtainable from these wells a definite estimate cannot be made, but the pumping test showed that water can be drawn from the ground in this region with much freedom; and, considering the character of the land about the ponds, the situation of the wells and the character of the soil in which the wells are located, it seems probable that an ample supply for the present needs of the town can be obtained from these wells without the use of water from Long Pond.

Long Pond, as stated in a previous reply of the Board relative to this source, is capable of supplying a much larger quantity of water than is needed by the town of Falmouth, and the indications are that the water would generally be of excellent quality for the purposes of a public water supply; but it is possible that it may be subject, in common with many ponds and reservoirs, at occasional periods to disagreeable taste and odor.

Under the circumstances, it will be best to use the water of the wells for the supply of the town, unless the quality shall change greatly in the future after continued use, of which the analyses at present give no indication.

The Board hereby approves the use of water from the tubular wells described in the application, and located on land between Long and Grew's ponds, as shown upon the plan entitled "Falmouth Water Company's Pumping Station and Well System, Falmouth, Mass. Scale, 1 inch=20 feet," and the Board also approves the use of water drawn from Long Pond, as shown upon the above-mentioned plan, for domestic use for a water supply for the town of Falmouth, under the provisions of chapter 66 of the Acts of 1898.

FRAMINGHAM (State camp ground). An application was received, Sept. 9, 1899, from the medical director of the First Brigade Massachusetts Volunteer Militia, for the opinion of the Board with reference to the quality of the water supply of the camp at South Framingham, and also as to the best method of improving the sanitary condition of the camp. The Board replied as follows: —

SEPT. 26, 1899.

In accordance with your request of Sept. 9, 1899, for advice with reference to the quality of the water used at the State camp ground at South Framingham, and as to the best method of improving the sanitary condition of the camp ground, the State Board of Health has caused the locality to be examined by one of its engineers, and samples of water from the source used to supply the camp grounds to be analyzed.

The results of the analyses show that the water is soft, nearly colorless, and does not contain an excessive amount of organic matter for a surface water, and, if unpolluted by sewage, the source would be a suitable one from which to take water for drinking and other uses at the camp ground; but an examination of the water-shed shows the presence of several buildings not far from the shore of the pond, from which it is probable that polluting matters, under present conditions, find their way at times into the pond. It appears also that considerable numbers of people resort to the pond for bathing in the summer season. Under these circumstances, the pond cannot be considered a safe source from which to take water directly for drinking, unless the pollution of the pond from the causes indicated can be prevented. It is probably feasible to prevent the pollution of the pond, but it might be more expensive to keep it free from pollution than to secure a suitable supply in some other way.

There are indications that an ample supply of ground water could be obtained by the construction of a well or filter-gallery near the shore of the pond, where the soil is coarse and porous, so far as can be judged from surface indications; and a good ground water supply would be more satisfactory than a supply taken directly from the pond, even if the pollution were prevented.

It appears that the pipes of the Framingham Water Company are already laid to the vicinity of the camp grounds, and, if a satisfactory arrangement to supply the camp grounds can be made, it is probable that the best way of obtaining a suitable water supply for the grounds would be to take water from these works. If, however, it is deemed desirable to secure an independent supply, the Board would advise investigations with a view to obtaining a supply of water from the ground in the vicinity of Learned's Pond, your present source.

With regard to the sanitary condition of the camp, the investigations of the Board show that, if the vaults now in use receive sufficient care, and if the contents are disinfected and removed at frequent intervals, the presence of these vaults need not be a nuisance or a menace to the health of the camp. The drainage from the cook houses, however, which is at present discharged upon the ground, creates a serious nuisance, and should be disposed of in some more suitable manner. It does not appear to be practicable to construct a sewer to convey this drainage to the Framingham sewerage system, and it is, of course, essential to keep it out of the small stream which flows near the camp; but the grounds are at such an elevation above the valley of the brook that it appears to be practicable to convey this drainage to some place in the valley of the brook, and purify it upon land and allow the effluent to discharge into the brook.

The Board would advise that you have a plan made for a general system of sewerage and sewage disposal for the camp, and when you have prepared such a plan the Board will upon receipt of a request give you further advice in this matter.

GRANVILLE. An application was received, June 8, 1899, from Claude A. Magill and others, for the advice of the Board, with reference to a source of water supply for domestic use in the village of Granville. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on June 8, 1899, an application for advice with reference to a proposed source of water supply for the village of Granville, in which two sources are suggested, one being Seymour Brook, the waters of which would be taken at a point a little over a mile south-west of the village, and the other a brook near the northerly side of the road from Granville to Granville Centre.

The Board has caused the water-sheds of both brooks to be examined by one of its engineers, and samples of the water of each brook to be analyzed.

The water of Seymour Brook is soft, but is highly colored and contains a large amount of organic matter, which would make it objectionable for many domestic purposes; and there is a considerable number of houses within the water-shed of the brook, several of which are located not far from the stream or its tributaries. Under the circumstances, this stream cannot be considered a suitable source of domestic water supply.

The other brook has the advantage of being much nearer the village than Seymour Brook, and the quality of its water is much better, since it is soft, has but little color and does not contain an excessive amount of organic matter; but there are indications that the water of this brook has been somewhat polluted by sewage, and the examination of the watershed shows that a portion of the village of Granville Centre is within the water-shed of the stream, and some of the houses are close to a tributary of the brook. With these conditions, the source cannot be considered a safe one from which to take water directly for drinking or other domestic purposes.

The quantity of water needed for the supply of the village of Granville is small, and the examinations made by the Board indicate that it may be practicable to obtain a sufficient supply of good water by constructing a reservoir upon the brook above the place where the pollution from the houses referred to is likely to affect the quality of the water of the stream; and the Board would advise that you made further investigations, to determine whether it is feasible to construct a reservoir upon the stream at some place where a sufficient supply of water for the village can be obtained and danger of the pollution of the water avoided.

The Board will, upon application, give you further advice in this matter when you have the results of further investigations to present.

GREAT BARRINGTON. An application was received, July 14, 1899, from the water commissioners of Great Barrington, for advice with reference to the present sources of water supply of the town, and as to the quality of the water of a spring which it was proposed to divert into one of the present reservoirs. To this application the Board replied as follows:—

OCT. 5, 1899.

The State Board of Health has considered your application for advice with reference to the present sources of water supply of the town of Great Barrington and as to the quality of the water of a spring from which it is proposed to divert water into one of your present reservoirs, and has caused the present sources and the proposed new source to be examined by its engineer, and samples of the water to be analyzed. The results of these and of previous examinations show that the East Mountain reservoir, the original source of supply of the town, furnishes a water that is quite soft and otherwise of good quality for the purposes of a public water supply, and that the water is derived from a mountainous water-shed free from population; but the quantity of water which this source is capable of yielding in the drier portion of the year appears to be only a small portion of the quantity required to supply the town; and it also appears that, even when the yield of this source is large, the quantity of water that can be obtained from it is at present limited by the small carrying capacity of the main leading to the town. To supply the remaining quantity of water needed by the town, water is drawn from Green River south-west of the village at two points, from one of which the water is pumped into the low-service system and from the other to a reservoir in connection with the high-service system. The water of Green River is nearly clear and colorless under ordinary conditions, but it is much harder than the water of the East

Mountain reservoir, and is turbid at times of high flow. The most serious objection to the use of this stream, however, is the population on the watershed, by which the water is exposed to pollution by sewage; and, under the circumstances, the Green River must be considered an unsafe source from which to take water for drinking or other domestic purposes.

The spring indicated by you from which it is proposed to divert water into the East Mountain reservoir would furnish a water of good quality; but the quantity of water which this spring is capable of supplying would not materially increase the yield of the East Mountain reservoir; and, even if the whole flow of the brook into which the spring discharges should be diverted at a point from which it could be discharged into the East Mountain reservoir by gravity, and the pipe from the reservoir to the town should be enlarged, the yield of the reservoir would probably still be so small that in the drier portion of the year a large portion of the supply of the town would have to be furnished from some other source.

In view of the circumstances, the Board does not at present advise the construction of works for diverting the water of the spring indicated by you into the East Mountain reservoir; but the Board believes it important for the town to secure, as soon as practicable, some source of supply which will be adequate to furnish a sufficient quantity of good water for Great Barrington, in order that the use of water from Green River may be discontinued. If a source can be secured at a sufficient elevation to supply the town by gravity, or at least to supply the low-service districts by gravity, it is possible that the annual cost of the new works might not be much greater than the cost of operating the present systems.

There appear to be sources in and near the town from which an adequate supply of water can be obtained, among which are Roaring Brook, Long Pond, Prospect Lake and Seekonk Brook; and the Board would advise the town to make a careful examination, before any partial works are built, of all available sources in the neighborhood of the village, to determine the probable cost of the construction and maintenance of works from such sources, in order that it may be practicable to form an opinion as to which source will be the most appropriate for the town to select. Such an investigation should be made under the direction of an engineer of experience in matters relating to water supply.

The Board will assist you by making all necessary examinations of samples of water, and will furnish you with such information as it may have as to sources in the vicinity of the town that have been examined by its engineer. When the results of further investigations are available, the Board will, upon application, again advise you as to any plans for a future water supply for the town that you may wish to present.

HARVARD (Hildreth Bros.). On March 9, 1899, an application was received from Hildreth Bros. of Harvard for advice as to the quality of the water of a well used as an auxiliary source of supply for the village. The Board replied to this application as follows: —

April 6, 1899.

The State Board of Health received from you, on March 9, 1899, an application stating that, acting under the authority granted by the town, you have laid pipes in the streets of the village of Harvard, and are supplying several families in the village with water for drinking and household purposes, using water from a tubular well near your factory, your original source of supply, but that recently you have begun the use of water from a second well, known as well No. 2, and you desire advice as to whether the water of this well is suitable for use as an auxiliary source of water supply for the village.

The Board has caused an examination of well No. 2 and its surroundings to be made by one of its engineers, and a sample of water from the well to be analyzed. The results of this analysis show that the water is free from color and odor, and is in other respects of good quality for the purposes of a public water supply, and that it is much less hard than the water of well No. 1, your present source of supply.

It appears that the quantity of water that well No. 2 is capable of furnishing is not sufficient for the requirements of the portion of the village at present supplied. Nevertheless, the Board is of the opinion that this well is, under the circumstances, a suitable auxiliary source of water supply for the portion of the village of Harvard referred to; and, on account of the fact that the water of this source is of better quality than that of well No. 1, the Board would advise that it is desirable to use all the water that this source will furnish, and to supply such further quantity as may be required by drawing from well No. 1.

Holyoke. An application was received, Jan. 18, 1899, from the water commissioners of Holyoke, for the advice of the State Board of Health relative to a proposed high-service system of water supply for the city. The Board replied to this application as follows: —

April 12, 1899.

The State Board of Health received from you, on Jan. 18, 1899, an application for advice with reference to a proposed high-service system of water supply for the city of Holyoke, and subsequently plans and a report by your engineer were received, showing the location of the proposed sources of supply, and describing the proposed system of works.

The plan is, in brief, to construct a storage reservoir on Tatro Brook, one of the tributaries of Ashley Pond, which flows from the mountainous region on the westerly side of the pond, and to use the water of this reservoir for the supply of the higher portions of Holyoke which are in need of a supply of water under a greater pressure than is furnished by the present works. The total population in the district which would probably be supplied from a high-service system is at the present time probably not far from 6,000.

According to the plans submitted, the proposed high-service reservoir on Tatro Brook will have an area of about 65 acres and will contain about 300,000,000 gallons. The water-shed, which has an area of about 400 acres, contains no dwelling houses or cultivated land, and it is understood that nearly all of it is already owned by the city of Holyoke. The plans also show that it is feasible to increase the drainage area of the proposed reservoir on Tatro Brook to about 650 acres by diverting into it the water of Dibble Brook, which flows near by at a higher level.

The Board has carefully considered the proposed plans and has caused the proposed sources of supply to be examined by its engineer, and samples of water collected from Tatro and Dibble brooks to be analyzed. Analyses of the water of Tatro Brook, upon which it is proposed to construct the storage reservoir, show that the water has but little color, and contains in the winter months only a small amount of organic matter, and that it is in other respects of good quality for the purposes of a public water supply. Whether the quality of the water will be satisfactory when stored in the proposed reservoir, will depend largely upon the care taken in the construction of the reservoir. If the plan submitted, which provides for cleaning the bottom of the reservoir, is carried out completely, and all the vegetable matter, soil and other material containing organic matter is removed, and if all areas of swampy land within the water-shed are thoroughly drained, so that the water falling upon the ground will flow quickly into the reservoir, the source will probably furnish a water of good quality, which will be nearly colorless, and seldom if ever have an unpleasant taste or odor.

The water of Dibble Brook has a high color and contains a large amount of organic matter, and is of poor quality as compared with the water of Tatro Brook. The poor quality of the water of Dibble Brook is due to the presence of a large swamp in the central portion of the water-shed, through which practically all of the water which now flows past the point at which the brook can be diverted into the proposed Tatro reservoir has to pass. It may be feasible, by constructing drains along the borders of this swamp on each side, to intercept the water flowing from the higher portions of the water-shed, and at the same time to drain the swamp thoroughly and prevent the water from standing thereon, and thus to improve greatly the quality of the brook water; and, unless a great improvement shall be made in the quality of the water, it is important that the water of Dibble Brook be kept out of the proposed new reservoir. There would be a considerable advantage in improving the quality of the water of this brook, even if it is not to be used as an auxiliary supply to the proposed high-service reservoir, because it is, under present conditions, an important feeder of Ashley Pond.

The quantity of water which the proposed source of supply will yield without the addition of water from Dibble Brook will probably be sufficient for a population about twice as great as is found in the proposed high-service district of Holyoke at the present time; and, if it is found to be feasible to improve the water-shed of Dibble Brook so as to obtain a water of satisfactory quality therefrom, a considerably larger population can be supplied from these sources.

There appear to be no means of estimating at all definitely at the present time the probable future increase in population in the proposed high-service district, and consequently it is not practicable to predict definitely for how long a time the proposed high-service works will be capable of supplying that district; but from the investigations which have been made it seems probable that the proposed high-service sources will be sufficient for the supply of the high-service district for about as long a time in the future as the sources now used, with their present development, will be adequate for the supply of the low-service district; and, while it is not practicable to determine at the present time the best method of increasing the supply for either district when a further supply shall become necessary, it may be said that it is evident from these investigations that a sufficient supply for many years in the future for both the low and high service districts can be obtained by further development of the Manhan River source in connection with the present works and the proposed high-service reservoir.

In view of all the circumstances, the Board is of the opinion that the plan providing for a reservoir on Tatro Brook is an appropriate one for supplying the higher portions of Holyoke, which are either already in need of a supply under greater pressure than is now furnished from the low-service works, or seem likely to require such a supply before many years.

Holyoke (American Thread Company). An application was received, May 27, 1899, from the American Thread Company of Holyoke, for the advice of the Board relative to the quality of the water of wells on the premises of the company. The Board replied to this application as follows: —

July 7, 1899.

In response to your application for advice with reference to the quality of the drinking water used at the Merrick Thread Company's mill No. 1 in Holyoke, the Board has caused the source and its surroundings to be examined by one of its engineers, and a sample of the water to be analyzed.

The sources of the drinking-water supply of the company are two tubular wells, located in the mill yard, about 150 feet from the canal and 50 feet from a tail-race which leads to a canal at a lower level. There is evidence that much of the water entering the wells comes by filtration through the ground either from the canal or from the tail-race, and the water, both of the canal and tail-race, is highly polluted by sewage.

The results of an analysis of a sample of water from the wells show that it has been polluted by sewage and not well purified in its passage through the ground to the wells.

Under the circumstances, the Board is of the opinion that the water of these wells is liable to be injurious to the health of those who may use it for drinking, and would advise that the further use of water from these wells for drinking purposes be prevented.

HYDE PARK. A communication was received from the Board of Health of Hyde Park, Sept. 1, 1899, requesting information relative to "the condition of the Hyde Park water supply, so far as it may affect the health of the consumers in the town." The Board replied to this application as follows: —

Nov. 3, 1899.

The State Board of Health has considered your application for information with regard to the condition of the Hyde Park water supply, so far as it may affect the health of the consumers in the town, and has carefully examined the results of chemical analyses of the water covering a period of several years, and has recently caused samples of water drawn directly from the wells which furnish the supply, and from faucets in various parts of the town, to be analyzed.

The source from which the Hyde Park Water Company takes its supply is the ground near the Neponset River, from which water is drawn by means of tubular wells.

Comparing the results of a long series of analyses of samples of water collected from the wells with a similar series of analyses of samples of water from the river, it appears that the changes which take place in the mineral constituents of the water correspond in a large degree with the changes that take place in the quantity of these substances in the water of the Neponset River, indicating that a large proportion of the water of the wells is derived from the river by filtration through the ground.

The Neponset River receives large quantities of sewage from tanneries and paper mills, and certain chemicals present in the sewage of the tanneries impart a distinct odor to the river water. In the recent examinations of water from the wells at the pumping station and from faucets in Hyde Park the odor imparted to the river water by the chemicals referred to has been detected.

The Neponset River is a highly polluted stream, and the safety of the water of the wells for drinking purposes depends upon the efficiency of the purification of the river water which finds its way into them by percolation through the ground. An examination of the analyses of the water supplied to the town from the wells for a period of many years shows that its quality has very greatly deteriorated, and that at the present time the quantity of organic matter present is much larger than is found in a good ground water, indicating that the water filtering from the river is imperfectly purified.

From the examinations made by the Board, it appears probable that the water of some of the wells is of very much poorer quality than that of others, and that the deterioration in the quality of the water is caused by the mingling of the very imperfectly purified water from some of the wells with the water of other wells which is much more thoroughly purified in its passage through the ground.

In view of these conditions, the water, as at present supplied to Hyde Park, must be regarded as unsafe for drinking.

It is probable that, by a careful examination of all of the wells and by discontinuing the use of those which furnish water of suspicious quality, the quality of the water of the remaining wells would be such that it might be used with safety, at least for a time; but, in order to make it practicable to do this, it will probably be necessary to secure an additional supply of water from some other source, and a sufficient additional supply should be secured to make it unnecessary to use the water of the wells until all those wells which are liable to furnish water of poor quality have been cut off from the works.

LAWRENCE. A communication was received from the Lawrence water board, Jan. 18, 1899, requesting the State Board of Health to furnish "a report of the state and quality of the water delivered to the citizens during the past four weeks." To this request the Board replied as follows: —

FEB. 2, 1899.

In response to your request of January 18, the Board presents the following result of its examinations of the Lawrence water since December 1: —

From the 1st of December to the 10th the water was of ordinary winter quality. From the 11th through the month to the 3d of January the chemical examinations show no marked change in the water; but the bacteriological examinations show an increased number of bacteria, which reached its height about the 24th of December and gradually decreased to the normal condition on January 3, since which time the number has varied little from the usual condition in winter.

In the judgment of the Board, the filter is now efficiently purifying the water, and, whatever effect the increased number of bacteria may have had, the condition which now exists is one in which the water may be safely used for domestic purposes.

LOWELL. The State Board of Health, having made an examination of the water supply of Lowell with reference to its action upon lead service pipes, and having found that lead was present often in dangerous quantities in the water drawn through such pipes, sent the following communication to the mayor, the water board and the board of health of Lowell: —

JUNE 29, 1899.

The State Board of Health has recently made investigations in the city of Lowell with reference to the action of the water of the public water supplies of the city upon the service pipes through which the water is supplied to consumers, a large proportion of which, it appears, is of lead.

In the course of these investigations many samples of water have been collected from lead service pipes in various parts of the city, and the results of the analyses have shown the presence of lead in all cases where the water has been drawn through pipes of that metal, and in many cases the quantity of lead present has been found to be dangerously large.

In connection with this investigation, information has been collected from about one-fifth of the physicians in the city, who report about 40 cases of lead poisoning, some of which are of very serious character, all of which have occurred within the last five years, or since the introduction of well water. Wherever practicable, samples of drinking water supplied from the house faucets in the houses of persons suffering from lead poisoning have been collected and analyzed, and the results in all cases have shown the presence of lead, generally in large quantities.

The ground waters in the State which take lead from pipes are found to contain an excess of carbonic acid, and the waters from the Cook and Hydraulic wells are found to contain more carbonic acid than any other water supply in the State. The water from the Boulevard wells contains less carbonic acid than that from the Cook and Hydraulic wells, and somewhat less than the water in other places where lead poisoning has become serious.

At the time of the examinations a part of the city was supplied with water from the Cook wells mixed with a small amount of water from the Hydraulic wells and the remainder with water from the Boulevard wells. Both waters attack the pipes, and sickness is found in houses supplied from all the sources, though the water of the Cook and Hydraulic wells appears to take up a larger quantity of lead from the pipes than the water of the Boulevard wells. The investigations made by the Board are not complete, but they have been carried far enough to show definitely that great injury is being done to the health of a large number of people in the city of Lowell by the use of water for drinking and for cooking which is drawn through lead pipes.

By boiling the water the lead is not driven off, but may be concentrated, so that the use of boiled water in making tea, coffee, etc., and in cooking may result in as serious injury as the use of the water directly for drinking. If the water is allowed to run freely before using, the quantity of lead taken up will be less than when the water is allowed to stand in the pipe for a considerable time; but even when allowed to run freely it may contain a sufficiently large quantity of lead to produce serious injury, and the only way in which safety can be insured is by removing all lead service pipe which conveys water used for drinking or for cooking, and replacing it with a pipe which will not be attacked by the water, or, if attacked, will not be liable to injure the health of those who use the water.

The other examinations of these waters drawn through galvanized-iron pipe show the presence of large quantities of zinc, so that the coating of zinc is not likely to protect the pipe for any considerable length of time. The indications are that if pipes of plain wrought iron should be laid, while no injury would be done to the health of people using the water, large quantities of iron might be dissolved from the pipes, rendering the water unsatisfactory. Pipes made of tin, or of lead lined with tin, could be used with safety for service pipes, and pipes of iron lined with cement, where the work was thoroughly done, would also be satisfactory.

Additional investigations having been made at Lowell by the State Board of Health with reference to the effect of the public water supply upon the lead service pipes, and of the effect of its use upon the health of the citizens of Lowell, another communication was addressed to the mayor, the water board and the board of health of Lowell as follows: —

SEPT. 25, 1899.

Since June, when the State Board of Health notified you of the danger to the citizens of Lowell from using the public water supply drawn through lead pipes, the Board has been informed by physicians in Lowell of 33 new cases of lead poisoning, some of which are very serious.

It now appears, from the reports of these physicians, who comprise but one-fourth of the whole number of physicians practising in Lowell, that in their practice there have occurred since the first of January, 1899, the following severe cases of lead poisoning, namely: 9 cases of partial paralysis of the legs, 10 cases of partial paralysis of the hands and wrists and 26 cases of lead colic, besides many cases of the milder effects of lead poisoning, which were arrested by treatment and discontinuing the use of city water.

Further examinations for lead in the water upon the south side of the river show very dangerous quantities existing in the water running through the pipes when in ordinary daily use. These quantities of lead average much higher than those found last year, indicating an increased action of the water upon the pipes from year to year.

As before, the water of the Cook and Hydraulic wells has a more rapid action upon the lead than the water from the Boulevard wells. The amount of lead found in water from the Cook and Hydraulic wells when drawn in houses supplied by lead pipe during the hours of ordinary daily use, during the past five months, has averaged 0.41 of an ounce of lead in 100,000 ounces of water, or one-quarter of a grain per gallon, which is eight times as much as we regard a dangerous quantity; and, in the opinion of the Board, the health of a large portion of the people of Lowell is seriously endangered by using, for drinking and cooking, water from the Cook and Hydraulic wells drawn through lead pipe. Nowhere else in the State do we find a public water supply acting so rapidly upon lead pipe and with such pernicious results; and we advise that measures be taken without further delay to prevent the continued use for drinking and cooking of this water drawn through lead pipe.

Water from the Boulevard wells dissolves lead much less rapidly than water from the Cook and Hydraulic wells; in fact, the examinations for lead in water in Centralville, where none but Boulevard well water enters the pipes, indicate an amount, when running in ordinary daily use, so small that we should not regard it as a menace to the public health, and we have learned of but one case of lead poisoning in Centralville.

On the south side of the river, 6 cases of lead poisoning were found, where the water, at the time of examination, was Boulevard well water, and some of this water contained dangerous quantities of lead; but it is probable that at other hours of the day or night these pipes receive Cook well water, which may so affect the lead that the Boulevard well water, when it passes through, takes up more lead than it would if the pipes were exposed to its action alone.

Water from the Boulevard wells, after standing in lead pipes over night, contains dangerous quantities of lead, and all such water should be wasted before drawing water for cooking, and water for cooking should not be drawn at any time from the lead hot-water pipes. With these precautions carried into practice, the Boulevard well water can at present be used without danger from lead poisoning with the ordinary length of service pipe; and this water is as good in other respects as that from the Cook and Hydraulic wells.

To guard against lead poisoning to an appalling extent in the city of Lowell two courses appear to be at hand, — one is to remove all lead service pipes through which water from the Cook and Hydraulic wells is drawn for drinking or cooking, and the other is to cease using the Cook and Hydraulic well water and extend the Boulevard well system to supply the whole city. The public health requires that one or the other remedy be applied as soon as possible.

LOWELL. An application was received, Nov. 24, 1899, from the water board of Lowell, for the advice of the State Board of Health relative to certain sources of water supply. The Board replied to this application as follows: —

DEC. 29, 1899.

The State Board of Health received from you, on November 24, an application for its assistance in the examination of sources of water supply of Lowell, in which you refer to Beaver Brook, Forge Pond and other sources; and the Board has caused an examination of the sources of supply referred to and others in the vicinity of Lowell to be made, and has caused samples of the water to be analyzed.

The results of a recent analysis of the water of Forge Pond and of an analysis made several years ago indicate that the water is quite variable in character. There are large swamps within the water-shed, and in its usual condition the water is probably quite highly colored and contains a large quantity of organic matter. The analyses also indicate that the water receives considerable pollution from the villages and houses within the water-shed. Under the circumstances, it is doubtful whether it is practicable to effect a sufficient improvement in the water-shed of this source to make it possible to obtain from it a water of satisfactory quality for the supply of Lowell. Moreover, it is very doubtful whether suitable storage reservoirs of sufficient capacity can be provided within the water-shed to make it practicable for the city to obtain its supply from this source for a reasonable time in the future. The cost of damages to water powers along Stony Brook below the pond would increase the cost of a supply from this source, and, considering all the circumstances, the Board does not regard it as an appropriate one for the water supply of the city of Lowell.

Beaver Brook, above the village of Collinsville, drains an area of about 88 square miles, nearly all of which lies within the limits of the State of New Hampshire. The water-shed contains the towns of Derry, Londonderry, Windham and Pelham, and portions of other towns in New Hampshire. This source would furnish sufficient water for Lowell; but the water is now polluted by sewage discharged directly into the streams or its tributaries, and it would be impracticable for the city of Lowell to prevent the pollution of this stream in New Hampshire. Under the circumstances, Beaver Brook would not, in the opinion of the Board, be a suitable source of water supply for the city.

Among other sources in the neighborhood of Lowell an examination has been made of the tributaries of Stony Brook below Forge Pond, to see whether they are capable of furnishing a sufficient water supply for Lowell; but it does not appear to be practicable to obtain a suitable supply of water for the city from these sources.

Long Pond and Tyng's Pond could also be made to furnish good water by removing existing sources of pollution, but both together would not furnish enough water for the present needs of the city. Even by using the tributaries of Stony Brook, in addition to Long and Tyng's ponds, it is not likely that a sufficient quantity of water could be obtained for more than the present needs of the city.

Aside from the sources referred to, there appear to be no other surface waters within ten miles of the city of Lowell that are capable of furnishing an adequate supply of suitable water for the city at a reasonable cost, without purification.

The experience with the ground-water sources used for the supply of Lowell shows that the water of the Boulevard wells dissolves lead much less rapidly, when supplied through lead pipes, than water from the other sources used for the supply of the city; and, where Boulevard water alone is used, the quantity of lead taken up during the ordinary day use is so small that it would not be regarded as a menace to the public health. The Boulevard wells evidently receive a portion of their supply from the land side, and the remaining portion, which is probably by far the larger one, by filtration through the ground from the river. The ground beyond the present north-westerly limit of the Boulevard system appears to be of a similar character to the ground in which the present wells are located, and it seems possible that a considerable additional quantity of water similar to the Boulevard water can be obtained from the ground by extending the well system farther up stream through this territory near the northerly side of the river.

It is highly important, in the opinion of the Board, either that the lead pipes be promptly removed or that a sufficient supply of water which will not attack lead pipes be secured with as little delay as practicable; and the location and arrangement of your works are such that a further supply from the region in which the Boulevard wells are located could probably be introduced in a shorter time and at less expense for the construction of works than from any other source, and there would be no extra cost to the city on account of damage to water power if more water should be taken from this region. The Board would therefore advise that further and sufficient tests be made beyond the upper end of the present Boulevard system, to determine whether it is practicable to secure in this region a sufficient additional quantity of water to furnish the whole supply at present required by Lowell, so that the use of water from the Cook and Hydraulic wells may be avoided.

The valley of Beaver Brook above Collinsville and south of the New Hampshire State line is nearly uninhabited, and, judging from surface indications, the soil in this region may be favorable to furnishing a large quantity of water from the ground. If it is not feasible to obtain sufficient water by extending the Boulevard wells, it may be practicable to obtain a suitable additional supply in this territory above Collinsville, if further tests shall show that the water is of suitable quality for domestic uses, and that it is not likely to take up excessive quantities of lead from lead pipes. If a suitable supply of water can be obtained in this region, the water can be diverted into your present system without special difficulty; but the cost of works would probably be greater than the cost of a supply from the vicinity of the Boulevard wells, and the city would be liable for damages to the owners of mill privileges on the stream below for the diversion of water.

The Board will assist you in the investigations by making the necessary analyses of water, and will give you further advice in the matter if you so request, when the results of the investigations are available. But if, upon investigation, it is not found practicable to obtain a sufficient additional supply either by extending the Boulevard wells or from wells in the valley of Beaver Brook above Collinsville, the Board would advise that, unless you are aware of some other source from which it is practicable to obtain an adequate additional supply, the subject of securing a suitable water supply for Lowell be committed to some competent engineer, to determine what can be done by filtering water from one of the surface-water sources in the neighborhood.

LOWELL (Lowell Bleachery and Dye Works). An application was received from F. I. Walsh, agent of the Lowell Bleachery, requesting an examination of the water now used at the bleachery, with reference to its use for drinking purposes. The Board replied to this application as follows: —

JULY 7, 1899.

In response to your application of March 18, 1899, for advice with reference to the use of water of the Concord River after filtration through mechanical filters for drinking in the Lowell Bleachery and Dye Works, the State Board of Health has caused a careful investigation of the operation of the filters to be made, and numerous samples of the water to be analyzed chemically and bacterially.

The Concord River receives considerable direct pollution by sewage, and the results of the investigations made by the Board show that on some days a large percentage of the bacteria present in the river water was removed by the filters, but on other days the number passing through was a very large proportion of the bacteria in the river water, and included kinds that show that the filtered water is at times dangerous to health;

moreover, alum was found in all of the samples of filtered water analyzed chemically, and, taking all the conditions into consideration, the filtered water from the filters in your works cannot, in the opinion of the Board, be regarded as a safe water for drinking.

MEDWAY. The board of health of Medway applied to the State Board of Health, Dec. 4, 1899, for its advice with reference to the quality of the water of a well used as a source of water supply for the town poor farm, this water having been reported to have a disagreeable taste and odor. The Board replied to this application as follows: —

JAN. 5, 1900.

The State Board of Health has caused the well and surroundings to be examined and a sample of the water to be analyzed. The results of the analysis indicate that the water is somewhat hard and contains a larger quantity of organic matter than is found in a good well water, and there are also indications that the water has at some time been slightly polluted. Nevertheless, if the water is properly protected from pollution by matters entering the well from the surface, it is probable that it could be used with safety. The well does not appear to be capable of yielding a sufficient supply of water in the drier part of the year for the requirements of the poor farm, and under the circumstances the Board would advise that a supply of good water, sufficient for all purposes for which water is required, be introduced from some suitable source in the neighborhood.

MILFORD. Information having been received by the State Board of Health, in the winter of 1896–97, that a serious case of lead poisoning had occurred in Milford, in a family where the public water supply was used, the State Board of Health ordered an investigation to be made, and found that the water obtained from the house where this patient lived "contained lead sufficient in quantity to be injurious to those who used the water for drinking." The Board therefore notified the board of health of Milford of this fact, on Jan. 21, 1897, in order that they might "take such action in the matter as was found to be necessary."

In the summer of 1899 the Board made further examinations of water collected from lead service pipes from various parts of the town, and communicated the results of the investigation to the board of health of Milford, as follows: —

JULY 7, 1899.

In a communication to your board, in 1897, the State Board of Health called attention to the danger of the use for drinking of the water of your public water supply drawn through lead pipes, and this Board has recently made further investigations in the town of Milford with reference to the action of the water of the public water supply upon the service pipes, most of which, it appears, are of lead, through which the water is supplied to consumers.

In the course of these investigations many samples of water have been collected from lead service pipes in various parts of the town, and the results of the analyses have shown the presence of lead in all cases where the water has been drawn through pipes of that metal, and in many cases the quantity of lead present has been found to be dangerously large.

In connection with this investigation, information has been collected from about half the physicians of the city, who report about 30 cases of lead poisoning in the towns of Milford and Hopedale, some of which are of a very serious character. Wherever practicable, samples of drinking water supplied from house faucets in the houses of persons suffering from lead poisoning have been collected and analyzed, and the results in all cases have shown the presence of lead, generally in large quantities.

The ground waters in the State which take lead from pipes are found to contain an excess of carbonic acid; and the water of the Milford supply has been found to contain an amount of carbonic acid that is only exceeded in the water supplies of three places in the State which have been investigated with reference to their action on lead pipe. The investigations made by the Board are not complete, but they have been carried far enough to show definitely that the health of a large number of people in the towns of Milford and Hopedale is being endangered by the use of water for drinking and cooking which is drawn through lead pipes.

By boiling the water the lead is not driven off, but may be concentrated, so that the use of boiled water in making tea, coffee, etc., and in cooking, may result in as serious injury as the use of the water directly for drinking. If the water is allowed to run freely before using, the quantity of lead taken up will be less than when the water is allowed to stand in the pipe for a considerable time; but, even when allowed to run freely, it may contain a sufficiently large quantity of lead to produce serious injury; and the only way in which safety can be insured is by removing all lead pipe which conveys water used for drinking or for cooking, and replacing it with a pipe which will not be attacked by the water, or, if attacked, will not be liable to injure the health of those using the water.

It has been found in the course of these investigations that water which attacks lead pipe will also take up the zinc from a galvanized-iron pipe, so that the coating is not likely to protect the galvanized-iron pipe for any considerable length of time. The indications are, that, if pipes of plain wrought iron should be laid, while no injury would be done to the health of people using the water, large quantities of iron might be dissolved from the pipes, rendering the water unsatisfactory. Pipes made of tin, or lead lined with a considerable thickness of tin, could be used with safety for service pipes, and pipes of iron lined with cement, where the work was thoroughly done, would also be satisfactory.

MILFORD. An application was received, Sept. 15, 1899, from the Milford Water Company, asking the advice of the State Board of Health relative to the use of a small pond near the present pumping station; and, later, additional advice was requested, with reference to preventing lead poisoning caused by the use of Milford water drawn through lead service pipes. The Board replied to these applications as follows: —

JAN. 5, 1900.

The question of the use of the small pond near the pumping station as an additional source of water supply for Milford was considered by the Board in response to an application by you in 1894, and a copy of the advice of the Board with reference to the use of this source at that time is enclosed herewith.

The recent examination that has been made by the Board does not show that any change has taken place in the conditions affecting this pond; but the quality of the water, as indicated by an analysis of a sample sent in by you, is not as good as at the time of your previous application. The water is likely to be very objectionable if supplied directly to the town, on account of the presence of a large quantity of organic matter, and if applied to the filters it may cause trouble in their operation, and even after filtration may not be satisfactory.. Considering the small yield of this source and the poor quality of the water, it is not desirable, in the opinion of the Board, to attempt to use this water for the supply of the town. If it is necessary to empty the basin near the pumping station, from which the present supply of your filters is drawn, a larger quantity of water than this pond would furnish can be obtained from the stream above the wells by constructing a temporary dam if necessary.

The Board has caused the wells and filters from which the water supply of Milford and Hopedale is drawn to be examined by its engineer, and samples of the water of the wells and filters and of the Charles River to be analyzed, and the quantity of carbonic acid, to which the action of water upon lead pipe is chiefly due, to be determined.

As a result of these examinations, it is found that the water of Charles River and of the filters contains so small an amount of carbonic acid that these waters would not be likely to attack lead pipe to such a degree as to cause lead poisoning. Analyses of the water of the three wells show very different results. The water of well No. 1, which is nearest the pumping station, was found to be of poor quality, on account of the presence of an excessive quantity of iron, and to contain a very large quantity of carbonic acid, which would undoubtedly cause it to take up large quantities of lead in passing through lead pipes. The water of well No. 2 was of better quality than that of No. 1, and contained about a quarter as much carbonic acid as that of well No. 1 at the time the examinations were made, but still a much larger quantity than the water of the river and the filters. The water of well No. 3 (of similar quality to well No. 2) contained considerably less carbonic acid than well No. 2, and generally not very much more than the water of the filters. It is probable that the action of the Milford water upon lead pipes is due very largely to the presence of an excessive quantity of carbonic acid in the waters of wells Nos. 1 and 2.

If the use of water from wells Nos. 1 and 2 should be discontinued, and the filtered water from the filter near well No. 2 should be diverted into well No. 3, it is probable that, if the water of well No. 3 remained the same as it was found to be by the recent analyses, the water supplied in this way would not seriously attack lead pipes; but it is impossible to tell whether the ground water which now filters into wells Nos. 1 and 2 would not find its way into well No. 3, and carry enough carbonic acid into that source to cause the water to take up large quantities of lead.

The Board is of the opinion that immediate action should be taken to discontinue the use of water of wells No. 1 and No. 2, to turn water from both filters into well No. 3 and supply the town from this well, and then see if this water takes lead from the pipes.

As soon as the proposed change is made, the Board will make further examinations as to the action of the water upon lead, and be prepared to give advice as to future action.

NEEDHAM. An application was received from the water board of Needham, May 4, 1899, for the advice of the Board, relative to an additional water supply for the town to be taken from wells in the neighborhood of its existing supply. The Board replied to this application as follows: —

JUNE 14, 1899.

The State Board of Health received from you, on May 4, 1899, an application for advice with reference to proposed plans for increasing the water supply of the town of Needham, in which you state that you propose to construct another large well east of your present well, in the vicinity of test wells Nos. 20 and 26, shown upon the plan submitted with your application. Subsequently, the results of tests of the ground by means of tubular wells located in the region in which it is proposed to construct the new well were submitted, showing the character of the soil and the approximate yield of the wells when pumping with a hand pump. You state also that you propose to construct a storage basin upon Bird's Hill Brook by means of a dam across the brook near the pumping station, as proposed in your plan submitted last year.

The Board has considered the plans and information submitted, and has caused the locality to be examined by its engineer, and samples of water collected from time to time since your investigations were begun from several of the test wells to be analyzed.

The results of the analyses of samples of water collected from these wells in the latter part of 1898 indicated that the water of some of the wells had been highly polluted, but subsequently completely purified in its passage through the ground to the wells. Examinations of additional samples of water from the wells in April and May of this year showed that the previous pollution of the water was considerably less than at the time the samples were collected last year, and that the quality of the water had improved. The cause of the pollution of the water has not been definitely determined, but it is apparently due to the presence for a long period of a large piggery and a large amount of polluting matter upon higher land east of the wells. It is understood that pollution from this source has been to a large extent prevented, but it should be completely removed from the neighborhood if water is taken for the supply of the town from the proposed source. The water in its present state is well purified and of good quality, and is not greatly different from that of your present sources of supply. Whether it will improve further, or deteriorate, when a large quantity of water is drawn from the ground, cannot be predicted with certainty; but the present indications are that, if the source of pollution referred to is removed, the water will remain satisfactory for drinking and other domestic uses.

The soil at the place where the test wells are located is coarse and porous to a considerable depth below the surface of the ground, and water could be drawn from the wells in large quantities with much freedom, and the soil in the vicinity of the wells appears also to be very coarse and porous; but observations upon the height of water in the test wells show that the height of the ground water in their vicinity is already affected somewhat by pumping from the present well, and the area of the watershed which will be tributary to both wells is small. Nevertheless, the lowering of the ground water that would be caused by pumping from a well at the place now proposed would probably make available a much larger portion of the water stored in the ground than is made available by pumping from the present well, and the area of territory from which ground water is influenced to flow toward the wells would probably be extended considerably beyond the limits that are affected by pumping from the present well. While the indications are that a large addition to your present supply of water can be obtained by the construction of the proposed new well, and while the yield of the wells might then be sufficient for the present needs of the town in a very dry season, the yield is hardly likely, at the present rate of increase in the use of water in Needham, to be sufficient for the supply of the town for any considerable time in the future, and a supply from a new source is likely to be required.

An additional supply of water is, however, urgently needed at the present time, and so far as is now known the most practicable way of obtaining such a supply is to take water from the ground at the place proposed in your application; and, under the circumstances, the Board is of the opinion that it is advisable to construct works without delay for taking an additional supply of water from the ground in that vicinity. On account of the very low rainfall in the months of April and May of the present year, and the indications that the yield of your present works may become insufficient for the supply of the town considerably before the end of the present year, it is probable that, if the construction of the proposed well should be begun at the present time, the necessary pumping at the excavation would still further reduce the yield of your present source, and the water pumped from the excavation would not be suitable to supply to the town. It appears to be feasible to connect some of the test wells already driven near the site of the proposed well to a pump, and to pump water from them through a temporary force main into your present well, and in this way to obtain a large increase in your supply to meet the present emergency; but it is not desirable to employ a large force of men in constructing a well near any of the test wells while the water is being used for the supply of the town. Under the circumstances, the Board would advise that you provide a pump and construct such temporary works as may be necessary for pumping water from the present test wells and such additional wells as may be found desirable into your present well, and at the same time cause samples of the water to be collected for analysis, to learn what changes, if any, take place in its quality. If the water remains satisfactory, the construction of a large well can be begun at such time as it may be found desirable to do so, and much additional information will have been obtained as to the probable yield of the works and the quality of the water. The Board will cause the water to be examined at such times as may be necessary or desirable, if you will collect the samples.

Regarding the plan of constructing a basin near the pumping station, the Board is of the opinion that it is doubtful whether, even if a large proportion of the water collected by the basin in the drier portion of the year should enter the ground and reach the wells, a material increase would be obtained in the yield of the wells; but it is understood that it is desired to construct the basin in part for ornamental purposes, and, since it is not likely that the presence of the proposed basin will affect the quality of the water of the wells as now located, there appears to be no serious objection to the carrying out of this portion of the plan. The basin would not be a proper source from which to draw water directly for supplying the town.

NORTH ADAMS (N. L. Millard & Co.). An application was received, Dec. 19, 1898, from N. L. Millard & Co., asking the advice of the Board, relative to the use of water of two wells beneath their factory for drinking purposes. The Board replied to this application as follows: —

APRIL 6, 1899.

The State Board of Health has considered your application for advice with reference to the use of water from two wells, situated beneath your factory, for drinking purposes, and has caused the locality to be examined by its engineer, and samples of the water to be analyzed. The results of the analyses show that the water is clear, odorless and nearly colorless, but that it is excessively hard, and has at some time been highly polluted by sewage and subsequently well purified in its passage through the ground. On account of the location of the wells, in a densely populated territory not far from the river, there is much danger that the quality of the water may further deteriorate.

In view of the circumstances, the Board is of the opinion that this water is not fit for drinking, and would advise that you do not introduce the water into the pipes through which water for drinking is supplied to the operatives or employees of the factory.

NORTH ADAMS. A communication was received from the board of health of North Adams, Sept. 14, 1899, stating that, in consequence of a scarcity of water in the public supply, it might become necessary to take water from artesian wells in the central part of the city, from which water had previously been used. The board of health therefore requested the State Board to make an examination of this water, and give its opinion with reference to its use for domestic purposes. The Board replied to this communication as follows: —

NOV. 3, 1899.

In response to your communication, requesting the advice of the Board as to the quality of the water of the two deep tubular wells located near the central part of the city of North Adams, from which a portion of the water supply of the city is sometimes drawn, the Board has caused the locality to be examined by its engineers, and a sample of the water to be analyzed.

The results of this analysis, and of several analyses made in previous years, show that, while the water is generally clear, colorless and odorless, it is excessively hard, being usually several times as hard as the water of your present supply from Notch and Broad brooks. It is also evident that the water entering the wells has at some time been polluted by sewage, though it has subsequently been well purified in its passage through the ground.

The wells are located within the densely populated portion of the city, and it is evident that much of the water which enters them percolates down through the ground in their immediate vicinity. It also appears that there has been complaint of the quality of the water, and that it is believed at times to have injured the health of those who used it.

Considering the circumstances, the Board is of the opinion that these wells are not suitable sources from which to take water for drinking, and that their use for this purpose should be prevented.

The consumption of water in North Adams appears, from a limited number of observations, to be much greater than in any city of similar size in the State, where records of the quantity of water used are kept, and it may be practicable to materially reduce the consumption of water in the city.

It is evident that, with your present consumption of water, a further supply is needed even in a year of ordinary rainfall; and the Board would advise that provision be made without delay for furnishing a sufficient supply of good water to the city, even in the driest seasons.

NORTHAMPTON (the Mount Tom Sulphite Pulp Company). An application was received, Aug. 23, 1899, from the Mount Tom Sulphite Pulp Company, for the advice of the Board relative to the quality of the water of certain tubular wells on the premises of the company. The Board replied to this application as follows: —

Nov. 3, 1899.

In response to your communication of August 23, requesting the opinion of the Board in regard to the quality of the water of tubular wells located in the vicinity of the works of the Mt. Tom Sulphite Pulp Company, in Northampton, the Board has caused the locality to be examined by one of its engineers and samples of the water to be analyzed.

The analyses show that the water is of good appearance, being clear, nearly colorless and odorless; but it has been found that it contains manganese in such a large quantity that it would be likely to prove injurious to those who might use the water for drinking.

Considering the circumstances, the Board does not advise the use of this water for drinking purposes.

PLYMOUTH. An application was received from the board of health of Plymouth, June 21, 1899, for the opinion of the State Board of Health relative to the quality of the water of the Pilgrim, or Elder Brewster, Spring, near the centre of that town. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on June 21, 1899, an application requesting the advice of the Board as to the suitability of the water of the Pilgrim, or Elder Brewster, Spring, so called, in the town of Plymouth, for drinking purposes. It appears that the water of this spring has for several years been supplied to a drinking fountain in the centre of the town, where it is used for drinking by large numbers of people in the warmer portion of the year.

The Board has caused the spring and its surroundings to be examined by one of its engineers, and a sample of the water to be analyzed, and has considered the results of previous analyses of the water made by the Board in 1890 and 1896. The analyses show that the water has been polluted, but has subsequently been well purified in its passage through the ground. The examinations made by the Board indicate that the water of this spring in its present state is safe for drinking, but the situation of the spring is such, being in the midst of a dense population, that it will have to be carefully guarded from pollution in the future.

If the spring and the ground in the region about it are kept free from pollution, the water will probably continue to be safe for drinking; but it is desirable, on account of the situation of the spring, that analyses of the water be made from time to time, in order that any deterioration in its quality may be detected.

PROVINCETOWN. An application was received from the authorities of Provincetown, early in 1896, for the advice of the Board relative to the removal of iron and organic matter from the public water supply of the town. Soon after receiving this application, examinations of the water were made and experiments with reference to its purification were begun under the direction of the Board, and the following communication was sent to the water commissioners, Aug. 4, 1899: —

The State Board of Health received from the authorities of Provincetown, early in 1896, a request for advice as to purifying the public water supply of the town, which has always contained an excessive amount of iron and a large quantity of organic matter, making the water offensive and objectionable for many domestic uses. Soon after the receipt of this application, examinations of the water were made and experiments with reference to its purification were begun under the direction of the Board.

The source of water supply of Provincetown at the time the application was made was a system of tubular wells, which was first used in the latter part of 1893, when the public water supply was first introduced. While the investigations were in progress, in the early part of 1898, a change was made in the source of supply, and a basin was excavated in the ground near the pumping station, from which all of the water used for the supply of the town has been drawn since that time, and the tubular wells have been abandoned. The change in the source of supply seems to have been of advantage, in that the basin furnishes an ample quantity of water at all times, while the wells formerly used required cleaning from time to time, on account of clogging.

Previous to the construction of the basin, the quality of the water of the wells had varied considerably from time to time; but the quantity of iron in the water had, on the whole, greatly increased since the works were constructed, and there was a large increase also in the quantity of organic matter. After the new basin was constructed and the use of water from this source was begun, the quantity of iron decreased greatly and became smaller than at any time since the works were constructed. After about six months' use, however, the iron increased rapidly, and became nearly as great as in the water of the tubular wells before they were abandoned.

The examinations of the water have also shown that it contains at times gases which will act rapidly upon iron when exposed to the water, but at other times these gases appear to be absent. It is also found that there is a considerable growth of filamentous algæ in the open basin.

The great changes in the quantity of iron present in the water from time to time and the variations in the quality of the water in other respects are such that a method of purifying it that is successful at one time may be entirely inadequate for the purpose in another season of the year; and it is these changes in the quality of the water which render it difficult of purification at all times; but, as a result of the investigations by the Board, a method of purification has been found which is adapted for all of the various conditions of the water that have thus far been observed, and, so far as our investigations have shown, has always given satisfactory results without increasing the hardness of the water or injuring it in any other way; in fact, the indications seem to be that the hardness will be considerably reduced in the operation.

While the method of purification referred to has been found satisfactory, the experiments have necessarily been made upon a small scale, and it is impracticable to determine satisfactorily, without experiments upon a larger scale, the size of filters and other works that will be necessary to purify the water at all times, and at the same time secure the greatest economy in the first cost of the works and in their operation. Such an experiment should be made by means of works located in the vicinity of your pumping station; and, if the town will provide such tanks and materials as are necessary to make a suitable test, the Board will advise as to the construction and operation of a suitable experimental plant, and will make such other investigations as may be necessary. After sufficient information has been secured for the purpose, the Board will advise as to the works necessary for effectually purifying the water supply of the town.

It is estimated that a suitable experimental plant for the purpose can be prepared in the vicinity of your pumping station at a cost of not over $500, and probably at a smaller cost.

RANDOLPH. An application was received from the board of health of Randolph, June 5, 1899, for advice relative to the quality of the water of a well which is used for the supply of several families in that town. The Board replied to this application as follows: —

JUNE 30, 1899.

In response to your application of June 5, 1899, for advice as to whether or not the water in the well on the premises of Alice Kenney, on Ward Street in the town of Randolph, is unfit for domestic use and likely to imperil the public health, the Board has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The well, which appears to be used by several families, is located in the thickly populated portion of the village, and there are many privies and cesspools in its neighborhood. The analysis of a sample of the water shows that the water which enters the well has been highly polluted by sewage, and has not been purified in its passage through the ground.

With these conditions, the Board is of the opinion that the water of this well in its present state is liable to be injurious to the health of those who may use it for drinking or other domestic purposes and is unfit for domestic use. There appears to be no practicable way in which the quality of the water of the well can be improved sufficiently to make it safe for drinking.

RUSSELL. An application was received, June 20, 1899, from William B. Shelley, requesting the advice of the Board relative to a proposed water supply for the town of Russell, to be taken from Black Brook in that town. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on June 20, 1899, an application for advice with reference to a proposed source of water supply for the town of Russell, in which you state that it is proposed to take water from Black Brook, at a point about one mile from the Boston & Albany Railroad station, and at an elevation of about 150 feet above the track. The application was accompanied by a plan showing the location of a proposed dam upon the brook.

The Board has caused the water-shed of the brook to be examined by one of its engineers, and a sample of the water collected near the site of the propōsed dam to be analyzed. The results of the analysis show that the water is soft, odorless and has but little color, and that it is otherwise of good quality for the purposes of a public water supply.

The examination of the water-shed shows that there are several farm-houses upon it, most of which are located near the edges of the water-shed, and at a considerable distance from the stream and its tributaries. An examination of the location of the houses nearer the central portions of the water-shed indicates that the pollution of the water of the brook from these houses can be prevented without serious trouble.

If suitable precautions are taken to prevent the pollution of the brook by sewage from houses on its water-shed, the Board is of the opinion that this source will be a suitable one for the supply of the village of Russell.

SALEM. A communication having been received, Jan. 1, 1899, by the State Board of Health, from the Salem water board, to the effect that complaints had been received relative to the taste of the water furnished from their sources of supply, the State Board of Health caused these sources to be examined by one of its engineers, together with the results of numerous analyses which had been made of the water of Wenham Lake and Longham reservoir, and addressed the following communication to the water board of Salem: —

MARCH 17, 1899.

The results of the analyses show that the water of Wenham Lake has contained more color and considerably more organic matter in the last four years than was the case for many years previously, a condition which has apparently been chiefly due to the introduction of water from the Longham source, which is very highly colored and usually contains a very large quantity of organic matter. The bad taste and odor which you have noticed recently in the water from the lake have probably been due to the presence of organic matter, and our investigations show that microscopic organisms are present in this water at times in considerable numbers. The cause of the presence and growth of such organisms in surface waters is not definitely known, but the numbers are apparently dependent largely on the nitrogenous matter contained either in the bottom of the pond or in the water which enters it. The very large quantity of organic matter usually present in the water of Longham reservoir is favorable to the development of microscopic organisms, and the introduction of this water into Wenham Lake has evidently had an unfavorable influence upon the quality of the water of the lake. It is important that as small an amount as possible of water from the Longham source be drawn into Wenham Lake, and that the Longham water be used so far as practicable only at times when its quality is least objectionable. A great improvement could apparently be made in the quality of the Longham water by certain changes and improvements in the reservoir and its water-shed, as suggested in a previous communication of the Board.

An application was received from the Salem water board, Dec. 7, 1899, requesting the opinion of the State Board of Health as to the fitness of the water of Longham Brook for use in connection with the water of Wenham Lake. The Board replied to this application as follows: —

DEC. 22, 1899.

The State Board of Health received from you, on Dec. 7, 1899, a communication stating that, on account of the low state of the water in Wenham Lake, you desire to turn the water of Longham Brook into the lake as soon as its condition will permit, and you request the advice of the Board as to the fitness of the Longham water for use in connection with the water of the lake, and as to the probability, if the water is not now suitable, of its becoming improved by the conditions which are likely to prevail during the winter months.

The results of analyses of samples of water collected from the basin on Longham Brook have shown that it is highly colored, and contains, especially in the summer season, a very large quantity of organic matter, and the turning of such water into Wenham Lake would have a very unfavorable effect upon its quality. In the earlier months of the year, usually from January until the end of April, when there is a large quantity of water flowing through the reservoir, the water is less highly colored and contains a much smaller quantity of organic matter than during other portions of the year. It appears that the basin has now been empty for several weeks, but the most recent analyses show that the quality of the water of the brook at the present time is not as good as the water of the basin was found to be during the winter and early spring months of the year, and it seems reasonable to expect that the quantity of organic matter in the brook water will become considerably less in the near future, while at the same time the flow of the brook will be considerably greater. There are indications that the turning of the water of the Longham Brook source into Wenham Lake has, at times in the past, had an unfavorable influence upon the quality of the water of the lake; and it is desirable, under present conditions, to divert as little water as practicable from this source into the lake, and to so divert it only at the season of the year when the quantity of organic matter in the Longham water is at the minimum.

The results of recent analyses of Longham water show that it was better during November than earlier in the fall, but it was not so good in the early part of December as in the preceding month; and, under the circumstances, if further lowering of the water in the lake will not interfere with the efficiency of the works of either of the cities of Salem or Beverly, the Board would advise that you delay using the water of Longham Brook until, by making weekly examinations, it is found that the water is of better quality than it has been found to be thus far this fall. It will be essential to watch the quality of the water carefully, especially after the first heavy rains, which may have an unfavorable effect upon its quality for a time. The Board will cause the necessary analyses to be made if you will collect the samples.

The consumption of water in Salem and Beverly is likely to increase in the future, and it will become necessary to draw larger and larger quantities from the Longham source into Wenham Lake. The effect upon the quality of the water of the lake is likely to become more noticeable as greater quantities of water from the Longham source are diverted into it; and the Board would again advise that the question of the improvement of the Longham source be carefully investigated, with a view to securing a water of much better quality than it is capable of furnishing under present conditions, and one which will not be likely to have an unfavorable effect upon the quality of the water of Wenham Lake.

SPRINGFIELD. An application was received from the water board of Springfield, Jan. 12, 1899, in which it was stated that the board of water commissioners of Springfield had voted to draw off the water of Ludlow reservoir early in the coming season, in order that the bed of the reservoir might be examined, and estimates obtained of the cost of removing the deposit at the bottom.

Meanwhile, in order to insure a full supply of water, it was proposed to draw water from Five Mile Pond, and, if necessary, to use this water and that of Loon Pond as an emergency supply. The opinion of the Board was requested with reference to the quality of these waters. To this application the Board replied as follows: —

FEB. 2, 1899.

The State Board of Health received from you, on Jan. 12, 1899, an application stating that you propose to draw off the water of Ludlow reservoir early in the coming season, in order that the bed of the reservoir may be examined and the amount of objectionable material at the bottom measured; and that, in order to insure a full supply of water to the city during the time that the reservoir is empty, you propose to supplement the supply from the canals, Ludlow basin and Chapin Pond, by the use of water from Five Mile and Loon ponds, if necessary; and you request the advice of the Board as to whether the quality of the water of those ponds is suitable for the supply of the city.

The Board has carefully considered your proposed plan, and the results of examinations which have been made of the proposed sources of supply from time to time for several years.

The results of chemical analyses of samples which have been collected and sent in by you at regular intervals since 1896 show that the waters of these ponds are soft, nearly colorless, and generally of good quality for the purposes of a public water supply.

The microscopical examinations have shown the presence at times of considerable numbers of organisms, of kinds which have been known to impart to water a disagreeble taste and odor; but it does not seem probable, from these examinations, that troubles from this cause will be frequent or long-continued. The ponds do not appear to be exposed to serious danger of pollution by sewage, excepting perhaps from visitors in the summer season, and danger of pollution of the ponds from this cause can be prevented.

It is not practicable to estimate definitely the probable yield of these sources of supply, taken in connection with Chapin Pond and with the canals discharging into Ludlow basin; but it is probable that the yield will be sufficient for the supply of Springfield for the next two or three years, unless a very dry year should occur, and in such an emergency it is probable that a further additional supply could be secured in time to avoid serious difficulty from a shortage of water. It is desirable, however, to make provision whereby, when water is wasting from the Ludlow basin, it can be discharged into Five Mile, Loon and Chapin ponds, whenever the level of the water in either of the ponds is below high water.

In view of the circumstances, the Board is of the opinion that Five Mile and Loon ponds are appropriate sources of temporary water supply for the city of Springfield.

STOUGHTON. An application was received, Aug. 15, 1899, from the water commissioners of Stoughton, requesting the advice of the Board with reference to certain proposed changes and improvements in the system of water supply of the town. The Board replied to this application as follows: —

OCT. 6, 1899.

The State Board of Health received from you, on Aug. 15, 1899, an application for advice with reference to certain proposed changes and improvements in the water supply system of the town of Stoughton, accompanied by a plan, showing your present collecting well and other works in the vicinity of the brook flowing from Muddy Pond, and proposed changes in these works which it is intended to make at the present time, and other changes which can be made by extending the proposed new works in the future.

The plan shows a line of pipe beginning at a proposed gate-chamber on the line of the present 12 inch pipe between the collecting well and the pumping station, at a point about 50 feet north of the collecting well, and extending in a south-westerly direction along the westerly side of the valley of the brook for a distance of a little less than 800 feet, where it turns from a south-westerly to a south-easterly direction, and runs 92 feet to a proposed settling basin, to be constructed on the brook about 200 feet above the "old dam," so called. It is proposed to take the brook water from the settling basin through this pipe to the present 12 inch pipe line, and thence directly to the pump well at the pumping station.

It appears that you propose that most of the works described shall form a part of works designed to secure a supply of ground water from the neighborhood of the springs about Muddy Pond, as suggested and recommended by this Board in 1893; and the plan shows a possible route by which your proposed pipe line may be extended from the point at which it is proposed to turn off to connect with the brook, further south through the valley of the brook, and around the southerly end of Muddy Pond, so as to intercept the ground water from this region and use it at some future time for the supply of the town; but it appears that for the present and for an indefinite time in the future it is proposed to take water for the supply of Stoughton directly from the brook flowing from Muddy Pond.

The Board has caused your present works and the region about Muddy Pond to be examined by its engineer, and samples of water collected by you at various points from the brook flowing from Muddy Pond to be analyzed, and has carefully considered the plan submitted and the results of previous investigations with reference to the water supply of Stoughton.

The water supplied to the town from your present works is at times highly colored, and contains a large quantity of organic matter taken up from the swamp about Muddy Pond. The water-shed of Muddy Pond is situated quite near the town, and, while it contains only a small population, and the pond and brook below it are but little exposed at the present time to danger of pollution by sewage, the use of a running stream in such territory as a source of public water supply should, in the opinion of the Board, be avoided.

Comparing the results of analyses of samples of water collected recently from the brook at the present intake with those collected from the brook near the proposed new settling basin and at the outlet of Muddy Pond, it is found that the water of the brook at the place at which it is taken at present is of slightly better quality, as indicated by these analyses, than it is nearer the pond; but the spring water flowing into Muddy Pond is of much better quality than either of them, and it does not appear that any material improvement would be made in the quality of the water used for the supply of the town of Stoughton by constructing only those portions of the proposed works which provide for taking water from the brook further up stream, as is now proposed.

While a general outline of that part of your plan which provides for extending the works at some future time so as to intercept the spring water which flows into Muddy Pond is shown on the plan submitted, the details of this plan are not presented. The plan shows a proposed collecting well near Drake Brook, and the location of a conduit pipe to be laid with open joints, extending from the well around the southerly side of the pond. It does not appear that any tests of the ground have been made in the vicinity of the site of the proposed collecting well which would indicate the character of the soil, nor is it understood that the line of the proposed conduit is definitely located.

The examinations which have been made under the direction of the Board during the present year tend to confirm the conclusions based on the result of examinations made in previous years, — that a supply of ground water of excellent quality sufficient for the needs of the town of Stoughton for the present, and probably for a long time in the future, can be obtained by constructing suitable works for collecting the ground water which now finds its way into Muddy Pond and the brook below it above your present collecting well; and, in the opinion of the Board, it is very desirable that works be built with as little delay as possible, to secure a supply of water for the town from this source.

It is important, before making any changes in your present works, to make further investigations and to prepare definite plans for collecting all of the spring water which can be made available; and when such investigations as may be necessary have been made and definite plans for the proposed works have been prepared, the Board will advise you concerning them, if you so request.

TYNGSBOROUGH. An application was received, Sept. 23, 1899, from the committee on water supply of the town of Tyngsborough, asking the opinion of the Board relative to the quality of the water of two sources proposed as alternative supplies for public uses in the village. The Board replied to this application as follows: —

Nov. 3, 1899.

The State Board of Health received from you, on September 23, an application for advice with reference to the quality of the water of a proposed source of water supply for a public drinking fountain and for the town hall in the town of Tyngsborough, in which it was stated that two sources were under consideration; but, at the time the application was received, works for furnishing a supply of water to the drinking fountain and town hall from a well located not far from the north-easterly side of the Dunstable Road, about a quarter of a mile north-west of the town hall, were already nearly completed, and the water was soon afterwards supplied by gravity to the fountain and the town hall through a lead pipe 1,300 feet long.

The Board has caused the well and its surroundings to be examined by one of its engineers, and has caused several samples of the water to be analyzed.

The results of an analysis of a sample of water collected on September 25 showed that the water had a disagreeable odor, which became stronger on heating, and that it contained an excessive amount of organic matter. A sample collected on October 6, after water had been allowed to run from the well for several days, was found to contain a much smaller quantity of organic matter; but the quantity was considerably larger than is found in ground waters of good quality, and the odor of the water was as disagreeable as in the first sample.

It has also been found, by an analysis of a sample of the water collected recently from a faucet in the town hall, that the water takes up lead from the pipe through which it is supplied in such large quantities that it would be very injurious to the health of those who might use the water for drinking.

It is not practicable to predict whether or not the water will continue to improve, and will become satisfactory for drinking, and remain so. It is also impracticable to tell whether its action on the lead pipe will continue as at present, or become greater, or less.

Under the circumstances, the Board is of the opinion that this water should not be supplied for drinking purposes, under present conditions.

It is understood that at the place where the well is located there is a considerable depth of peaty soil, and it is possible that, if a well could be located outside of the area covered by soil of this character, a water of good quality could be secured which will not act on the lead pipe; and the Board would advise that an investigation be made, to see whether it is feasible to secure water from a well in the vicinity of the present source which can safely be supplied to the drinking fountain and town hall through the present pipe line. The Board will assist you, if you so request, in any further investigations you may decide to make, by causing such analyses of samples of water as may be necessary to be made, and will give you further advice in the matter when you have further information to present.

WARE. An application was received, June 7, 1899, from the board of health of the town of Ware, for the opinion of the State Board of Health as to the purity of certain springs and wells in use in that town as water supplies for a small number of families. The Board replied to this application as follows: —

SEPT. 8, 1899.

In response to your request, of June 7 last, for advice with reference to the quality of the water of certain springs and wells in the town of Ware, the Board has caused an examination of the sources indicated by you to be made by one of its engineers, and samples of the water to be analyzed.

Two of the sources examined are springs owned respectively by the Gilbert Manufacturing Company and the C. E. Stevens Manufacturing Company, from both of which water is supplied for the use of several families for drinking and other domestic purposes, through lead pipes running from the spring in each case to tanks near the houses. The springs are located in a meadow near high, gravelly land, upon which there is a considerable number of dwelling houses; and the water of both springs gives evidence of previous pollution by sewage, that of the Gilbert Manufacturing Company being less affected than that of the Stevens Manufacturing Company.

The water of both sources, as indicated by analyses of two samples of water from each, was found to be quite hard, that of the Stevens Manufacturing Company being considerably harder than the water of the Gilbert Manufacturing Company. The water from the spring of the Gilbert Manufacturing Company was clear, nearly colorless and free from odor. The water from the spring of the Stevens Manufacturing Company was clear and nearly colorless, but both samples had a slight odor, and the quantity of organic matter present was much greater than it was in the spring of the Gilbert Manufacturing Company.

Neither source can be considered a desirable one from which to take water for drinking or other domestic purposes; moreover, the water of both sources is conveyed through long lead pipes to the places where it is used, and analyses of the water showed the presence of small quantities of lead after passing through the pipes. It is understood that the water flows continuously, and the quantity of lead is less on this account than would be the case if the pipe was closed and water drawn only by opening the faucets. It is not practicable to tell, with our present information, whether the quantity of lead taken up by the water in its passage through the pipe is larger or smaller at other seasons and under different conditions than it was at the time these samples were collected; but, considering all the circumstances, it is advisable, in the opinion of the Board, to discontinue the use of water from these springs drawn through lead pipe for supplying water for drinking and other domestic purposes to any of the inhabitants of the town, and to provide for domestic use water from the town works, supplied through suitable pipes.

You have also called attention to several wells located in the village, from which water is used for drinking and other purposes, and the water of two of these wells has been analyzed by the Board. The results show that the well of the Gilbert Manufacturing Company, near South Street, is considerably polluted by sewage; and the well of Arthur R. Kane, near Water Street, is very highly polluted by sewage; and the use of water from these sources for drinking and cooking should be prevented.

The conditions prevailing in the vicinity of several other wells were such as would be likely to have a very unfavorable effect on the quality of the water, and in general the use of water from wells located in the thickly built up portion of the town should be avoided, unless a thorough examination shall show that the water is safe for drinking.

WARREN. An application was received, Dec. 4, 1897, from John S. Gould and associates, for the advice of the Board relative to a proposed water supply for the town of Warren, to be taken from the ground near the Quaboag River. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on Dec. 4, 1897, an application for advice with reference to a proposed water supply for the town of Warren, in which you make the following statement as to the proposed plans for supplying the town: —

> It is proposed to obtain water from the gravelly ground on the north or south side of the Quaboag River, near where test wells were driven by the town committee in 1892 when they were making examinations for a water supply; this point is just east of the new Warren Steam Pump Company's plant, and not far from the Boston & Albany Railroad tracks (on land of one Bridges).
>
> It is proposed to take the water from a filtering gallery, collecting well or a series of driven pipes, as seems best upon a further investigation of the situation, and after proper tests have been made.
>
> A brief description of this and other sources will be found in the printed report of the Warren town committee of 1892, a copy of which is furnished with this application.
>
> It is further proposed to use a covered reservoir on Marks' Mountain, substantially as outlined in the report referred to above.
>
> It is proposed to use cast-iron pipe for the distribution; for the mains, 12, 10 and 8 inch; and for the laterals, 6 inch, and nothing smaller.
>
> As will be seen in the accompanying report, the water from wells near the proposed location of the supply has been analyzed by your Board, being samples No. 9202 and 9203.

Analyses of samples of water from two test wells referred to, in the region of the Quaboag River, above Warren, made by the State Board of Health in 1892, indicate that the water from a well on the north side of the river was affected by an excessive quantity of iron, which would make it objectionable for many uses, while water from a well on the south side of the river contained so much foreign matter that its character could not be satisfactorily determined.

Soon after receiving your application, the Board caused the territory along the Quaboag River above Warren to be examined by its engineer; but the location of the test wells could not then be found, and there was no means of obtaining samples of the ground water in this region for analysis. It was suggested that tests be made of the ground in the vicinity of the place where it was proposed to locate the collecting works, by means of further wells; and, in expectation that further tests would be made, the Board has delayed its reply, but no further information has been presented.

The ground in the valley of the Quaboag River above the village of Warren appears to be of a coarse and porous character, especially on the south side of the river, and, so far as can be judged from surface indications, the conditions are favorable for obtaining water in considerable quantity from the ground in this region; but it is not practicable, in the absence of satisfactory tests, to determine whether the quality of the water obtainable from the ground in this region will be suitable for all domestic purposes, or whether the quantity will be sufficient for the supply of the town.

Under the circumstances, the Board is unable to advise you as to the most appropriate source from which to obtain a supply of water for Warren, and would recommend that further and thorough investigations be made of all available sources before the construction of works is planned.

WELLESLEY. A communication was received from the special committee on additional water supply of the town of Wellesley, Nov. 18, 1898, presenting an account of the work done in furnishing an additional water supply for the town; at the same time requesting the opinion of the Board whether the work fulfils the recommendations and advice of the Board, presented in its letter of Feb. 4, 1897. To this communication the Board replied as follows: —

FEB. 2, 1899.

The State Board of Health received from you, on Nov. 18, 1898, a communication giving an account of the work done in constructing an additional water supply for the town of Wellesley, and requesting the opinion of the Board as to whether the work fulfils the recommendations and advice given in the letter of the Board bearing date of Feb. 4, 1897. Subsequently, you submitted a copy of the report of your committee and of your engineer, together with plans of the new works.

The Board has caused the locality to be examined by its engineer, and has carefully considered the plans submitted and the results of analyses of samples of water collected during the past year from your works for additional supply, as well as from the sources originally used. The results of the analyses show that the quality of the water is about the same as that collected from test wells in this region in 1896. The water appears to be affected to a slight extent by the presence of dwelling houses in the valley of the brook, but is in its present state excellent for the purposes of a public water supply. The purchase by the town of a considerable tract of land in the region about the wells, including two dwelling houses and their out-buildings, the occupation of which probably had a tendency to pollute the ground water of this region, was a necessary and important measure in protecting the purity of the new water supply. The water of the well at Williams Spring and the filter-gallery was also examined during the year 1898, and the quality of the water was found to be about the same as in previous years. It appears that no water has been used from either of these sources since April 19, 1898.

It is not practicable to estimate definitely the quantity of water that the new works will yield, but they seem likely to furnish, in connection with the present works, an ample supply of water for the needs of Wellesley for a considerable time in the future. The new wells cover a large territory north of Worcester Street and a considerable territory south of that street, in a region where there appear to be deep beds of porous gravel; and it appears to be practicable to obtain a larger supply of water in this region, if necessary, by extending the works for collecting ground water. The construction of a covered reservoir and its use in connection with the present works makes it practicable to deliver water to consumers without exposure to the light.

The works as a whole are, in the opinion of the Board, at the present time capable of supplying an ample quantity of good water to all of the inhabitants of Wellesley; and, by means of the covered reservoir, it is practicable to deliver the water to consumers without danger of deterioration on account of exposure to light.

It appears that some of the wells south of Worcester Street are located at places where there is a considerable deposit of mud and organic matter at the surface of the ground, which is usually saturated with water, and you recommend the removal of this mud and organic matter, which does not appear to be of great depth. The presence of soil of this character is liable to have an unfavorable effect upon the quality of the water of the wells located in its vicinity, and, in the opinion of the Board, this material should be removed, if it is feasible to do so, or the areas should otherwise be thoroughly drained, so that water may not stand upon them.

The Board has not made a further examination of the water-shed of Rosemary Brook, to determine the extent to which the brook is being polluted at present. All direct connection between your sources of water supply and the brook having now been cut off, the prevention of the pollution of this stream is not so important as if its waters were used directly; nevertheless, the Board is of the opinion that measures should be taken to keep the water of the brook free from direct sewage contamination, and the town authorities of Wellesley have power to prevent any such pollution under existing laws.

WESTON. An application was received, June 29, 1899, from Charles W. Hubbard of Weston, for the opinion of the Board relative to a proposed water supply for a small community in that town. The Board replied to this application as follows:—

SEPT. 8, 1899.

The State Board of Health has considered your application for advice as to the location of a proposed well to be used as a source of water supply for a portion of the town of Weston, and has caused the locality in which you propose to construct the well to be examined by one of its engineers.

The place indicated is about 1,100 feet from Charles River, and at such an elevation above that stream that the supply of water coming to the well would not be enlarged by filtration of water from the river through the ground toward the well; and the area from which it seems at all likely that water can be influenced to flow toward the proposed well is so limited that, in the opinion of the Board, even if the soil in the vicinity is coarse and porous and favorable to yielding water freely from the ground, it is not probable that the yield will be sufficient to furnish the quantity of water which you estimate will be necessary for the supply of the district under consideration.

The Board, therefore, does not advise the construction of a well in the vicinity of the place indicated in your application.

WEST SPRINGFIELD. An application was received from the water commissioners of West Springfield, Jan. 5, 1899, requesting the advice of the Board relative to plans for increasing the present water supply of that town. The Board replied to this application as follows:—

JUNE 2, 1899.

The State Board of Health received from you, on Jan. 5, 1899, a communication stating that you have employed engineers to make investigations relative to the water supply of West Springfield, and requesting the Board to examine the various plans and recommendations and advise you thereon. The application was accompanied by plans and a report of your engineers, in which the results of the investigations of many sources are presented, and several plans for supplying the town with water for present and future requirements are considered. The plans considered in the report of your engineers may be summarized as follows:—

1. The development of the present source of water supply, Darby Brook, by enlarging the present reservoir and constructing two new ones upon this brook, and by diverting into these reservoirs, or one of them, the waters of Block, Bagg and Pepper brooks, and the north and south branches of Hyde Brook.

2. Taking water from Leonard's Brook in Agawam.

3. Taking water from Block Brook, either by constructing a storage

reservoir on the brook near its mouth, or by means of wells or similar works in the valley of the brook.

4. Taking water from Bear Hole Brook.

5. Purchasing water from the city of Holyoke, the water to be taken from the Manhan River supply of that city.

The Board has caused the various possible sources of supply to be examined by its engineers, and has carefully considered the plans submitted. By the first plan referred to, which provides for increasing the storage capacity of your present reservoir and constructing two new reservoirs on Darby Brook, and diverting into these reservoirs the waters of Block, Bagg, Pepper and Hyde brooks, the use of your present sources of supply would be continued, and a quantity of water obtained that would doubtless be sufficient for the supply of the town for several years in the future at the rate of consumption estimated by your engineers. The quality of the water of your present reservoir on Darby Brook is very unsatisfactory at times, on account of the presence of excessive numbers of organisms, and there is reason to expect that the proposed new reservoirs would be similarly affected. Much of the water which would enter them from their own water-sheds would be ground water, which deteriorates on exposure to light; and the indications are that the water of some of the brooks which it is proposed to divert into the reservoirs would also be largely ground water at times. The water of Block Brook, which would be diverted into the upper reservoir, appears to contain a large quantity of organic matter, probably due to the slow passage of the water through swamps, and might further affect unfavorably the quality of the water of your reservoirs. It also appears that much of the land within the water-sheds of the brooks is highly cultivated, and some of these water-sheds already contain a considerable population, which is liable to increase in the future on account of their nearness to public transportation routes and large centres of population, and endanger the quality of the water, unless the control of large areas of land is secured by the town and the construction of buildings prevented. With these conditions, the indications are that the protection of these sources from pollution would increase largely the cost of a supply by this plan above the estimated cost for works.

The second plan referred to, which provides for taking water fron Leonard's Brook in Agawam, may be dismissed from further consideration, since it appears from the report of your engineers that the area of water-shed is so small that the quantity of water it would yield would be insufficient for the needs of West Springfield.

The third source mentioned is Block Brook, which has been considered both with reference to the feasibility of obtaining from it a surface-water supply and a ground-water supply. It is probable that, by constructing a storage reservoir on this stream, as outlined in the report of your engineers, a sufficient quantity of water could be obtained from it to supply the present needs of the town and to allow for a considerable increase in the use of water in the future. The water of Block Brook, as already stated, is highly colored in the upper portion of its course, and contains a large amount of organic matter, owing to its slow passage through swamps. The proposed reservoir would be quite shallow over much of its area, and under the circumstances it is probable that if water is taken from this source it would be of unsatisfactory quality, on account of excessive growths of organisms and disagreeable tastes and odors. Much of the land in portions of the water-shed is highly cultivated, and there is already a considerable population on the water-shed which is liable to increase greatly in the future, on account of the nearness of the source to the thickly settled portions of the town. Under the circumstances, the Board is of the opinion that this source is not a desirable one from which to obtain a surface water supply for West Springfield.

It does not appear that any investigations of the ground within this water-shed have been made to determine whether it is feasible to obtain there a sufficient supply of ground water for the town by means of wells or filter-galleries; but, considering the small size of the water-shed, and judging from a general examination of its character, it does not seem probable that a sufficient supply of water for West Springfield could be obtained from the ground in this valley.

The proposed method of developing Bear Hole Brook, as indicated in the report of your engineers, will provide an ample supply of water for the present needs of West Springfield and probably for the requirements of many years in the future. The water of this brook is of good quality for the purposes of a public water supply, and the water-shed is quite remote from the town and nearly free from population. By removing thoroughly all soil and vegetable matter from the area to be flowed by the reservoir, it is probable that a water of good quality could be obtained from this source.

By the final plan considered by your engineers it is proposed to take water from the pipe line of the city of Holyoke, which at present conveys water from the Manhan River to Ashley Pond. In this way an ample supply of water could be obtained for the town of West Springfield for an indefinite time in the future, provided that the city of Holyoke shall increase the capacity of the Manhan works when necessary. The water of the Manhan River is sometimes highly colored, but is soft and otherwise of good quality for the purpose of a public water supply. The water-shed contains a small and scattered population, which is decreasing; but, if water is taken directly from the present main pipe for the supply of West Springfield, as proposed, danger of the pollution of the water from the population on the water-shed will have to be carefully guarded against, because the water coming from the Manhan River probably receives very little benefit from the short time that it would be stored in the present reservoir.

Leaving out of consideration Leonard's Brook, for reasons already given, and comparing the four plans by which it appears to be practicable to obtain a sufficient supply of water for West Springfield with reference to the quality of the water that is likely to be obtained from each, it appears probable that the plan of developing the present sources and diverting several brooks into the proposed reservoirs on Darby Brook would furnish a water which would be of good quality during much of the year, if the pollution of the source from inhabitants on the water-shed is prevented; but the water would be subject at times to the presence of excessive numbers of organisms, which would make the water objectionable for many uses, and it is probable that the water that would be furnished by this plan would be of less satisfactory quality than that obtainable by either the Bear Hole Brook or the Manhan River plans. The water of Block Brook, as already stated, is likely to be of unsatisfactory quality. By developing Bear Hole Brook it is probable that, if the storage reservoir is properly prepared for the storage of water by the removal of all soil and vegetable matter, a water would be obtained which would rarely, if ever, be objectionable for drinking or other domestic uses. The water of the Manhan River source would be likely to have a higher color at all times than that of either of the others, excepting Block Brook, but it would probably be in other respects of good quality.

The cost of the plans has been considered by your engineers, and from their estimates it appears that the cost for dams, reservoirs, pipes, pumping stations and other works necessary for storing and supplying water to the town would be much less in case a supply should be taken from the Manhan River source than by either of the other plans considered; but in each case there are other items of cost which it has not been practicable to estimate definitely. In the case of the plan providing for the development of the present sources it seems probable that a large additional cost would have to be incurred for the protection of the sources of supply. In the case of Bear Hole Brook it would be necessary to pay for lands taken and probably damages for the diversion of water. If water should be taken from Holyoke it will be necessary to pay a yearly sum to the city of Holyoke for the supply of water.

With the information at present available it seems probable that, of the plans presented for obtaining a supply of water for West Springfield, the plan of taking water from Holyoke would require the least expenditure by the town, and a water of good quality would be obtained, though it might be inferior in some respects to the water that could be obtained from Bear Hole Brook.

There is no doubt that if a supply of good ground water could be obtained, sufficient for the present needs of West Springfield and capable of being developed so as to supply the town for a reasonable length of time in the future, it would, if kept from exposure to light, prove far more satisfactory to consumers than any water from a surface source.

Your investigations and the examinations made by the Board do not show any place from which a satisfactory ground-water supply can be obtained within the limits of West Springfield; but the examinations of the Board have shown that on the western side of the mountain range which lies between West Springfield and Westfield, in the valley of Pond Brook, which forms the outlet of Hampton and Horse Ponds, the conditions for obtaining a large quantity of water from the ground appear to be very favorable, so far as can be judged from surface indications. If investigations should show that it is practicable to obtain an ample supply of good ground water from this valley, it might be found to be for the best interests of the town to select this source; and it is probable that the cost of works for supplying this water to West Springfield would be less than the cost of works for developing a supply from Bear Hole Brook, and not greatly in excess of the cost of supplying the town from the Holyoke works, when the whole cost of the water is taken into consideration, while a much better water could be obtained. But, while, if the source should upon investigation be found satisfactory, it might be of advantage to the town to build the works with as little delay as possible, it would probably be necessary for the town to secure an act from the Legislature before water could be taken or diverted from this water-shed. An additional supply of water is greatly needed by the town, and, if a suitable supply can be obtained in the valley of Pond Brook, a main pipe might be laid to connect temporarily with the Manhan pipe line of the city of Holyoke, and a supply obtained until the town is prepared to proceed with the construction of its independent works, when the pipe line used to obtain a supply from Holyoke could form a part of the independent works of the town.

Further information relative to the possibility of obtaining a supply of ground water for West Springfield from the valley of Pond Brook seems to be necessary, to determine which of the plans it will be for the best interests of the town to adopt in selecting a water supply. The Board would advise that the town cause investigations to be made in the valley of Pond Brook, in the vicinity of the place where the brook is crossed by the line of the New York, New Haven & Hartford Railroad, between Westfield and Holyoke, to determine the character of the soil, the probable quality of the ground water and the feasibility of obtaining a sufficient supply of ground water in this region. Careful estimates should also be made of the probable cost of works for obtaining a ground-water supply in this territory, including all items of damage that are likely to be incurred.

The Board will co-operate with you in such investigations as you may decide to make, by analyzing samples of water, and will, upon application, advise you further with reference to this source when further information has been obtained.

WILMINGTON. An application was received from the board of health of Wilmington, Sept. 18, 1899, requesting the opinion of the Board relative to the quality of the water used for drinking purposes at a certain school-house in that town. The Board replied to this request as follows: —

OCT. 5, 1899.

The State Board of Health has considered your application for advice as to the fitness for drinking purposes of the water of a well designed for the use of pupils of a public school in the south district of Wilmington, and has caused the well and its surroundings to be examined by one of its engineers and a sample of the water to be analyzed. This source was examined by the Board last year, in response to a request by you; but it appears that a change has been made in the surroundings, by extending the drain which formerly discharged near the well so that it now discharges further away, and that the well has been cleaned out. The results of a chemical analysis of a sample of the water, however, show that it has a very disagreeable odor and contains a large quantity of organic matter, and is worse than when analyzed in response to your former request.

The source must still be regarded as a dangerous one from which to take water for drinking, and the Board would advise that the well be abandoned and its further use prevented.

SEWERAGE AND SEWAGE DISPOSAL.

The following is the substance of the action of the Board during 1899 in reply to applications for the advice of the Board relative to sewerage and sewage disposal, under chapter 375 of the Acts of 1888, or for the approval of sewerage systems or the taking of land for sewage disposal, under other acts: —

BRIDGEWATER (State Farm). An application was received, March 30, 1899, from the superintendent of the State Farm at Bridgewater, for the advice of the Board relative to a proposed system of sewage disposal at the State Farm. The Board replied to this application as follows: —

MAY 5, 1899.

The State Board of Health received from you, on March 30, 1899, an application for advice with reference to a proposed system of sewage disposal for the buildings at the State Farm, and subsequently plans of the proposed system were received through your engineer.

The plan submitted provides for collecting the sewage of the institution into a main sewer ten inches in diameter, which will convey it in a northwesterly direction to filter beds to be located about three-quarters of a mile from the buildings in the valley of a small brook on the westerly side of Conant Street, where it is proposed to purify the sewage by intermittent filtration, and discharge the effluent into a brook which flows into the Taunton River below the pumping station of the State Farm water works. A flush tank or reservoir, having a capacity of about 12,600 gallons, which is designed to discharge its contents automatically at intervals, is shown on the line of the main sewer about 1,400 feet from the buildings.

At the place where it is proposed to locate the filter beds the soil is not suitable for the purpose, but suitable material is found close by, and it is proposed to use the material in the construction of the beds. According to the plans, the filtration area will consist of eight filter beds, each having an area of 8,000 square feet.

The Board has carefully considered the proposed plan, and has caused the locality to be examined by its engineer and samples of the sand with which it is proposed to construct the filter beds to be analyzed.

The location of the proposed main sewer appears to be suitable for the reception of all of the sewage at present flowing from the institution, and its size is sufficient to remove a considerably greater quantity of sewage than the present flow, if necessary. While the grade of the sewer in some places is less than is desirable, the location of the flush tank is such that by the discharge of a large quantity of sewage at intervals it will have a decided influence in preventing deposits from taking place in the sewer. The intermittent discharge of sewage from this tank will also be of advantage in the disposal of the sewage upon the filter beds, especially in the winter season.

The filter beds are located close to the highway, but they are quite remote from any dwelling house, and the location appears to be in other respects a satisfactory one. Analyses of the sand of which it is proposed to construct the filter beds show that it is of good quality for the purification of sewage, and, if the beds are constructed as proposed, having a depth of filtering material of at least four feet above the underdrains, they should be capable of purifying all of the sewage flowing from the institution at the present time; moreover, in the case of an increase in the quantity of sewage it will be practicable to enlarge the area of the beds in the future without special difficulty.

The plan as a whole is a feasible and satisfactory one, and is probably as economical as any that it is practicable to adopt, and the Board would advise the construction of the works in general accordance with this plan. It is suggested that in constructing the tank the overflow be placed at a somewhat higher level with reference to the outlet pipe of the tank than is now proposed, in order to insure the operation of the siphon; and it will probably also be desirable to provide a siphon of somewhat larger diameter than four inches, in order to secure more rapid discharge of the tank.

EASTHAMPTON. An application was received, July 8, 1899, from the sewer commissioners of Easthampton, for the advice of the Board with reference to a plan of sewage disposal for that town. The Board replied to this application as follows: —

DEC. 8, 1899.

The State Board of Health received from you, on July 8, an application for advice with reference to a proposed system of sewage disposal for the town of Easthampton, accompanied by plans and a report of your engineers describing the proposed method of disposing of the sewage of the town. The plan in general provides for a main sewer to receive the sewage from the present sewerage system in the valley of Broad Brook and from portions of this valley which are likely to require sewerage in the future, and to convey it by gravity to a proposed filtration area, situated between the Manhan River and the Mount Tom Branch Railroad, east of Broad Brook, where it is proposed to purify the sewage by filtration, and to discharge the effluent into the Manhan River. There is a small territory in the immediate vicinity of Broad Brook below the dam of the Nashawannuck Pond, the sewage from which cannot be delivered into the proposed new main sewer by gravity; and provision is made for collecting the sewage from this district at a convenient point, and discharging it into the proposed main sewer by pumping. There will remain a small portion of the village bordering the Manhan River from which sewage is now discharged into the Manhan River above the water works pumping station which will not be connected with the new works, otherwise the plan provides for the purification of the sewage of all the thickly settled portions of the town.

The proposed intercepting sewer will be laid along the northerly side of the valley of Broad Brook, in the vicinity of, or between, the railroads to Ferry Street, where it will turn to the east, and cross the valley of Broad Brook in the form of an inverted siphon to the filtration area. The area upon which it is proposed to purify the sewage is located between the Mount Tom Branch Railroad and the Manhan River, east of Broad Brook, and the plans submitted show thirty-one filter beds, having a total area of 3.6 acres, which are intended to receive and purify the sewage.

The Board has carefully considered your application and the plans and report submitted therewith, and has caused the territory to be examined by its engineer, and samples of the soil of the proposed filtration area to be analyzed. The plan in general appears to the Board to be well suited to the collection and disposal of all of the sewage of the portions of Easthampton lying in the valley of Broad Brook which are now provided with sewerage, or seem likely to require sewerage for many years in the future; and the location of the filtration area and proposed method of purifying the sewage appear to be the best that it is practicable to adopt. It is desirable to make a more thorough examination of the soil in all parts of the proposed filtration area before beginning the construction of the filters, since it is possible that by making some changes in the location of the filters a saving in their cost can be effected.

The discharge of the sewage of a portion of the town in the vicinity of South Main Street into the Manhan River above the water works pumping station is a danger to the health of the inhabitants of the village, since it appears that a direct connection is maintained with the river, by means of which water from the river would be pumped into the water pipes of the town in case of an emergency. It is feasible to construct filter beds near the base of the steep bluff near the Manhan River, along the northerly side of the village, for the purification of all sewage from houses which are so situated that the sewage cannot be discharged into the sewers in Broad Brook valley; or it may be practicable to pump the sewage from this portion of the village into the sewer in the valley of Broad Brook, and dispose of it with the other sewage of the village. The Board would advise that provision be made, either for purifying the sewage upon filters as suggested, or for removing it from the portion of the Manhan River above the water works dam.

You also request the advice of the Board as to the discharge of sewage into the Manhan River in the vicinity of the proposed filtration area without treatment. Considering the probable quantity of water flowing in the Manhan River and the character of the Manhan and Connecticut rivers below the proposed outlet, the Board is of the opinion that the discharge of the sewage of Easthampton into the Manhan River, as proposed, without purification, would be likely to produce a serious nuisance, and the Board does not advise the discharge of sewage directly into the Manhan River at any point.

FOXBOROUGH. An application was received from the sewerage committee of Foxborough, Dec. 13, 1897, for the advice of the Board with reference to a proposed system of sewerage for the town of Foxborough. On Jan. 25, 1899, a further application was received for the advice of the Board, and was accompanied with plans of a general system of sewerage and sewage disposal for the town. To these applications the Board replied as follows: —

FEB. 2, 1899.

The State Board of Health received from you, on Dec. 13, 1897, an application for advice with reference to a proposed system of sewerage for the town of Foxborough, and in connection with that application samples of soil from lands proposed as places of sewage disposal were examined under the direction of the Board and the results communicated to your committee. Subsequently, on Jan. 25, 1899, a further application for the advice of the Board was received, accompanied by plans of a general system of sewerage and sewage disposal for the town, prepared by J. J. Van Valkenburg, civil engineer.

The plans provide for a system of pipe sewers to collect sewage from all of the thickly settled portions of the main village of Foxborough, connecting with a main sewer which passes through South Street and across private land to a proposed filtration area on the northerly side of South Street, bordering on the Wading River, about one and three-quarters miles from the village.

The Board has caused the proposed system, the location of the proposed filtration area and the character of the soil to be examined by its engineers, and has carefully considered the proposed plans.

The system of sewers as designed provides satisfactorily for the collection and removal of all of the sewage of the portions of Foxborough which are in need of sewerage facilities at the present time, and a reasonable allowance has been made for an increase in the quantity of sewage in the future.

The sewers are not intended to receive storm water, and special provision is to be made for keeping ground water out of the sewers by providing underdrains or by constructing the sewers of iron pipe with lead joints in places where large quantities of ground water are likely to be encountered. It is important to keep all storm water and ground water out of the sewers, so far as practicable, because, if considerable quantities of such waters should be admitted, the sewers might need to be made considerably larger in size and a greater area of filter beds would be necessary, thus increasing the cost of constructing and maintaining the works.

The area which it is now proposed to use for the disposal of the sewage is located in a very thinly settled region, and the location of the filter beds is such that no odors from them are likely to be noticeable in the neighborhood. Examinations of the soil from test pits in this area show that it is very coarse and porous, and well adapted to the purification of sewage by intermittent filtration. The size of the area is ample for the purpose, and the plans provide satisfactorily for the distribution of the sewage upon it. An area of three acres of filter beds, prepared and operated as proposed, will probably meet the requirements of the town for several years, and additions can be made when required.

The effluent from the filter beds will flow into the Wading River, and with reasonable care in the operation of the beds the effluent from these works will not have a noticeable effect upon the appearance or condition of this stream.

The plans as a whole are, in the opinion of the Board, well adapted for the collection and purification of the sewage of Foxborough in a satisfactory manner.

FOXBOROUGH (Massachusetts Hospital for Dipsomaniacs and Inebriates). An application was received, June 28, 1899, for the advice of the Board with reference to certain proposed improvements in the system of sewage disposal for the hospital. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on June 28, 1899, an application for advice with reference to improving the sewage-disposal system of the Hospital for Dipsomaniacs and Inebriates, located at Foxborough, Mass., together with a plan and report by J. J. Van Valkenburg, civil engineer, showing the proposed changes in the present system.

It appears that all of the sewage of the hospital, which contains a population of about 200, together with the rainfall from the roofs of the buildings, is discharged upon a filter bed having an area of about 50,000 square feet. This filter bed contains suitable material for the purification of sewage, and is underdrained, but an examination of the bed has shown that the underdrains have in some way become inoperative, and the material near the surface has apparently become clogged. The plan submitted provides for a new system of underdrainage, and for dividing the filtration area into four small beds of nearly equal area, so that only one bed will be used at a time. The suggestion is also made that the roof water be disposed of in some other way than by discharging it into the sewers leading to the filter beds.

The Board has caused the filter bed to be examined by one of its engineers, and has considered the plans and report submitted. While the filter bed is of ample size for the disposal of all of the sewage at present flowing from the hospital, even including rain water, the underdrains have evidently become stopped, and the surface of the filter is apparently seriously clogged.

The proposed plan will provide for an adequate system of underdrainage, and by dividing the area into four smaller beds a much more satisfactory application of the sewage will be secured, and opportunity will be given to keep the surface of the beds in suitable condition.

of a general system of sewerage and sewage disposal for the town. To these applications the Board replied as follows: —

FEB. 2, 1899.

The State Board of Health received from you, on Dec. 13, 1897, an application for advice with reference to a proposed system of sewerage for the town of Foxborough, and in connection with that application samples of soil from lands proposed as places of sewage disposal were examined under the direction of the Board and the results communicated to your committee. Subsequently, on Jan. 25, 1899, a further application for the advice of the Board was received, accompanied by plans of a general system of sewerage and sewage disposal for the town, prepared by J. J. Van Valkenburg, civil engineer.

The plans provide for a system of pipe sewers to collect sewage from all of the thickly settled portions of the main village of Foxborough, connecting with a main sewer which passes through South Street and across private land to a proposed filtration area on the northerly side of South Street, bordering on the Wading River, about one and three-quarters miles from the village.

The Board has caused the proposed system, the location of the proposed filtration area and the character of the soil to be examined by its engineers, and has carefully considered the proposed plans.

The system of sewers as designed provides satisfactorily for the collection and removal of all of the sewage of the portions of Foxborough which are in need of sewerage facilities at the present time, and a reasonable allowance has been made for an increase in the quantity of sewage in the future.

The sewers are not intended to receive storm water, and special provision is to be made for keeping ground water out of the sewers by providing underdrains or by constructing the sewers of iron pipe with lead joints in places where large quantities of ground water are likely to be encountered. It is important to keep all storm water and ground water out of the sewers, so far as practicable, because, if considerable quantities of such waters should be admitted, the sewers might need to be made considerably larger in size and a greater area of filter beds would be necessary, thus increasing the cost of constructing and maintaining the works.

The area which it is now proposed to use for the disposal of the sewage is located in a very thinly settled region, and the location of the filter beds is such that no odors from them are likely to be noticeable in the neighborhood. Examinations of the soil from test pits in this area show that it is very coarse and porous, and well adapted to the purification of sewage by intermittent filtration. The size of the area is ample for the purpose, and the plans provide satisfactorily for the distribution of the sewage upon it. An area of three acres of filter beds, prepared and operated as proposed, will probably meet the requirements of the town for several years, and additions can be made when required.

The effluent from the filter beds will flow into the Wading River, and with reasonable care in the operation of the beds the effluent from these works will not have a noticeable effect upon the appearance or condition of this stream.

The plans as a whole are, in the opinion of the Board, well adapted for the collection and purification of the sewage of Foxborough in a satisfactory manner.

FOXBOROUGH (Massachusetts Hospital for Dipsomaniacs and Inebriates). An application was received, June 28, 1899, for the advice of the Board with reference to certain proposed improvements in the system of sewage disposal for the hospital. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on June 28, 1899, an application for advice with reference to improving the sewage-disposal system of the Hospital for Dipsomaniacs and Inebriates, located at Foxborough, Mass., together with a plan and report by J. J. Van Valkenburg, civil engineer, showing the proposed changes in the present system.

It appears that all of the sewage of the hospital, which contains a population of about 200, together with the rainfall from the roofs of the buildings, is discharged upon a filter bed having an area of about 50,000 square feet. This filter bed contains suitable material for the purification of sewage, and is underdrained, but an examination of the bed has shown that the underdrains have in some way become inoperative, and the material near the surface has apparently become clogged. The plan submitted provides for a new system of underdrainage, and for dividing the filtration area into four small beds of nearly equal area, so that only one bed will be used at a time. The suggestion is also made that the roof water be disposed of in some other way than by discharging it into the sewers leading to the filter beds.

The Board has caused the filter bed to be examined by one of its engineers, and has considered the plans and report submitted. While the filter bed is of ample size for the disposal of all of the sewage at present flowing from the hospital, even including rain water, the underdrains have evidently become stopped, and the surface of the filter is apparently seriously clogged.

The proposed plan will provide for an adequate system of underdrainage, and by dividing the area into four smaller beds a much more satisfactory application of the sewage will be secured, and opportunity will be given to keep the surface of the beds in suitable condition.

It is very desirable to separate the roof water from the sewage, if it can be done at a reasonable expense, and to dispose of the roof water by discharging it into a natural water course.

It is necessary, in the opinion of the Board, that some action be taken, without unnecessary delay, to effectually purify the sewage of the hospital; and the proposed plans, if carried out, will effect the necessary improvement in the method of disposing of the sewage.

GARDNER. An application was received, Nov. 24, 1899, from the sewer commissioners of Gardner for advice in relation to the plans for sewage disposal outlined in the following statement: —

The town wishes to provide an outlet for a part of the town. This section is provided for by the system of 1889, and is known in the report of W. E. McClintock of that year as the Parker Street outlet. It is now desired to extend this proposed outlet sewer to such a point as will make it possible to treat the entire sewage of the town at a common point. By surveys it has been found that such a point can be reached by extending the present sewer from the present filter area through Broadway and private land to a point near Parker Street, where the Otter River crosses said street. This sewer will also take the sewage of South Gardner. The Parker Street district will be conducted to this point by a sewer through private land and Parker Street.

The land proposed to be taken for treatment area lies a few feet above the river. It has an area of from twelve to fifteen acres. This area can be increased by using the low river bottom or extending into the woods towards the present filter area. The land rises with a very gentle slope from the river. This area would be levelled into beds. There is no proper filtering material in the area, but on the opposite side of the Otter River and within the town of Templeton are large gravel banks of a very superior filtering material; it is proposed to use this material to build the beds. It is intended only to build for the Parker Street outlet at present, but to be able to extend the main outlet to this point when South Gardner sewers are built, or the present area becomes too small to treat the sewage of that part of the town now draining to that point.

The Board replied to this application as follows: —

JAN. 5, 1900.

The Board has caused the location of the proposed new filter beds and the material of which it is proposed to construct them to be examined by one of its engineers, and has considered the proposed plans and the results of observations upon the operation of the present disposal works. These works receive the sewage from the present sewerage system in the central part of the town; and, while the filters are well constructed, they are entirely inadequate for the purification of the sewage discharged upon them, and large quantities of sewage are discharged untreated into Pond Brook, near the filter beds, which is badly polluted thereby.

In the opinion of the Board the present sewage-disposal works are inadequate for the purification of the sewage now conveyed to them, and adequate means of purifying all of this sewage should be provided without delay.

By your present plan it is intended to build at the present time a system of sewerage for the Parker Street district and filter beds for the disposal of the sewage of this district; and you have chosen a filtration area so located that the sewage from the present sewers and from South Gardner, when sewers are built in the latter village, can be conveyed to the same filtration area, and all of the sewage of the town purified at one place. The area selected for the disposal of the sewage is in a remote part of the town, and its use for this purpose is not likely to be objectionable. The land is not adapted to the purification of sewage by intermittent filtration, but suitable soil is found on the opposite side of the Otter River in the town of Templeton, and you propose to take gravel and sand from the latter region and convey it across the Otter River for the construction of the filter beds. The plan, so far as can be judged from the outlines submitted, is, in the opinion of the Board, a practicable and an appropriate one for the purification of the sewage of the thickly settled portions of the town of Gardner which are at present provided with sewers or likely to require sewers, for many years in the future, and there does not appear to be any area containing soil suitable for this purpose which can be utilized for the disposal of all of the sewage of Gardner at less expense than the one selected.

When you have prepared the necessary detailed plans that will precede the construction of the works, the Board will advise you concerning them, if you so request.

HAVERHILL. An application was received from the mayor of Haverhill, June 9, 1899, for the advice of the Board with reference to proposed plans for the disposal of sewage from certain districts in that city. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, on June 9, 1899, an application for advice relative to the sewerage of two districts in the northerly and easterly portions of Haverhill, accompanied by plans and a report by the city engineer, describing proposed systems of sewerage for these districts.

One of the districts, known as the Dustin Square district, comprises the territory draining toward the Fishing River and toward Little River below the Fishing River, the most thickly settled portion of which at the present time is in the region of Dustin Square, where no sewers have yet been provided. The plan submitted shows a proposed main sewer for this district which will begin at the upper end of the present sewer in Hilldale Avenue at the corner of Lafayette Street, and extend up the valley of the Little River on the westerly side of the stream nearly to the Hilldale cemetery, and then, crossing to the easterly side of the stream, will continue up the valley of Little River and of its tributary the Fishing River nearly to the outlet of Kenoza Lake. It is proposed to construct the sewers in this district upon the so-called separate plan, excluding all surface water and ground water, so far as practicable, except from a short portion of the main sewer in Hilldale Avenue near its lower end, where surface water will be allowed to flow into the sewer.

The other district, known as the Kenoza Avenue district, comprises the westerly portion of the water-shed of Kenoza Lake and a portion of the water-shed of Lake Saltonstall. The plan submitted shows a main sewer for this district, beginning at the upper end of the present sewer in Mill Street near Summer Street, and extending through Mill Street and around the easterly end of Lake Saltonstall, and thence through the divide between Lake Saltonstall and Lake Kenoza, in private land and land owned by the city of Haverhill to Kenoza Avenue, through which it will pass to the Newton road. It is possible to extend this sewer around the base of the hill between the Newton road and the stream which forms the outlet of Lake Kenoza to Gile Street, if necessary in the future. It is proposed to construct all sewers within the water-shed of Lake Kenoza upon the so-called separate plan; but within the water-shed of Lake Saltonstall it is proposed to receive a portion of the surface water into the main sewer, and allow the remainder to flow into the lake without entering the sewer. Below the outlet of Lake Saltonstall it is proposed to construct the sewers on the combined plan.

The Board has caused the locality to be examined by its engineer, and has carefully considered the plans and other information submitted.

In the Dustin Square district, so called, the most serious need of sewerage at the present time is in the region immediately about Dustin Square; but in designing a sewer for this district the probable future needs of other territory in this region has properly been taken into consideration, and the plans submitted provide for the disposal of the sewage of such territory in the valley of Fishing River and in the valley of Little River below the Fishing River as seem likely to require sewerage in the future.

It is very important, in the opinion of the Board, to prevent the pollution of any of the streams in this territory by sewage, and the circumstances are such that it will be much more economical and satisfactory for the city to adopt a separate system of sewerage in this district than to attempt to remove both sewage and storm water in the same pipes. The plan submitted provides for keeping all storm water out of the proposed sewers above Hilldale Avenue, and it is proposed also to construct underdrains beneath the sewers wherever necessary to remove ground water. If the plan is carried out completely, the proposed sewer will, in the opinion of the Board, provide satisfactorily for the removal of all of the sewage of the district which it is designed to serve. The quantity of sewage flowing in the main sewer in the beginning may not be large enough to produce sufficient velocity in the proposed siphon under the Little River to keep deposits from forming, and flushing will probably be necessary; nevertheless, the proposed method of crossing the river appears to be the best that it is practicable to adopt.

The Hilldale Avenue sewer, into which it is proposed to discharge the sewage, is capable of conveying all of the ordinary flow of sewage to the Merrimack River; but in times of heavy storms a portion of the mingled sewage and storm water from this sewer will be discharged into Little River at two points in the densely populated part of the city. The channel of the river is of such a character that matters floating upon or in suspension in the water tend to collect in places along its bottom and sides, and this stream is liable to be offensive during the warmer portion of the year, unless all sewage and other polluting matters are kept out of it. If this is not practicable, its condition should be improved as much as possible, to prevent polluting matters from collecting on its bottom and sides.

The Board has carefully considered the plan for disposing of the sewage of the westerly portion of the water-shed of Lake Kenoza, known as the Kenoza Avenue system, together with various other plans suggested, and concludes that the plan submitted has advantages which make it the best one to adopt for the disposal of the sewage of this territory. The plan provides for the construction of the sewers in the Kenoza Lake water-shed upon the so-called separate plan, though it is proposed in the beginning to discharge the underdrains temporarily into the main sewer. It is suggested by your engineer that a storm-water sewer is needed in this district, and that such a sewer would naturally be discharged into the stream below the outlet of Lake Kenoza, and that the underdrains could subsequently be connected with this sewer when constructed. It is desirable that some provision for removing the storm water as well as the sewage from this territory be made as soon as practicable, and it will be best to dispose of the underdrainage in connection with the storm water. There is danger that, if underdrains are discharged into the sewers for the collection of house sewage, the mingling of sewage and underdrainage water may produce conditions favorable to the growth of some form of fungus in the sewer, which may interfere greatly with the flow of the sewage. The Board would therefore advise that the underdrainage water be kept out of the sewers for house sewage, and that a storm-water sewer be constructed to remove the storm water and drainage from the thickly settled portion of the district for which sewerage is now to be provided.

The proposed main sewer of the Kenoza Avenue system passes through the water-shed of Lake Saltonstall, and you ask to be advised whether the adoption of the proposed system will make it necessary to abandon the use of Lake Saltonstall as a source of water supply. If the lake is to be continued as a source of water supply, its pollution should be prevented, and all sewage and drainage and all storm water collected by any sewers or drains within the district should be kept out of the lake. Analyses of the water of the lake show that it already receives, directly or indirectly, a considerable quantity of sewage from houses on its water-shed; and the proposed sewer, which would provide for the removal of the sewage and a portion of the storm water from the water-shed, would have a tendency to improve the quality of the water of the lake, but would reduce its yield. The source is a small one, and not needed at the present time for the supply of the city, since by the construction of the new works at Millvale an ample supply has been secured for many years in the future without the use of this lake; and, on the whole, the source does not seem of sufficient value, in the opinion of the Board, to warrant the expense which would be necessary to keep it in suitable condition for the supply of the city.

The proposed main sewer around Lake Saltonstall will be laid close to the shore of the lake, and at a level considerably below the surface of the water; and it will be necessary to construct this sewer with special care, to prevent an excessive leakage of water into it, and it may be desirable to use iron pipe with lead joints.

The proposed method of disposing of the sewage of the Kenoza Avenue district by discharging it into the Merrimack River is the best that it is practicable to adopt. The outlet will be in the vicinity of a large population, and it is desirable that the dry-weather flow of sewage be discharged well out in the stream, to prevent fouling the bank of the river. The mingled sewage and storm water during heavy storms may probably be discharged close to the bank of the river without becoming objectionable. It is understood that for the present the sewage will be discharged into an existing sewer in Mill Street at the corner of Summer Street, but that this sewer will be relaid whenever it shall become necessary.

HOPEDALE (the Draper Company). An application was received, Oct. 7, 1899, from the Draper Company of Hopedale, for the advice of the Board relative to the disposal of the sewage from its mills and several houses in the village. To this application the Board replied as follows: —

DEC. 7, 1899.

The State Board of Health received from you, on October 7, a notice of your intention to introduce a system of sewage disposal for the purification of the sewage from your works at Hopedale and from a portion of the village, accompanied by plans and a description of the proposed works prepared by your engineer.

The plans provide for the collection of the sewage in a reservoir of sufficient capacity to hold the estimated night flow of sewage, from which the sewage is to be pumped in the daytime to filter beds situated on land near the westerly bank of Mill River, south of Main Street. It is stated by your engineer that the present flow of sewage is about 110,000 gallons in twenty-four hours, and the proposed plan of disposing of the sewage is described as follows: —

The proposed plan of sewage disposal involves septic tank treatment followed by filtration upon two sand filter beds, aggregating 1.3 acres in area.

The proposed septic tank, built of Portland cement concrete, has a capacity, in 8 feet depth, of 50,000 gallons, in two compartments, each 35 feet long by 12 feet wide by approximately 10 feet deep, connected with each other by a 10-inch overflow and with the river by a 10-inch vitrified Akron pipe, discharging at a point 6 inches above high-water mark.

All pumping is to be done during the working day, and it is proposed to keep the tank as nearly full as possible throughout the day until just before shutting down the works at night, when the tank is to be pumped down about 8 feet (to a point about 2½ feet from its bottom), thus leaving a storage capacity of 50,000 gallons for the night flow. The present night flow is from 40,000 to 45,000 gallons. . . .

The two filter beds, aggregating 1.3 acres in area, will be used alternately, morning and afternoon, the gates being operated by hand. The filter beds are located upon high ground, about three-fourths of a mile from the town. It is proposed to strip the loam and subsoil to a depth of approximately 18 inches to 2 feet from the surface in the preparation of the beds, in order to get into a free, coarse sand. In the various test pits dug over this area and shown upon the plan no strata of impervious or compact material have been encountered.

Subsequently a further communication was received, modifying portions of the plans to allow for an anticipated increase in the quantity of sewage. In this communication it is stated that the diameter of the force main will be increased from 8 to 10 inches; the septic tank will probably be increased to 40 feet in length, instead of 35 feet; and that an additional tank in extension of the first, or circular in form, of a capacity of approximately 70,000 gallons, for a pump well, may also be built. If the pump well is not built, the increase in the size of the tank or reservoir will allow for the expected increase in the night flow of sewage, so that the pumping can still be done in the daytime. No plans for enlarging the filtration area have been presented, and, excepting that the size of the force main will be increased, it does not appear that the changes suggested have been definitely adopted.

The Board has considered the plans and information submitted, and has caused the locality to be examined by its engineer and samples of the soil of the proposed filter beds to be analyzed.

The proposed tank into which the sewage is to be collected is expected to allow for the decomposition and putrefaction of the sewage, so that the solid matters may be broken up and be drawn out of the tank with the sewage, and thus make it practicable to purify the sewage more readily, and avoid the necessity of providing for the disposing of sludge. It is evident, from the experiments made by the Board and the results obtained in actual practice where sewage is stored in a tank or reservoir like that proposed in the plan submitted, that the solid matters in the sewage will become broken up to a considerable extent in the tank, and be more readily disposed of on the filters; but a considerable quantity of heavier matters will accumulate in the proposed tank with the conditions under which it is proposed to operate it, and these matters will have to be removed from time to time. If they are discharged on beds prepared for the purpose and quickly mixed with earth and carted away, the mixture can be disposed of effectively, but this method of removing the sludge is likely to produce bad odors, and should not be carried on in the neighborhood of the factory or dwelling houses. The heavier matters that accumulate in the tank can be pumped to the filtration area with the sewage and disposed of without special difficulty or objection, if suitable provision is made therefor.

The proposed filtration area is nearer the thickly settled portion of the town than is desirable; but, if a sufficient area of filters is provided and they are properly cared for, the disposal of the sewage at this place is not likely to be objectionable to those living in the village. The material in some portions of the area is coarse and porous, but in other portions it is somewhat fine; nevertheless, if the soil and subsoil are removed from the filter beds, and underdrainage is provided where necessary, a sufficient area of filter beds of suitable depth can be prepared upon this area to purify all of the sewage discharged from the sewers at present, or even if a considerable enlargement is made in the present works. The area of filters which it is proposed to prepare in the beginning will, however, be no more than sufficient for present needs, and may even be found inadequate, if the quantity of sewage is larger in the winter and spring of the year than it was found to be at the time the measurement of the flow was made.

In the opinion of the Board, it would be found of much advantage in disposing of the sewage to divide the area into a larger number of beds than two, the number you now propose, and very little advantage is likely to be gained by pumping the sewage during the entire day at the rate at which it flows into the tank.

The proposed overflow pipe from the tank or reservoir through which sewage may flow into the river when the tank is full is a desirable precaution in case of accident to pumping machinery or force main, but sewage should not be allowed to discharge through this overflow except in such an emergency.

The plan in general, with the modifications suggested, is, in the opinion of the Board, an appropriate one for the purification of the sewage from your works at Hopedale and from the houses which are connected with the sewers at present, and the works can be enlarged if necessary, so as to dispose of a considerably greater quantity of sewage.

LONGMEADOW. An application was received, Aug. 24, 1899, from the selectmen of Longmeadow, for the advice of the Board relative to the disposal of the sewage of a portion of that town. The Board replied to this application as follows: —

Nov. 3, 1899.

The State Board of Health has considered your application for advice with reference to a proposed additional sewerage system in the town of Longmeadow, and the plans and information submitted therewith, and has caused the territory to be examined by one of its engineers.

It appears that the system now proposed is intended to provide for the sewerage of the portion of the town in the vicinity of the common south of the system built last year; and you state that you propose to dispose of the sewage upon a tract of about eleven acres of land belonging to Everett B. Allen, which is located on the southerly side of Longmeadow Brook, near the place where it crosses the Bark Haul Road, so called. You further state: —

It is proposed, as soon as the exigencies of the case require, to construct artificial filter beds on this tract of land; but, with the very small amounts of sewage that will require to be disposed of for a year or more, it is believed that with a very small filter bed or by broad irrigation all the sewage that we shall have can be effectively disposed of.

From such information as is available it appears that the proposed system will provide sewerage for a population of about 250, and that the aggregate length of sewers will be about 1½ miles.

The examinations made under the direction of the Board show that the proposed sewage-disposal area would have the advantage that it is located a long distance from any dwelling house; but the soil in test pits dug in various parts of the area is found to be composed of loam at the surface, with clay underneath, so that it is entirely unsuitable for the purification of sewage, and the Board is of the opinion that the disposal of sewage upon this land would create a nuisance, unless filter beds of suitable material for the purification of the sewage are provided in the beginning.

There appears to be suitable soil in the region about the tract of land referred to which might be used for the construction of artificial filters upon this land; but the cost of constructing filters there would be large, as compared with the cost of suitable filters at some place where the soil is naturally adapted for the purification of sewage. Under the circumstances, the Board does not at present advise the construction of artificial filters at the place selected by you for the purification of sewage, but would advise a further and thorough investigation, to learn whether it may not be practicable to secure a suitable area of land upon which filter beds can be prepared, at less cost than upon the land now proposed.

The Board will assist you in these investigations, if you desire, by making examinations of samples of soil, and will give you further advice as to the disposal of the sewage when you have the results of further investigations to present.

LUDLOW. An application was received, April 10, 1899, from the selectmen of Ludlow, with reference to the discharge of sewage from Joy Street in that town into the Chicopee River. The Board replied to this application as follows: —

MAY 5, 1899.

The Board has caused the locality to be examined by one of its engineers, and has considered the proposed plan for the disposal of the sewage. It appears that the proposed sewer is intended to provide for the disposal of the house sewage from several houses on Joy Street west of North Street, in the village of Ludlow. The proposed point of discharge, as indicated by you, is less than 150 feet down stream from the point at which it is proposed to discharge the sewers of the Ludlow Manufacturing Company.

The proposed method of disposing of the sewage by discharging it in a crude state into the Chicopee River appears to the Board to be permissible under the present conditions, though the time may come when it will be found necessary or desirable to divert all sewage, both from this sewer and from the sewer of the Ludlow Manufacturing Company, from the river.

It is important, in discharging the sewage into the river, that the outlet pipe be carried well out into the stream, so as to discharge the sewage at a considerable distance from the shore, and thus avoid, so far as possible, the danger of floating matters from the sewage collecting upon the shores in the vicinity of the outlet.

It is also important that all storm water, and, so far as possible, ground water, be kept out of the sewer, since the admission of storm water to the sewer would increase the cost of disposing of the sewage in the future, if it shall become desirable to divert it from the river.

MIDDLEBOROUGH. An application was received, May 1, 1899, from the selectmen of Middleborough, for the advice of the Board with reference to the disposal of the sewage of the town. The Board replied to this application as follows: —

JUNE 14, 1899.

The State Board of Health received from you, on May 1, 1899, an application for advice with reference to a proposed system of sewerage and sewage disposal for the town of Middleborough, accompanied by a report by Freeman C. Coffin, civil engineer, and plans of the proposed system.

The plans, in general, provide for two main sewers, one on the easterly and the other on the westerly side of the main village, to collect the sewage from existing sewers and from the thickly settled portions of the town which seem likely to need sewerage facilities in the future, and convey it by gravity to a proposed filtration area located in the vicinity of the Plymouth & Middleborough Railroad, north-east of North and Everett streets, and between those streets and the Nemasket River, where it is proposed to purify the sewage by intermittent filtration, and to discharge the effluent into the river.

The sewage from a small portion of the village in the vicinity of the river near the Star Mills and Water Street cannot be discharged into the proposed system by gravity, and the plan provides for collecting the sewage from this portion of the village and pumping it into the easterly main sewer, which will pass near by, but at a higher elevation, whenever sewerage facilities shall be required in this district.

The existing sewers, which at present discharge their contents into the Nemasket River, receive both sewage and storm water, so that the flow is very variable. Measurements made by your engineer indicate that the flow in dry weather is probably less than 250,000 gallons per day at the present time, while at times of rainfall the flow has been found to exceed 7,000,000 gallons per day. The plans submitted provide for the separation of storm water from the sewage by diverting the storm water from the existing sewers and discharging it into natural drainage channels, or into the outlets of existing sewers below the point where sewage will be intercepted and below all house connections.

The sewage as it arrives at the filtration area will flow into a distributing tank which is to have a capacity of about 12,000 gallons, from which the sewage is to be discharged automatically onto filter beds and trenches which it is proposed to prepare upon the filtration area.

The westerly main sewer is designed to take sewage principally from the territory west of the railroad, in which no sewers have as yet been constructed. When this sewer is built, it will convey sewage to the same filtration area through a sewer to be laid in the vicinity of the railroad.

The Board has considered your application and the plans and report submitted, and has caused the locality to be examined by its engineer and samples of soil from test pits at the proposed filtration area to be analyzed.

It is not practicable to convey all of the mingled sewage and storm water flowing from the present sewers at times of storms and winter thaws to the filtration area and purify it, so that, unless the sewage is separated from the storm water, it will be necessary at such times to discharge large quantities of the mingled sewage and storm water into the Nemasket River, or some of its tributaries, through overflows. These overflows would have to be so arranged that sewage would not be discharged into the river except at times of rain or thaw, and it would necessarily be impracticable to avoid conveying to the filtration area at such times much larger quantities of sewage than would flow in the sewers at any time if storm water is excluded. It would consequently be necessary to provide a much larger area of filter beds than would be required to properly purify the sewage if the storm water should be wholly separated from the sewage in the beginning. The estimates of cost submitted by your engineer show that, to separate the sewage wholly from the storm water in the beginning and convey the sewage to the filtration area, while the storm water is allowed to flow through natural channels or otherwise into the Nemasket River, would not very materially increase the cost of the works; and, under the circumstances, the Board is of the opinion that it is decidedly for the best interests of the town to separate the sewage from the storm water in the beginning, and to prevent further pollution of the Nemasket River by crude sewage.

Examinations of the soil of the proposed filtration area show that it is well adapted to the purification of sewage by intermittent filtration, and the area is of ample size to provide for the disposal of all of the sewage of the present population of Middleborough and to allow for a considerable increase in the quantity of sewage in the future. The plan for disposing of the sewage upon the proposed filtration area provides for the preparation of a part of the area in the form of filter beds, from which all of the soil and subsoil will be removed down to coarse gravel, and for the preparation of other portions of the area where circumstances make it desirable in the form of trenches, which will be excavated to the coarse gravel beneath the subsoil and refilled with suitable filtering material. Two sets of filter beds and trenches are shown upon the plans submitted: one on the easterly side of the area, consisting of filter beds A, B, C, D, E and F, and trenches contiguous to beds C and F; and the other consisting of filter beds G, H, I and J, with trenches contiguous to those beds on their westerly side. The Board would advise the construction in the beginning of beds G, H, I and J, and the construction of the easterly trenches shown upon the plan submitted and about half of the westerly trenches contiguous to the filter beds. This area of filters will be ample for the present needs of the town, and will not require enlargement until the quantity of sewage becomes considerably greater than at present, if storm water is kept out of the sewers.

The plans, as a whole, with the modifications suggested, are, in the opinion of the Board, well adapted to the collection and purification of the sewage of the thickly settled portions of Middleborough, in which sewers have already been built or in which sewerage facilities seem likely to be required in the future, and the prevention of the pollution of the Nemasket River.

By excluding storm water wholly from the sewers which receive sewage and constructing the filter beds as herein advised, and by providing a wide fringe of vegetation along the sides of the filtration area, as suggested by your engineer, all reasonable objections to the use of this area for the disposal of sewage can, in the opinion of the Board, be avoided if the beds are properly managed.

In response to the request contained in your application, received May 15, 1899, for the approval by the Board of the purchase or taking of certain lands for sewage-disposal purposes, described in the application and shown upon a plan submitted therewith, the State Board of Health gave notice that a public hearing on this matter would be given at its office on June 1, 1899, under the provision of chapter 50, section 1, of the Public Statutes, as amended by chapter 124 of the Acts of 1890. After this hearing the State Board of Health voted to approve the purchase or taking by the town of Middleborough for the purification and disposal of sewage of two lots of land situated on the north-east side of North and Everett streets and between those streets and the Nemasket River, as shown upon a plan submitted by the authorities of Middleborough on May 15, 1899, entitled "Plan of land in Middleborough, Mass., belonging to Job Braley, to be taken for filtration purposes for Middleborough sewerage system. Chester E. Weston, surveyor, May, 1899. Scale, 1 inch=80 feet," the said land being bounded, measured and described as follows: —

Description of Land in Middleborough, Mass., belonging to Job Braley, to be taken for Filtration Purposes for Middleborough Sewerage System.

Two lots of land situated in Middleborough, in the county of Plymouth and Commonwealth of Massachusetts, on the north-east side of North and Everett streets; said lots are bounded and described as follows: —

Number one: Beginning at a stone bound on the north-east side of Everett Street, a corner of land owned by George R. Sampson, thence in said Sampson's line, north 87° 30′ east, six hundred and fifty (650) feet to a stone bound; thence same course about twenty-seven (27) feet to the Nemasket River; thence in the line of said river upstream to the line of land of the Plymouth & Middleborough Railroad; thence in line of the northerly side of said railroad land in a westerly direction, to a stone bound in line of said North Street; thence in line of said street, north 21° 23′ west, two hundred eight and seven-tenths (208.7) feet to a stone bound; thence in line of said Everett Street, north 15° 54′ west, nine hundred ninety-one and six-tenths (991.6) feet to a stone bound; thence in line of said street, north 14° 20′ west, three hundred fifty-three (353) feet to the bound first mentioned; containing twenty-seven and one-half (27½) acres.

Number two: Beginning at a stone on the north-easterly side of North Street, thence north 33° 34′ east, in line of land of Job Braley, eight hundred twenty-two and seven-tenths (822.7) feet to a stone bound in the line of the southerly side of the said Plymouth & Middleborough Railroad; thence in said railroad line, south 80° 8′ east, three hundred and eighty-one (381) feet to the Nemasket River; thence in line of said river upstream to the land owned by the heirs of Philander Washburn, deceased, to a stone bound; thence in line of said Washburn land, south 27° 26′ west, two hundred and forty-three (243) feet to a stone bound; thence in line of said Braley's land, north 57° 9′ west, two hundred and ten (210) feet to a stone bound; thence north 68° 44′ west, one hundred thirty-five and thirty-five one-hundredths (135.35) feet to a stone bound; thence south 33° 34′ west, three hundred thirty-four and seven-tenths (334.7) feet to a stone bound in line of said North Street; thence in line of said street, north 68° 5′ west, thirty and sixty-five one-hundredths (30.65) feet to the bound first mentioned; containing four (4) acres.

North Adams. An application was received, July 5, 1899, from the commissioner of public works of North Adams, for the advice of the Board with reference to a proposed plan for diverting the sewage from a portion of State Street, which now enters the south branch of the Hoosac River, and conveying it by means of an inverted siphon beneath the river to the general sewerage system of the city. The Board replied to this application as follows: —

Sept. 8, 1899.

The State Board of Health received from you, on July 5, 1899, an application for advice with reference to a proposed plan for diverting the sewage from an existing sewer in State Street, in North Adams, through which sewage now flows into the southerly branch of the Hoosac River on the westerly side of the stream, and conveying it by means of inverted siphons beneath the river to an existing sewer in State Street on the easterly side of the stream, which is a part of the general sewerage system of the city.

The plan submitted provides for receiving the sewage from the State Street sewer on the westerly side of the river in a man-hole which will also serve as a catch-basin from which two inverted siphons of iron pipe will be laid to the State Street sewer on the easterly side of the river. Each of these siphons at the point of beginning will have a diameter of 14 inches, according to the plan submitted, which quickly reduces to 12 inches, and the sewage will be taken from a level considerably below the surface of the sewage in the man-hole or catch-basin, but above the bottom, so as to avoid taking floating matters or sediment into the siphons. The inlet to one siphon is placed at a somewhat higher level than the other. Between this man-hole, or catch-basin, and the westerly side of the river another man-hole is placed, surrounding the principal bend in the iron siphon pipes, and provision is made for opening the pipes in this man-hole for the purpose of cleaning them out in case they should become stopped up. A connection with the water pipes of the city is also shown just above this man-hole, and provision is made for the necessary gates, so that the available pressure of the city water works can be used in flushing out the siphons if necessary. On the easterly side of the river the provisions for cleaning out the sewer in case of stoppage are the same as on the westerly side, excepting that there is no connection with the water main.

The Board has caused the locality in which it is proposed to construct the siphon to be examined by one of its engineers, and has carefully considered the plan submitted. It will be advisable to so arrange the pipes at the upper end of the siphon that the lower pipe will take the ordinary flow of sewage and the higher one not come into operation except at times of unusual flow, as otherwise more care might be necessary in keeping the pipes free from obstruction. With this modification the plan is, in the opinion of the Board, a satisfactory one for the purpose for which it is proposed.

NORTHAMPTON. Under the provisions of section 2 of chapter 354 of the Acts of 1888, the State Board of Health, on March 22, 1889, approved a system of sewage disposal, which had been proposed by the board of sewer commissioners of Northampton, with certain modifications and amendments, one of which required an extension of the outlet of the system within ten years from the date of the reply of the Board, unless the time should subsequently be extended by the Board.

On March 9, 1899, the Board therefore sent a communication to the mayor of Northampton, calling attention to the provisions of this act and to the reply of the State Board of Health, dated March 22, 1889, a copy of which was enclosed in this communication.

PITTSFIELD. A general plan for a system of sewerage and sewage disposal for the city of Pittsfield was presented to the Board, May 11, 1891, under the authority of chapter 357 of the Acts of 1890, and was approved by the State Board of Health, May 12, 1891, with the following provisions: —

This plan provides for the permanent disposition of the sewage by intermittent filtration through the areas of upland indicated, and allows the temporary discharge of the sewage into the river at a given point during the construction of the work; but such discharge is not to continue after June 1, 1900.

An order was adopted by the city authorities of Pittsfield, June 5, 1899, providing for the appointment of a special committee to petition the State Board of Health for an extension of time in which to take the sewage of the city out of the Housatonic River.

After having received this petition, the Board, in compliance therewith, and after due notice, held a hearing at the court house in Pittsfield, Sept. 14, 1899, at which parties interested were present from Pittsfield, and from other towns on the Housatonic River, below Pittsfield.

The Board took the subject into consideration, and answered the petition of the special committee of Pittsfield as follows: —

Oct. 6, 1899.

To the Special Committee of the City of Pittsfield on Extension of Time for the Removal of the Sewage from the Housatonic River.

Gentlemen: — In response to the petition of the city of Pittsfield for an extension of time for the removal of the sewage of the city from the Housatonic River, beyond June 1, 1900, the State Board of Health, at a meeting held at its office, upon Oct. 5, 1899, took the following action: —

Voted, That further action of the State Board of Health in the matter of the Pittsfield sewage disposal be postponed till June 1, 1900, when, in the opinion of the Board, it might then be proper to extend the time for the completion of the sewage-disposal works until Oct. 1, 1901, provided the city of Pittsfield shall have meanwhile shown due diligence in causing the necessary surveys to be made and in doing such work as is practicable for carrying out the work of sewage disposal in accordance with the plan approved by the State Board of Health in 1891.

Somerville. An application was received, July 18, 1899, from the mayor of Somerville, for the advice of the Board relative to a proposed system of drainage for a district in that city, and subsequently the approval of the Board was requested of a plan for discharging sewage and storm water into Miller's River. The correspondence and final reply of the Board were as follows: —

Aug. 11, 1899.

Hon. George O. Proctor, *Mayor of Somerville, Mass.*

Dear Sir: — Your application for advice, under the authority of chapter 375 of the Acts of 1888, with reference to a proposed system of drainage for the city of Somerville, has been considered by the State Board of Health, and the Board has concluded that, in view of the provisions of chapter 275 of the Acts of the present year, the Board is required to give a hearing before taking any action with reference to advising the city or approving any plan as to the disposal of its drainage. The Board has therefore taken no further action in the matter, but a hearing will be given as promptly as possible, upon receipt of a request and plans from the city of Somerville, under the provisions of section 2 of chapter 275 of the Acts of 1899.

The plans submitted with your present application are returned herewith.

SEPT. 25, 1899.

In accordance with the offer of the city of Somerville, made at a hearing before the State Board of Health, September 7, to furnish the Board with information that it might desire relative to the system of sewerage and drainage of the city of Somerville, and to the proposed plan to construct and maintain a drain which shall discharge into Miller's River, in order to dispose of any storm-water overflow from its main drain and common sewers, and of any surface water or any other waste water not polluted with the sewage, the Board would request that more definite information be furnished with reference to the points herein mentioned.

It appears, from information furnished by the city at the hearing referred to, that at the present time the sewage and storm water, which is not received into the metropolitan sewer in times of storm, flow to Charles River through a sewer in Somerville Avenue in Somerville and Bridge Street in Cambridge, but that the capacity of this sewer is overtaxed at times of heavy rain and sewage backs up into the cellars of several hundred houses in Somerville.

The plan submitted for the approval of the Board provides for a new sewer to be laid from the present sewer near the line between Cambridge and Somerville into Mill River; but the plans and information submitted do not make it clear to the Board that the proposed new sewer and outlet would relieve to a material extent the trouble which now occurs.

It also appears that it is proposed to construct a separate system of sewerage for a part of the territory which now delivers sewage and storm water into the Somerville main sewer, and that it is proposed to discharge the sewage into the metropolitan sewer, but the proposed extent of the separate system of sewerage is not defined. It further appears that, when the proposed separate system of sewerage is constructed, the buildings in the low districts are to be disconnected from the present main sewer and its tributaries, and connected with the separate system, but that all storm water and drainage will continue to flow into existing sewers tributary to the Somerville main sewer. Drains for receiving storm water only have apparently been constructed in parts of the district tributary to the Somerville Avenue main sewer, but these drains discharge into the main sewer, so that the water becomes mingled with sewage.

In considering the effect of the proposed outlet into Miller's River, the Board desires the following information: —

1. The limits of the area in which flooding occurs at times of heavy rain, under present conditions.

2. The general elevation of the ground in the various parts of the above area and the general elevation of the cellars of buildings in the area.

3. The extent of the area in which it is proposed to provide a separate system of sewerage, and the time when it is proposed to complete and begin the use of the separate system.

4. The proposed method of collecting and disposing of the storm water in the district in which it is proposed to provide a separate system of sewerage, and the proposed method of collecting and disposing of the sewage and storm water in the remaining portion of the district now tributary to the Somerville Avenue main sewer, in which sewers upon the separate plan will not be provided.

5. Profiles of the Somerville Avenue main sewer and its principal tributaries in the district now affected by flooding, and an estimate of the amount of rain that must enter the sewer to cause an overflow into Miller's River.

6. Such information as you can give as to the time required for sewage that may be discharged in the vicinity of the proposed sewer outlet, at the upper end of Miller's River, to be carried by the tide into the main current of Charles River.

It appears that much work has already been done by the city of Somerville in separating the sewage from the storm water in the district in question; and the Board desires to be informed whether it is not feasible for the city of Somerville to carry out further the plan for separating the sewage of the district in question from the storm water, so that storm water unpolluted by sewage can be discharged into Miller's River, and at the same time the flooding of the low districts be prevented as far as it is practicable to prevent it.

Nov. 17, 1899.

The State Board of Health received from you, on Aug. 24, 1899, the following application with reference to a storm-water overflow from the main drain and common sewers of the city of Somerville: —

Acting under the authority of chapter 275 of the Acts of 1899 of the Legislature of said Commonwealth, the city of Somerville, a municipal corporation within the said Commonwealth, hereby gives notice of its intention to construct and maintain a drain which shall discharge in Miller's River, in order to dispose of any storm-water overflow from its main drain and common sewers, and of any surface water or any other waste water not polluted with sewage, and herewith submits a plan thereof for your approval.

The application was accompanied by a plan showing the district drained by the Somerville Avenue main sewer at the place at which the proposed overflow is to be located, and by a plan showing the proposed storm-water overflow drain, beginning at Somerville Avenue main sewer near the line between Cambridge and Somerville, and ending at low-water mark at the head of Miller's River, at the boundary line between the cities of Cambridge and Somerville.

Upon receipt of the application the State Board of Health gave notice that a hearing would be given at its office on Thursday, Sept. 7, 1899, with reference to the proposed plan. At this hearing the authorities of the city of Somerville offered to furnish the State Board of Health with further information that it might desire relative to the system of sewerage and drainage of the city of Somerville, and to the proposed overflow from its main drain and common sewers; and in response to a request of the Board of September 27 you presented further information as to the matters referred to, in a letter and in a reply of your engineer to questions submitted by the Board.

Your plan for relief from the trouble from flooding of cellars is stated in a general way by your engineer as follows: —

One scheme for partial relief involves an outlet into Miller's River on the north side of the Boston & Lowell Railroad at the East Cambridge line. The outlet would be protected by automatic tide gates, so arranged as to exclude the tide as long as the water within the sewer was lower than the elevation of the water outside. . . .

Records of the United States government show that in a period of eighteen years the number of tides reaching grade 13 was 41 and the average rise of the tide during the same period was 10½ feet above mean low water.

These figures demonstrate that there could be a theoretical possibility of cellars at grade 13 being flooded about twice a year, on an average, even after the construction of the relief drains. It would, of course, be necessary, in order to produce this flooding, that there should be rain during or immediately preceding the brief period of excessive tidal height. But another means of preventing this flooding has been considered and adopted in conjunction with the foregoing scheme.

The sewers of Somerville are designed on what is known as the "combined system," in which the sewage from the houses and the rainfall from the entire area are both dealt with by a single underground channel. The capacity of these channels is practically determined, not by the comparatively insignificant volume of sewage, but the maximum flow of rainfall estimated to reach them at a given time. The sewers in the Somerville Avenue district are far from being large enough to deal with this estimated volume under the normal head in the respective sewers, but, as has already been stated, the discharge through them can be, and is, largely increased by working them under pressure.

The only means by which this could be taken advantage of, for future drainage, without subjecting adjacent cellars to the present risk of flooding, is to cut off the house drains from the existing sewers, use the latter for storm water only, and construct a new system of sewers, of greatly reduced size, to receive the house sewage (not including roof water) through new connections between them and the cut-off house drains.

This system provides for pipe sewers in each street; in many cases two sewers, one under each sidewalk, are included, so as to avoid the numerous house drain crossings under the larger existing sewers.

The alteration of the house drainage would in many cases be a distinct gain in a sanitary sense, as much of this work, in the older part of the city, was done before the adoption of the regulation now in force affecting this class of work.

A modification of this scheme, restricting the new "separate" sewers to the low-lying area in which trouble from flooding is experienced, has been adopted, and about 3½ miles will be completed in 1899. When wholly completed, it provides for all parts of the area in which low cellars exist; the house sewage from the remainder of the area, the high portion, would continue to be dealt with by the existing combined sewers.

The information furnished by you further shows that the area affected by flooding includes about 255 acres, and that within this area there are about 900 cellars that are subject to flooding under present conditions, some of them being below the level of an ordinary high tide. It is also stated in the communication of your engineer that no accurate estimate of the amount of rainfall required to cause an overflow into Miller's River can be determined under all the varying circumstances and conditions encountered within the area, but that the discharge in the Somerville Avenue main sewer would increase to about four times the present dry-weather flow before an overflow would take place.

With regard to the time required for the sewage that would be discharged by the proposed plan in the vicinity of the proposed new outlet at the upper end of Miller's River to be carried by the tide to the main current of Charles River, it is stated in the communication of your engineer that the discharge from the overflow would reach Charles River at different intervals of time, according to the different conditions of tide and the time of discharging, any floating matter being carried to Charles River on the next return tide out of Miller's River.

The Board has carefully considered the plans and information submitted, and has caused an examination to be made of the proposed outlet into Miller's River and tests of the movements of the water in this estuary to be made by means of floats. It is evident that, as stated by your engineer, the proposed overflow into Miller's River will in itself be only a partial relief for the flooding of cellars in Somerville, since from the information submitted it appears that some of these cellars are below the level of an ordinary high tide and many more below tides that frequently occur.

While the proposed new outlet would reduce somewhat the height to which water in the sewers would rise, and consequently would reduce somewhat the number of cellars that would be affected by flooding and the depth to which they would be flooded, it appears that you do not expect full relief until some indefinite time in the future, when the separate system for the low area may be completed.

At the present time, the dry-weather flow of sewage is taken into the metropolitan sewer; but when the flow is increased by rain or melting snow to about three times the dry-weather flow, the flow into the metropolitan sewer is shut off, and the mingled sewage and storm water finds an outlet through the present sewer into Charles River at Craigie bridge. By the proposed plan it appears from the information furnished by you that an overflow will take place into Miller's River, when the quantity of mingled sewage and storm water amounts to about four times the present dry-weather flow of sewage. Judging from the information available as to the quantity of this dry-weather flow and from the size of the water-shed, it appears that the dry-weather flow would be increased to four times its present quantity by a rainfall of about .014 of an inch per hour reaching the sewers; so that it is evident that the overflow would come into operation in nearly every shower or thaw that will cause water to flow in the street gutters, at which times the street washings and nearly all of the sewage of the Somerville Avenue sewer would be flowing into Miller's River.

There is no stream flowing into the upper end of Miller's River to maintain a current through it, and tests made by the Board by means of floats show that floating matters deposited in the water in the vicinity of the upper end of Miller's River are likely to remain within the stream for three or four days and even longer. Under these conditions, if sewage is introduced the suspended organic matters will settle and collect on the sides and bottom of the river and will undoubtedly produce a nuisance, which must be avoided

It is highly important to prevent the flooding of cellars in the low districts of Somerville, and it appears to be entirely practicable to do this in nearly all cases by disconnecting the sewers from the Somerville Avenue sewer and connecting them directly with the metropolitan sewer, and if the storm water was separated wholly from the sewage it would be permissible to discharge this storm water into Miller's River; but the Board is of the opinion that the public health requires that sewage should be kept out of Miller's River, and that no sewage should be discharged into this estuary, at least above the Prison Point bridge. Furthermore, if the plan you propose should be carried out and a separate system of sewers constructed in the low districts discharging directly into the metropolitan sewer, and the present sewers be utilized to remove the storm water of the low districts, together with the mingled sewage and storm water of the high districts tributary to the Somerville Avenue sewer, this sewage would still be discharged into Miller's River, and such a method of disposing of any of the sewage of Somerville should, in the opinion of the Board, be avoided. This can be done by separating the storm water wholly from the sewage in a portion of the district and conveying this storm water unpolluted by sewage to Miller's River. By thus diverting a sufficient portion of the storm water from the present main sewer in Somerville Avenue to prevent its capacity from being overtaxed at times of storms, this sewer can be used to remove to Charles River the storm water which may be mingled with sewage from the remainder of the district; and, in the opinion of the Board, it is desirable that progress be continually made toward separating the sewage from the storm water and removing all of the sewage of this district directly into the metropolitan sewer, to the end that finally no sewage be discharged with the storm water into Charles River.

For the reasons given, the State Board of Health, acting under the authority of chapter 275 of the Acts of 1899 of the General Court of the Commonwealth, does not approve the plan presented by the city of Somerville for disposing of the storm-water overflow from its main drain and common sewers by discharging it into Miller's River.

SOUTHBRIDGE. An application was received, June 19, 1899, from the sewer commissioners of Southbridge, for the advice and approval of the Board of a system of sewerage and sewage disposal for that town. The Board replied to this application as follows: —

AUG. 4, 1899.

The State Board of Health received from you, on June 19, 1899, an application for the approval of a system of sewerage and sewage disposal for the town of Southbridge, said application being as follows: —

The town of Southbridge, by its sewer commissioners and in conformity to section 2 of an act authorizing the town of Southbridge to construct and maintain a system of sewage and sewage disposal, passed in the year 1899, respectfully petition your Honorable Board to approve of a system of sewerage adopted by the town at a meeting held June 29, 1898, with such modifications as may seem proper to your Honorable Board, a plan already being on file at your office.

Also, that said town may by its commissioners construct such part or parts of said system as are shown on the small plan, accompanying this petition, the proposed work being shown in green.

Also, that said town may construct such part or parts of a main sewer, leading to the disposal beds, and make such modifications in the same, as are shown on said small plan, and are marked in orange thereon.

Also, that said town may make, construct and use, on land already purchased, disposal beds for the purification and disposal of its sewage, as will more fully appear on the plan of proposed filter beds and description annexed hereto and made a part of this petition.

Also, the right to take, use or construct all ways or drains necessary to carry out the above proposed work, with such modifications or changes as may seem proper, when detail and working plans are made for the construction of the same.

The application was accompanied by a report and plan of a system of sewerage and sewage disposal, prepared by F. L. Fuller, C.E., of Boston, and adopted by the town of Southbridge at a town meeting held on June 29, 1898; and by two other plans, one showing the proposed modifications in the plan of sewerage adopted by the town on the above date, and the other showing a system of filter beds which it is proposed to construct on the northerly side of the Quinebaug River in the vicinity of the Saundersdale millpond and a short distance below the new Lensdale dam, so called.

The plan of sewerage and sewage disposal adopted by the town at its meeting on June 29, 1898, provides for a general system of sewerage for all of the thickly inhabited portions of the town of Southbridge, and for the disposal of the sewage, except from a small district near Saundersdale, upon filtration areas, one of which is located on the northerly side of the Quinebaug River in the vicinity of the Saundersdale millpond and a short distance below the new Lensdale dam, and the other in the vicinity of Dean Brook, a short distance further down stream. The small district near Saundersdale is provided for by a sewer in Main Street extending from a point a short distance east of the North Woodstock road to the Quinebaug River just below the bridge at Saundersdale, where it is proposed, apparently, to discharge the sewage directly into the river.

It is proposed in the beginning to construct filter beds on land owned by the town located on the northerly side of the Quinebaug River in the vicinity of the Saundersdale millpond, this land being included in the upper of the two filtration areas referred to above. The proposed system provides for sewers to receive sewage only, and it is proposed to keep storm water, and, so far as practicable, ground water, out of the sewers.

Several sewers have already been constructed in the town, and on one of the plans submitted with your application you indicate certain streets in which it is proposed to begin the construction of sewers. This plan also shows a modification in the line of the main sewer, whereby, instead of carrying the main sewer across the millpond above the Lensdale dam to the proposed filtration area on the northerly side of the river in the vicinity of the Saundersdale millpond, it is proposed to continue the sewer on the southerly side of the river through Main Street and private land to the intersection of Main Street with the North Woodstock road, from which point it is proposed to carry the sewer across the river to the proposed filtration area by means of a bridge.

The plan of the proposed filtration area submitted with your application shows 24 filter beds, having an aggregate area of about 11½ acres, 16 of which are located on land owned by the town, and it is proposed to construct these 16 beds for immediate use. The elevation of the surface of the proposed filter beds and the elevation of the top of the dam at the outlet of the Saundersdale millpond are shown upon this plan, and the location of the underdrains beneath the filter beds are also shown. At the request of the Board you have also shown details of a proposed flush tank, into which the sewage will be discharged at the filtration area, and the method of distributing the sewage and removing surface water and underdrainage.

The Board has carefully considered the application and the report and plans submitted therewith, and has considered the results of examinations of the proposed system and of the location of the filter beds made by its engineers. The proposed system of sewerage will provide satisfactorily for the removal of the sewage of all of the district which it is designed to serve, and the filter beds are of ample size to purify all of the sewage from the sewers now constructed and the sewers which it is proposed to construct in the near future, as indicated upon the plan submitted, if storm water, and, so far as is practicable, ground water, are kept out of the sewers. It appears to be practicable to enlarge the filtration area by constructing filter beds Nos. 17 to 24 inclusive, as shown upon the plan submitted, whenever extensions of the system of sewerage or the increase in the quantity of sewage shall make additional filter beds necessary. When the capacity of this filtration area has been fully developed, suitable areas for the disposal of the sewage are found in the valley of Dean Brook, near the river further down stream, to which the main sewer can be extended when necessary.

The plan adopted June 29, 1898, shows a sewer extending from Main Street across the millpond about 550 feet above the new Lensdale dam, and thence along the northerly side of the river as far as the valley of Dean Brook. A portion of this sewer is now rendered unnecessary by the proposed modifications in the plan submitted, and the remaining portion by which sewage would in the future be conveyed to the valley of Dean Brook would be much more difficult to construct than a sewer located on the southerly side of the river; so that it is probable that, when it becomes necessary to make an extension of the system to the valley of Dean Brook, some other route for the sewer will be found desirable. It seems probable that further examination may show that it is practicable to purify the sewage which would naturally be discharged into a sewer laid in Main Street from the vicinity of the North Woodstock road to the Quinebaug River at Saundersdale, and it is very desirable, in the opinion of the Board, to avoid the pollution of the Quinebaug River by crude sewage. In any case, it does not appear that the need of sewerage in this portion of the town is likely to require the construction of this sewer for a considerable time in the future.

Since the sewer on the northerly side of the river already referred to does not seem to be necessary, and since it appears to be for the interests of the town to avoid the discharge of crude sewage into the river in the vicinity of Saundersdale, the Board modifies and amends the plans submitted by striking out therefrom all of the sewer shown upon the plans which extends from Main Street across the millpond above the new Lensdale dam and along the northerly side of the Quinebaug River down to the valley of Dean Brook; and by striking out the proposed sewer in Main Street from a point about 200 feet east of the junction of Main Street with the North Woodstock road to the Quinebaug River at Saundersdale. With these two modifications and amendments, the Board approves the plan of sewerage and sewage disposal for the town of Southbridge, prepared by F. L. Fuller, C.E., of Boston, and adopted by the town of Southbridge at a town meeting held on June 29, 1898; and approves the modifications proposed by your board and shown upon the plan submitted to the State Board of Health June 19, 1899, entitled "Plan of sewerage for the town of Southbridge," upon which the proposed modifications are shown; and approves the plan of sewage disposal as shown upon the plan submitted by you June 19, 1899, entitled "Town of Southbridge. Plan of proposed filter beds on area No. 1. 11.44 acres. Scale 80′ = one inch. A. C. Moore, C.E. 1899."

By providing underdrains beneath the sewers in wet places and discharging them into local water courses, much leakage into the sewers may be prevented and a considerable saving effected in the cost of disposing of the sewage.

The plans submitted show a waste pipe from the man-hole in Main Street opposite the filter beds, through which the sewage, by opening a gate, can be discharged directly into the river. Some emergency may arise which may require the use of this overflow; but it is understood that it is to be opened only in emergency, and is not for frequent or regular use, and that there are to be no automatic overflows in connection with the system by which sewage may be discharged at any place except upon the filter beds.

It is proposed to remove sludge from the flush tank by pumping it into carts and removing it to a suitable place of disposal. This will be a somewhat expensive method, and, while it does not seem likely that the quantity of sludge that will require removal in this way will be large, it would probably be best to provide a sludge bed upon which the tank could be discharged from time to time when it is desired to clean it out. Even if it should be necessary to locate the sludge bed at some place where it would be flooded at periods of high water in the river, the flooding would not seriously interfere with its usefulness if the bed is protected from injury by the current of the river.

The main underdrains beneath the filter beds appear to be of ample size to remove the drainage that may be expected to enter them, and it is proposed to provide lateral underdrains as frequently as may be found necessary. The beds are so situated that it is difficult to predict how large a quantity of underdrainage will have to be removed, since there is liable to be a considerable filtration of water from the river into the beds and a considerable flow of ground water toward them from the land side. If in the construction of the beds it is found that the quantity of ground water to be dealt with is likely to be larger than is now expected, it will be necessary to provide a liberal system of underdrainage to keep the water at a low level in the beds and allow ample opportunity for the air to enter the filters after each application of sewage.

STOCKBRIDGE. An application was received from the authorities of Stockbridge, March 6, 1899, for the advice of the State Board of Health with reference to the sewage disposal of the town. The Board replied to this application as follows: —

MAY 18, 1899.

The State Board of Health received from you, on March 6, 1899, an application for advice with reference to the disposal of the sewage of the town of Stockbridge, accompanied by plans showing a system of sewers for the main village of Stockbridge connecting with a main sewer running north-westerly near a brook parallel with Main Street to Church Street, through which street and the road to West Stockbridge the sewer passes to a proposed filtration area known as the Barnes pasture lot, situated on the northerly side of the Housatonic River about one mile north-west of the main village of Stockbridge, where it is proposed to purify the sewage by applying it to land and to discharge the effluent into the Housatonic River.

On May 9, 1899, a modified plan of the sewage-disposal area was received, showing filter beds for the purification of the sewage by intermittent filtration, having an area of about one acre and a half, and an area of about three acres of land upon which it is proposed to dispose of a portion of the sewage by irrigation.

The plans submitted provide for the construction of six filter beds by taking sand from the higher parts of the sewage-disposal area and depositing it on the land in the lowest portion of the area. The elevation of the land at the place where it is proposed to construct the filter beds is for the most part between 2 and 3 feet above the level of ordinary high water in the river, which is approximately at grade 81, and it is proposed to construct the beds so that their surfaces will be at a level about 5 feet above high water, or at grade 86 on the plan submitted.

It is proposed to provide underdrains about 23 feet apart beneath the beds, the elevation of the underdrains at their upper ends being at grade 82 and at the lower end from grade 81 to grade 81.3. The depth of the filtering material over the underdrains will therefore be from 4 to 5 feet, and between the underdrains the depth will range from 3½ to 4 feet.

The land which it is proposed to prepare for irrigation is to be graded with the most available material to a uniform slope of 1 foot in 100 from the upper side to the lower side, the total width of the field being about 330 feet and the surface at the upper side being at grade 87. This area is also to be underdrained with drains 30 feet apart, which will be 4.5 feet below the surface at the upper side of the area and about 2.7 feet at the lower side.

The Board has caused the locality to be examined by its engineer and has carefully considered the reports and plans submitted. The main and tributary sewers provide for collecting sewage from practically all of the present buildings in the main village of Stockbridge and for the conveyance of this sewage to the proposed disposal area.

By a plan submitted in 1896 the basements of several buildings in the village were below the level of the sewers into which cellar fixtures would naturally drain. By the present plan some of the sewers will be laid at a higher level, but no information has been submitted to show whether a larger number of cellars would be affected in the manner referred to than by the previous plan. In the plan submitted it appears to be feasible to lower the level of some of the sewers, and it is the opinion of the board that wherever it is practicable to do so it is desirable to lay the sewers at a sufficiently low level to make it possible to connect basement fixtures with them if necessary. It is important to lay the underdrains for receiving ground water sufficiently below the bottom of cellars so that the ground beneath the cellars may be drained. The grades of some of the sewers are somewhat flat, and in cleaning the sewers it would be of advantage if manholes were placed at more frequent intervals.

It is very important that all storm water be excluded from the sewers, and that ground water be excluded, so far as practicable, by care in the making of joints and by the construction of underdrains as proposed beneath the sewers to discharge ground water to local water courses wherever practicable.

The area proposed for the disposal of the sewage is the same as that proposed in your former application, concerning which the Board advised that it appeared to be the most suitable one which it is practicable to use for the disposal of the sewage without pumping, and that its location was satisfactory from a sanitary point of view. Examinations of the soil of this area by means of test pits have shown that the soil of the higher portions beneath a surface layer of loam consists largely of sand suitable for the purification of sewage by filtration; but the elevation of most of these portions of the land is such that sewage from the proposed system cannot be discharged upon them without pumping. The lower portions of the area contain sandy soil in some places, but the soil of large portions is of clay or other very fine material not suited to the purification of sewage. By the proposed plan all of the material for the proposed filter beds will have to be moved to the place where the beds are to be located, and by selecting the material best suited for filtration satisfactory filter beds can be constructed having an area of one and one-half acres, as proposed.

The depth of filtering material in the proposed filters is less than is desirable, but the quality of the sand of which the filters are to be composed is such that a satisfactory purification of the sewage will be effected by the proposed filters, if care is taken to carry out the plans thoroughly and to provide a thickness of filtering material of at least 4 feet over the underdrains and for a distance of at least 5 feet on both sides of each underdrain. The trenches in which the underdrains are laid for about a foot from the pipe should be filled with gravel, and the use of sand in these places should be avoided, because sand will run into the joints of the pipes and impair the efficiency of the beds.

The proposed irrigation area, if composed of coarse material like the filter beds, would dispose of a considerable quantity of sewage in the summer season; but, if constructed of the material most available, as appears to be the intention from the information submitted, care will be necessary to avoid discharging a greater quantity of sewage upon this area, especially in winter and in wet weather (at other seasons of the year), than the ground is capable of readily absorbing, since the sewage would otherwise accumulate in the lower portions of the area and create a nuisance.

The proposed flush tank at the disposal area will be capable, with the addition of storage in the lower end of the sewer, of discharging nearly 21,000 gallons at one time; and, considering the area of the proposed filter beds, satisfactory results could probably be obtained with a tank two-thirds the size.

The plans as a whole, with the modifications suggested, will, if carried out, in the opinion of the Board provide satisfactorily for the collection and purification of all of the sewage of the thickly settled portions of the town of Stockbridge, and the capacity of the works can be enlarged in the future, if necessary, by increasing the area of the filter beds.

In response to the request of the board of selectmen of the town of Stockbridge for the approval by the Board of the purchase or taking of a certain lot of land in the town of Stockbridge, known as the Barnes pasture lot, for sewage-disposal purposes, the State Board of Health gave notice that a public hearing upon the matter would be given at its office May 4, 1899, as required by chapter 50, section 1, of the Public Statutes, as amended by chapter 124 of the Acts of 1890. At this hearing no person appeared to oppose the purchase or taking of land referred to for sewage-disposal purposes; and the Board hereby approves the purchase or taking by the town of Stockbridge, for the purification and disposal of the sewage of the said town, of land on the northerly side of the Housatonic River, between the river and the road from Stockbridge to West Stockbridge and about a mile west of the village of Stockbridge, as shown upon a plan entitled, "Plan of land sold by James Barnes to the town of Stockbridge, Mass., May 11, 1899. Scale 1 inch=100 feet." Said land being bounded, measured and described as follows: —

Beginning at a stone monument on the south side of the road leading from Stockbridge to West Stockbridge, being the northerly corner of the land of Mrs. B. Blakeman; thence along the southerly side of the road to West Stockbridge N. 42° 32′ 30″ W., 1,996.4 feet to a stone monument on the line of the land of Chas. L. Lynch; thence with the line of said Lynch S. 13° 9′ 00″ W., 527 feet to a stone monument on north bank of the old channel of Curtis Mill Brook; thence with the line of the land of Walter H. Lynch S. 32° 29′ 00″ E. 106.3 feet to a stone monument on the south bank of the old channel of Curtis Mill Brook; thence with the line of said W. H. Lynch S. 12° 10′ 00″ E., 738.3 feet to a stone monument on the north bank of Curtis Mill Brook; thence with the thread of said brook south-westerly 225 feet to the north bank of the Housatonic River; thence along the bank of the river south-easterly 610 feet to the land of Mrs. Birdseye Blakeman; thence with the line of the said Mrs. Blakeman N. 70° 23′ 00″ E., 25 feet to a stone monument in the said line; thence N. 70° 23′ 00″ E., 983.3 feet to the point of beginning, containing about 29 acres, be the same more or less.

WAKEFIELD. Applications were received from the sewerage committee of Wakefield for advice with reference to the sewage disposal of that town, and from the selectmen of Wakefield for the approval of a certain tract of land in that town for sewage-disposal purposes, according to the provisions of chapter 124 of the Acts of 1890. Under the provisions of this act a hearing was held at the office of the Board, July 6, 1899, after due notice, and the Board sent the following communication to the sewerage committee and the board of selectmen: —

AUG. 3, 1899.

The State Board of Health received from the sewerage committee of the town of Wakefield, in June last, an application for advice with reference to the disposal of the sewage of the town of Wakefield, accompanied by plans showing a proposed main sewer to receive the sewage from the thickly settled portions of the town and convey it to a proposed filtration area located in the easterly portion of the town between Montrose Avenue and the Saugus River north of Water Street, where it was proposed to purify the sewage by applying it to filter beds of gravel and sand and to discharge the effluent into the Saugus River. Subsequently, a modified plan of the sewage-disposal area was presented, providing for a main effluent drain to be laid from the proposed filter beds along the westerly side of the Saugus River to a point of discharge into the Wakefield branch of the Saugus River, also known as Crystal Brook, near its mouth.

An application has also been received from the board of selectmen of Wakefield, requesting the approval by the State Board of Health of the purchase or taking by the town of Wakefield of the lands in the easterly portion of the town upon which it is proposed to purify the sewage.

By the plan of sewerage submitted by the sewerage committee the town is divided into two districts, one to be known as the high-level district and the other as the low-level district. The high-level district, according to the plan submitted, comprises the portion of the town above contour line 105 Boston base, in the region about the easterly side of Lake Quannapowitt, and the area above contours 100 to 110 in the region lying west of a line from Crystal Lake to Lake Quannapowitt. There is also a district extending east from Crystal Lake to Farm Street, which it is proposed to connect with the high-level sewer. The sewers of the high-level district will discharge into a proposed main sewer commencing on Railroad Street near Avon Street, thence running through Railroad Street, Nahant Street, land of the town of Wakefield and private property to Water Street, thence by Water Street, Montrose Avenue and private property to the proposed filter beds.

The low-level sewer you state can be built along the Newburyport branch of the Boston & Maine Railroad, and will pass near the rattan factory; and then, by following the valley of Wakefield Brook and Water Street, will be carried to the filter beds, where the sewage will be pumped to a sufficient height for disposal; or the route may be changed in the vicinity of the rattan factory, and the sewer built across the valley near Melvin and Valley streets, and the sewage pumped to the high-level sewer at some convenient place; but no definite location for a pumping station for the low-level district is indicated in the plans submitted.

In constructing the sewers it is proposed to provide for a large increase in population in the town, and a sub-drainage system is to be provided beneath the main sewers, so that wet districts, when practicable, can be drained of ground water. It is proposed to discharge the underdrains into local water courses where convenient.

At the filtration area it is proposed to construct 8 acres of filter beds in the beginning upon land lying northerly of a small brook which crosses the proposed filtration area and discharges into the Saugus River about 1,500 feet above the mouth of the Wakefield branch. When a larger filtration area is needed, other beds can be constructed south of this brook. Filter beds are to be constructed of porous material suitable for the purification of sewage, and provided with suitable underdrains. It is proposed to distribute the sewage to the different beds in the beginning without the use of a flush tank, using the storage capacity of the main sewer for the purpose of discharging a considerable quantity of sewage on the beds at one time.

The Board has carefully considered the application and plans submitted, and has caused the territory to be examined by its engineer, and samples of the soil collected from various test pits on the area to be analyzed.

The proposed plan of sewerage, by dividing the town into high-level and low-level districts, and by conveying the sewage from the high-level district to the filtration area by gravity, is a desirable one to adopt in this case; and it is probable that for many years the greater portion of the sewage of the town will be discharged into the high-level sewers and conveyed by gravity to the filtration area. It appears to be practicable to construct a low-level main sewer, so as to provide for collecting the sewage of all of the low-level districts of the town which seem likely to require sewerage for many years in the future without providing for pumping the sewage more than once, excepting possibly for a very small district near Lake Quannapowitt.

The filter beds are to be located in a thinly populated portion of the town, and suitable material for the purification of the sewage is present upon the proposed filtration area in sufficient abundance to make it practicable to provide a sufficient area of filter beds to purify all of the sewage of the town satisfactorily for many years in the future.

The proposed system of sewerage and sewage disposal, so far as it is outlined by the plans submitted, is, in the opinion of the Board, an appropriate one for the collection and disposal of the sewage of the town of Wakefield, and its construction will make it practicable to prevent the further pollution of the streams in the town and greatly improve the condition of those tributaries of the Saugus River, especially the so-called Wakefield branch. It is highly important, however, that in the construction of the filter beds adequate provision be made whereby all the effluent can be diverted from the Saugus River into the proposed effluent drain, and discharged into Crystal Brook whenever the city of Lynn again concludes to take water from the river at any point below the filter beds.

When definite plans of the sewers and the low-level pumping station have been prepared, it is the opinion of the Board that they should be submitted for further consideration.

In response to the request of the board of selectmen of the town of Wakefield for the approval by the Board of the purchase or taking of certain lands in the town of Wakefield for sewage-disposal purposes, the State Board of Health gave notice of a public hearing in the matter to be held at its office on July 6, 1899, as required by chapter 124 of the Acts of 1890. After this hearing the State Board of Health voted to approve the purchase or taking by the town of Wakefield, for the purification and disposal of the sewage of the said town, of land in the easterly part of Wakefield, located between Montrose Avenue and the Saugus River, north of Water Street, as shown on a plan entitled "Wakefield, sewerage. Plan showing land included in application to State Board of Health, dated May 25, 1899. Scale, 50 feet per inch. May 18, 1899. Louis E. Hawes, civil and hydraulic engineer, Boston, Mass.," said land being bounded, measured and described as follows: —

Parcel 1. — Land belonging to E. Maria Eaton of Wakefield, Mass., and Sarah A. Leatherbee of Jamaica Plain, Boston, Mass., described, measured and bounded as follows: —

A lot of wood land situated on the easterly side of Montrose Avenue, so called, formerly Wiley Street, in the town of Wakefield, Mass., comprising 8.97 acres, more or less, the same being a portion of Lot No. 3, on a plan of David Wiley's farm drawn October, 1848, by H. L. Eaton, recorded Middlesex South District Registry of Deeds, plan book 3, page 59, and described in a partition of the estate of David Wiley, recorded Middlesex in said Registry of Deeds, 1874, Book No. 26, page 577; said portion being bounded and measured as follows: —

Beginning at a stake in an angle of the easterly side of said Montrose Avenue, at the north-west corner of land belonging to Salva S. Butterfield and devisees under the will of George W. Butterfield, deceased; thence by land of said Salva S. Butterfield *et al.*, 60° 33′ south-easterly 771 feet, more or less, on a wall to a corner; thence continuing by land of said Salva S. Butterfield *et al.*, 44° 47′ north-easterly 278.5 feet, more or less, on a wall to a corner stake; thence by other land of E. Maria Eaton and Sarah A. Leatherbee, 22° 48′ north-easterly 261.78 feet more or less to a stake; thence continuing by said other land of E. Maria Eaton and Sarah A. Leatherbee, 72° 00′ north-westerly 981.36 feet more or less, to a stake at Montrose Avenue; thence by the easterly side of Montrose Avenue, 0° 47′ south-westerly 160.55 feet, more or less, to a stake at an angle; thence continuing by Montrose Avenue, 9° 17′ south-westerly 202 feet more or less to a stake at the point of beginning; and as shown on a plan by Louis E. Hawes, civil and hydraulic engineer, entitled, "Wakefield sewerage, plan showing land included in application to State Board of Health, dated May 25, 1899."

Parcel 2. — Land belonging to Mrs. Salva S. Butterfield of Saugus, Mass. (address Wakefield, Mass.), and devisees under the will of George W. Butterfield of Saugus, Mass., deceased; said devisees being Dr. George W. Butterfield of Wakefield, Mass.; Laura Marion Knight (born Butterfield) of Salem, Mass.; Roscoe S. Butterfield of Saugus, Mass. (address Wakefield, Mass.); and Anna M. Pike (born Butterfield) of Everett, Mass.; described, measured and bounded as follows: —

A lot of grass land and swamp with the buildings thereon, if any, situated on the easterly side of Montrose Avenue, so called, formerly Wiley Street, in the town of Wakefield, Mass., comprising 12.6 acres, more or less, the same being the portion which lies within the town of Wakefield of Lot No. 2 on a plan of David Wiley's farm, drawn October, 1848, by H. L. Eaton, recorded Middlesex South District Registry of Deeds, plan book No. 3, page 59, and described in a deed from G. L. Hawkes to Geo. W. Butterfield, recorded Middlesex South District Registry of Deeds, 1879, book 1512, page 256; said portion being bounded and measured as follows: —

Beginning at the north-west corner of the lot on said Montrose Avenue, at a stake in an angle of the easterly side of said avenue and at the south-westerly corner of land of E. Maria Eaton and Sarah A. Leatherbee, described in parcel 1 of this schedule; thence by said Montrose Avenue, south-westerly in three courses, 16° 17′, 27° 52′ and 35° 22′ on a wall measuring respectively 54.5 feet more or less, 100 feet more or less and 176 feet more or less to land of Salva S. Butterfield; thence by land of said Salva S. Butterfield, 56° 30′ south-easterly on a line passing through a barn and on a wall 149.5 feet more or less, to a stake; thence continuing by land of said Salva S. Butterfield 31° 34′ south-easterly on a wall, 389.62 feet more or less, to land of Elizabeth H. Sanborn formerly of David Wiley and called lot 1 on said plan of David Wiley's farm; thence by said land 78° 51′ north-easterly on a wall 209.35 feet more or less to a corner in the wall; thence continuing by said land 37° 9′ south-easterly 13.75 feet more or less on the wall to an angle;

thence continuing by said land easterly in two courses S. 75° 21′ E. and S. 70° 16′ E., measuring respectively 92.8 feet more or less and 237 feet more or less on a fence and ditch to the thread of the Saugus River, said thread of the river being the boundary line between the town of Wakefield and the town of Saugus; thence by the thread of the Saugus River, up the stream, on the said boundary line and by other land of said Salva S. Butterfield and devisees aforesaid, in the town of Saugus, 940 feet more or less to land of E. Maria Eaton and Sarah A. Leatherbee aforesaid; thence by land of said E. Maria Eaton and Sarah A. Leatherbee north-westerly in three courses, 20° 40′, 35° 16′ and 67° 27′, measuring respectively 57 feet more or less, 53.5 feet more or less and 376.73 feet more or less on a wall to a stake at a corner; thence continuing by land of said E. Maria Eaton and Sarah A. Leatherbee 44° 47′ south-westerly on a wall 278.5 feet more or less to a corner; thence continuing by land of said E. Maria Eaton and Sarah A. Leatherbee 60° 33′ north-westerly on a wall 771 feet more or less to said Montrose Avenue and said stake at the point of beginning; and as shown on a plan by Louis E. Hawes, civil and hydraulic engineer, entitled "Wakefield sewerage, plan showing land included in application to State Board of Health, dated May 25, 1899."

Parcel 3. — Land belonging to Salva S. Butterfield of Saugus, Mass. (address Wakefield, Mass.), described, measured and bounded as follows: —

A lot of grass land and swamp, with buildings thereon, if any, situated on the easterly side of Montrose Avenue, so called, formerly Wiley Street, in the town of Wakefield, Mass., comprising 4.24 acres, more or less, the same being the northerly portion of lot No. 10 on a plan of David Wiley's farm, drawn October, 1848, by H. L. Eaton, recorded Middlesex South District Registry of Deeds, plan book 3, page 59, said portion being described in a deed from John Howlett to Salva Butterfield, recorded Middlesex South District Registry of Deeds, 1869, book 1096, page 8; and is bounded and measured as follows: —

Beginning at the most northerly corner of the lot on said Montrose Avenue at the south-westerly corner of land of Salva S. Butterfield and devisees under the will of George W. Butterfield, deceased, described in parcel 2 of this schedule; thence by said Montrose Avenue, 40° 14′ south-westerly on a fence 402.5 feet more or less, to a stake at land of Elizabeth H. Sanborn, formerly David Wiley's and a part of said lot No. 10 on said plan of David Wiley's farm; thence by said land 26° 54′ south-easterly on a fence 308.35 feet more or less, to a stake and corner; thence continuing by land of said Elizabeth H. Sanborn, formerly of David Wiley and called lot No. 1 on said plan of David Wiley's farm, north-easterly on a wall in two courses, 66° 16′ and 77° 51′, measuring 347.04 feet more or less, and 133.45 feet more or less, to land of Salva S. Butterfield and said devisees; thence by land of said Salva S. Butterfield and said devisees, north-westerly on a wall and through a barn in two courses, 31° 34′ and 56° 30′, measuring respectively 389.62 feet more or less and 149.5 feet more or less, to said Montrose Avenue and the point of beginning; and as shown on a plan by Louis E. Hawes, civil and hydraulic engineer, entitled "Wakefield Sewerage, plan showing land included in application to State Board of Health, dated May 25, 1899."

Parcel 4. — Land belonging to Elizabeth H. Sanborn of Wakefield, Mass., formerly a part of David Wiley's farm, described, measured and bounded as follows: —

A lot of cultivated land and swamp, situated easterly from Montrose Avenue, so called, formerly Wiley Street, and northerly from Water Street in the town of

Wakefield, Mass., comprising 5.54 acres, more or less, the same being a portion of lot No. 1 on a plan of David Wiley's farm, drawn October, 1848, by H. L. Eaton, recorded Middlesex South District Registry of Deeds, plan book No. 3, page 59; said portion being bounded and measured as follows: —

Beginning at the most southerly corner of the lot at land now or formerly of Enos Wiley, on the east, and land of heirs of Charlotte P. Roberts formerly of Warren Wiley, on the west; thence by land now or formerly of said Enos Wiley easterly by two courses N. 85° 6′ E. and S. 76° 44′ E., on a wall and fence measuring respectively 694.1 feet more or less and 177 feet more or less, to the thread of the Saugus River and the boundary line between Wakefield and Saugus to other land of said Elizabeth H. Sanborn, formerly of David Wiley, in the town of Saugus; thence by said land northerly up stream on said boundary line and thread of the river 256 feet more or less, to land of Salva S. Butterfield and devisees under the will of George W. Butterfield, deceased (called parcel 2 of this schedule); thence by land of said Salva S. Butterfield *et al.*, westerly in two courses, N. 70° 16′ W. and N. 75° 21′ W., on a ditch and fence, measuring respectively 237 feet more or less and 92.8 feet more or less; thence continuing by land of said Salva S. Butterfield *et al.*, 37° 9′ north-westerly on a wall 13.75 feet more or less to a corner; thence continuing by land of said Butterfield *et al.*, 78° 51′ south-westerly on a wall 209.35 feet more or less to land of Salva S. Butterfield; thence by land of Salva S. Butterfield (called parcel 3 of this schedule) south-westerly in two courses, 77° 51′ and 66° 16′, on a wall measuring respectively 133.45 feet more or less and 347.04 feet more or less to land of Elizabeth H. Sanborn, formerly of David Wiley; thence by said land southerly 5° 51′ W. 29.8 feet more or less to land of Charlotte P. Roberts' heirs; thence by land of Charlotte P. Roberts' heirs, formerly of Warren Wiley, 18° 34′ south-easterly on a wall and fence 138.27 feet more or less to the point of beginning; and as shown on a plan by Louis E. Hawes, civil and hydraulic engineer, entitled "Wakefield sewerage, plan showing land included in application to State Board of Health, dated May 25, 1899."

WEBSTER. An application was received from the sewer commissioners of Webster, June 20, 1899, requesting the approval by the State Board of Health, under the provisions of chapter 345 of the Acts of 1898, of a tract of land in that town for the purpose of sewage disposal. A hearing was held at the office of the Board, after due notice, on Aug. 3, 1899, after which the Board sent the following communication to the sewer commissioners: —

SEPT. 7, 1899.

The State Board of Health received from you, on June 20, 1899, an application requesting the approval by the Board, under the provisions of chapter 345 of the Acts of 1898, of a proposed system of sewerage and sewage disposal for the town of Webster, accompanied by plans of the proposed system of sewerage, of the lands which it is proposed to use for the purification and disposal of the sewage, and of the filter beds which it is proposed to construct in the beginning upon a portion of these lands, prepared by Lucian A. Taylor, C.E., of Boston. Subsequently, a further communication was received, containing the following outline of the proposed system: —

The sewerage system designed for the town of Webster is to be essentially a separate system. At the present time one or two of the old sewers receive surface water. It is proposed to separate this surface drainage, turning it into the natural water courses and the French River. As designed, the system will provide for the entire settled section of the town. In the event of any further extension being needed in the northern or eastern part, it can be connected with the outfall sewer, advantage being taken of the fall in the French River.

It is not designed to discharge any sewage into any water course or river except after passing through the filter beds. It is planned to have an overflow at the outlet of the outfall sewer that might be used in case of emergency or serious accident to the machinery at the pumping station or any of the connecting works.

It is not proposed to lay underdrains to remove ground water as a part of the general system. With the exception of the outfall sewer, the sewers are almost wholly above ground-water level. The outfall sewer itself will be composed quite largely of cast-iron pipe.

The ordinary stage of the river is at elevation 406 where the Southbridge branch of the New England Railroad crosses it below Chase's woollen mills, so called.

The outlet of the outfall sewer at the collecting well will begin at an elevation of 406.50, and will follow along the easterly bank of or in the French River to Peter Street. This line will pass through Chase's millpond and under the Norwich & Worcester Railroad tracks north of the depot in the bed of the river, cast-iron pipes being used in these sections of the work; the size will be 18 inches in diameter, the grade not less than 0.15 of a foot per 100 feet, and the distance about 6,900 feet. At Hill Street the depth is about 15 feet; Chase Avenue, 13.3 feet; Main Street, 19.3 feet; Pleasant Street, 15.3, and Peter Street, 17 feet.

From Peter Street northerly it is proposed to run the sewer in the bed of the river to a point opposite Church Avenue. This will provide for the wastes from the Slater woollen mills. The sewer from the North village will connect with the main sewer on the easterly side of the river at Church Street, as shown on the plan.

The collecting well into which the sewage will be discharged is to be 100 feet in diameter, covered, and of a sufficient average depth to hold at least 650,000 gallons below the centre line of the sewer. It is proposed to pump to the filter beds during the day time, when the wastes from the woollen mills are discharged. These wastes will probably constitute a very large percentage of the total amount of sewage to be dealt with. The filter beds will have not less than 5 feet of filtering material and where underdrains are laid they shall be from 5 to 6 feet below the surface.

The distribution from the force main is to be from 8-inch iron pipes, connected with the same, and from trenches between the filter beds, during the summer months it being made from the trenches between the beds, and in the winter season wholly from the distribution pipes.

The plan in general provides for a system of sewerage to receive the sewage of the thickly settled portion of the town and manufacturing sewage from certain large factories, and to convey it in a main sewer to be laid in the vicinity of the French River to a reservoir to be built on the easterly side of the river between the Norwich & Worcester division of the New York, New Haven & Hartford Railroad and the Southbridge branch of that railroad, about 1,500 feet south of Hill Street, from which it is proposed to pump the sewage to filter beds to be located on both sides of the Southbridge branch of the Norwich & Worcester division of the New York, New Haven & Hartford Railroad, and to discharge the effluent into the French River.

The Board has caused the locality to be examined by one of its engineers and samples of the sewage resulting from manufacturing processes carried on in the mills of the town to be analyzed, and has carefully considered the plans and other information that has been submitted.

It appears that the principal portion of the manufacturing sewage which now pollutes the river comes from woollen mills, and results from the scouring of wool and the washing and dyeing of cloth. An examination of a sample of scouring liquid shows that it contains an excessive amount of grease and solid matters, and it will be necessary to remove the grease and much of the solid matter before the sewage is admitted to the town sewers, or great difficulty will otherwise be experienced in keeping the sewers free from deposits and in the operation of filter beds. In the process of washing cloth a large quantity of water is used, part of which appears to be seriously polluted. It is not desirable to take all of the water used in washing the cloth into the sewers, but it may be found desirable to separate the water first used in washing the cloth from that used for rinsing, so that the seriously polluted portion of the water used in the process can be taken into the sewers and the cleaner water allowed to flow into the river. The liquid waste from the process of dyeing contains a much smaller quantity of organic matter than that resulting either from scouring wool or washing cloth; but the waste dye liquor greatly discolors the water of the stream, and, considering its character, it should be kept out of the river so far as is practicable.

No profiles of the sewers, with the exception of a statement as to the slope of the main sewer, have been submitted to the Board, so that the Board is unable to advise as to these portions of your proposed plans; but from a general examination of the information submitted and of the slope of the land in the town it appears to be practicable to construct sewers with satisfactory grades to convey the sewage of the various portions of the town to the main sewer.

The plans provide for constructing the main sewer of iron pipe in the region where it runs close to the river, or in the river bottom. The size and slope of the main sewer between Peter Street and the collecting reservoir, as indicated by you, are sufficient for the removal of the domestic sewage which is likely to be discharged into this sewer for several years in the future, and also for the removal of such manufacturing sewage as it seems desirable to keep out of the river, if surface water and ground water, so far as is practicable, are kept out of the sewers.

It appears that no underdrains are to be provided beneath the sewers, and under the circumstances much care will have to be exercised in places where the sewers are laid below the level of the ground water to prevent serious leakage into them.

Details of the proposed collecting reservoir have not been submitted, and the Board is unable to advise you concerning it. In order to avoid difficulty in the operation of the pumps it will be very desirable to provide for screening the sewage at the collecting reservoir to remove large substances which may find their way into this reservoir. In your proposed plans it is stated that an overflow is to be provided in the vicinity of the pumping station through which crude sewage may be discharged into the French River. While it may be desirable to provide a waste gate which can be opened in an emergency, such a gate should not be automatic, and should be used only in case of accident to the pumps, pumping station or force main.

From the pumping station a short force main will convey the sewage to the proposed filter beds. Examinations of the soil at the place where it is proposed to construct the filter beds show that beneath a layer of loam at the surface the soil is of excellent quality for the purification of sewage by intermittent filtration, and the filter beds indicated upon the plan are likely to be of sufficient area to provide for all the sewage that may be expected to be conveyed to the disposal area in the beginning. The areas on the easterly side of the railroad included in the land which you propose to secure for sewage-disposal purposes contain soil that is equally well adapted to the purpose, so that it will be practicable to enlarge the area of filters without special difficulty whenever it becomes necessary, by constructing filters on the easterly side of the railroad.

The method of applying the sewage to the filter beds provides for distributing the sewage upon the beds in the winter season through pipes discharging at the corners of the beds, while during the summer season it is proposed to discharge the sewage into trenches in the top of the embankments between the beds, and allow it to flow over the edges of the trenches upon the beds. If the sewage is delivered through pipes of suitable size leading to each bed, a satisfactory distribution of the sewage can be effected at all seasons of the year; on the other hand, if sewage is discharged from trenches in the embankments as proposed, there will be great danger that the embankments will be washed away.

The Board would therefore modify this portion of the plan, and does hereby modify it by striking out the portion of the plan which provides for trenches in the embankments between the beds, so that the sewage will be distributed from the pipes in the embankments between the beds through suitable openings at all seasons of the year.

The State Board of Health, having given notice of the presentation to it for its approval of a proposed system of sewerage and sewage disposal for the town of Webster, gave a hearing with reference to the proposed system at its office on Aug. 3, 1899. At this hearing no person appeared to oppose the plan of sewerage and sewage disposal proposed by the town of Webster; and the State Board of Health, having modified and amended the proposed plans, as stated herein, hereby approves the proposed system of sewerage and sewage disposal outlined above as so modified and amended.

WESTBOROUGH. An application was received from the sewer commissioners of Westborough, May 3, 1899, for the advice of the State Board of Health with reference to proposed plans for enlarging the filtration area for the purification of the sewage of the town and for eliminating ground water from the main sewer leading to the filtration area. The Board replied to this application as follows: —

MAY 16, 1899.

The State Board of Health received from you, on May 3, 1899, an application for advice with reference to proposed plans for enlarging and improving your present filtration area for the purification of the sewage of the town of Westborough and for eliminating ground water from the main sewer leading from the town to the filtration area. The application was accompanied by a report by J. J. Van Valkenburg, civil engineer, and plans showing the proposed new works and changes in your present works.

According to the plans submitted, it is proposed to construct three acres of filter beds upon land in the vicinity of your present filter beds by taking gravel from higher lands near by and depositing it upon the lower lands, and to reconstruct the present filter beds located at the southerly side of the filtration area and numbered 4 and 5 on the plan submitted, which are not capable of purifying sewage satisfactorily in their present condition. According to the plan, the surface of the bed nearest the sewer outlet will be at an elevation about 5½ feet above the level of high water in the Assabet River, as it was found in the early spring of 1899; and the surface of the lowest bed will be at an elevation about 4½ feet above high water in the river. A main underdrain is shown through each bed, generally at a depth of between 4 and 5 feet beneath the surface of the bed, and lateral underdrains are shown beneath each bed and about 25 feet apart, connecting with this main underdrain which will discharge into the Assabet River. Near the ends of some of the laterals the depth of filtering material would not be much more than 3½ feet. The total area of the filter beds will be about 5 acres, and it is proposed in constructing the beds to divide beds Nos. 3, 4 and 5, as shown upon the plan submitted, into two parts.

The second portion of the plan submitted provides for reconstructing a part of the main sewer between the town and the filter beds, using iron pipe with lead joints, in order to prevent leakage into the sewer.

The Board has caused examinations of the main sewer and filter beds, so far as practicable, to be made by its engineers, and has examined the plans and other information submitted with reference to the condition of the main sewer and the filter beds. The quantity of mingled sewage and ground water which flows to the filtration area during much of the year at the present time is so great that at times it would be difficult to purify all of it upon the filters now proposed; but if the ground water which enters the main sewer is excluded, as proposed, the filter beds will, in the opinion of the Board, be of suitable size to provide for the disposal of the sewage at all times, and will provide for a considerable increase in the quantity of sewage flowing from the town in the future. This is a desirable provision to make, since the quantity of sewage is likely to increase largely when the system becomes more generally used in the town.

The depth of filtering material in portions of the proposed beds is less than is desirable in order to secure satisfactory purification of the sewage, but on account of the limited elevation of the sewer as it reaches the filtration area above the level of the river it does not appear to be practicable to construct filter beds at a higher elevation than is proposed; but it is desirable to so arrange the underdrains as to insure a depth of at least 4 feet of filtering material above them, if possible. Filtering material of excellent quality can be obtained near the proposed location of the filter beds, and, if the beds are properly constructed, under the supervision of an engineer of experience in such matters, and are properly operated, the Board is of the opinion that satisfactory purification of the sewage will be effected by the proposed beds.

It appears from information submitted by you and from investigations by the Board that the flow of sewage in the main sewer at man-hole No. 19, which is situated on the main sewer, about 500 feet westerly of Summer Street, and below all the house connections in the town, was at the rate of about 140,000 gallons per day on April 4 of the present year, while the flow from the sewer as it reached the filtration area about 4,710 feet from man-hole No. 19 was at the rate of a little over 700,000 gallons in twenty-four hours. Measurements at intermediate points indicate that between man-hole No. 19, already referred to, and man-hole No. 12, which is 1,950 feet nearer the filter beds, there was a leakage into the sewer of 489,000 gallons per day at the time the measurements were made; and between man-hole No. 12 and man-hole No. 7, which is 1,060 feet nearer the filtration area than man-hole No. 12, there is a leakage into the sewer of about 122,000 gallons per day. From man-hole No. 7 to the filtration area the sewer appears to be laid most of the way above the level of the ground water. It further appears, from information furnished by you, that the sewer becomes nearly clogged at times with a fungus growth, which takes place in the main sewer between the point where the ground water begins to leak freely into the sewer and the filter beds, and that this growth is so great as to clog the sewer and require removal from time to time. It also appears that even when the sewer is clean the quantity flowing is so great that its capacity is liable to be overtaxed when the sewers shall have come into more general use in the town. For these reasons it appears to be essential to reconstruct the main sewer so as to exclude ground water therefrom, and by the plan proposed the greater portion of the leakage can be excluded. The investigations have indicated, however, that there is considerable leakage between man-holes Nos. 12 and 7, a portion of the sewer which it is not proposed to reconstruct. One of the chief difficulties produced by the present conditions appears to be the fungus growth, which apparently at times nearly clogs the sewer and which appears to be associated with the presence in the sewer of the ground water mingled with the sewage. Not enough is known as to the conditions which are favorable to the development and growth of this organism to make it practicable to predict whether the growth would continue to give trouble in the portion below man-hole No. 12 after the sewer has been reconstructed. Under the circumstances, the Board would suggest that a further examination of this section of the sewer be made, to determine whether it is not practicable, by reconstructing a portion of the sewer in this length, to exclude all or the greater portion of the ground water leaking into the sewer in this vicinity.

The plans as a whole, with the modifications suggested, are, in the opinion of the Board, well adapted to the removal and purification of all of the sewage at present flowing from the town of Westborough, and will provide for an increase in the quantity of sewage which is to be anticipated in the future.

In the process of relaying the main sewer it will be necessary to make suitable provision for conveying the sewage from the town to the filtration area without allowing any portion of it to escape into any of the streams, especially those which are tributary to the Sudbury River, which is used as a source of water supply for the metropolitan district. The Board would advise that ample provision be made in the beginning for preventing danger of the escape of any sewage into any of these waters.

WESTBOROUGH (Lyman and Industrial Schools). An application was received, Sept. 11, 1899, from the trustees of the Lyman and Industrial Schools at Westborough, requesting the advice of the State Board of Health with reference to the disposal of the sewage of that institution. The Board replied to this application as follows: —

OCT. 5, 1899.

In response to your request, received September 11, for advice as to the disposal of the sewage of the Lyman and Industrial Schools, the Board has caused the present system of sewage disposal to be examined by one of its engineers. In this examination it appears that the sewage of the various buildings is now disposed of by applying it to several different areas of land through pipes laid beneath the surface of the ground. It appears that these pipes become clogged with sewage and have to be relaid from time to time, at considerable trouble and expense. Moreover, several of the areas in which the pipes are laid already appear to be surcharged with sewage, notwithstanding the dry weather, probably on account of the fineness of the material, which is not adapted to the purification of sewage.

The best method of disposing of the sewage of the buildings would be to collect it all and convey it to some place where suitable filter beds can be constructed and the sewage purified by intermittent filtration, and it appears to be practicable to collect the sewage of most if not all of the buildings, and convey it to a single filtration area.

Examinations by the board also show that it is probably practicable to dispose of the sewage by discharging it into the sewerage system of the town of Westborough; and if this could be done, it would probably be the most satisfactory method of disposing of the sewage, if satisfactory arrangements can be made with the town. The board would advise that you employ an engineer of experience in matters relating to sewage disposal to make an investigation as to the feasibility and probable cost of disposing of the sewage by collecting it and conveying it to some convenient point where it may be purified by filtration, and of the cost of conveying it into the sewerage system of the town of Westborough. When these investigations have been made, the Board will, upon request, give you further advice in the matter.

Pollution of Ponds, Streams and Other Bodies of Water.

The following is the substance of the action of the Board during the past year in reply to applications for advice relative to the pollution of ponds, streams and other bodies of water: —

Dracut. A letter was received, Nov. 4, 1899, from the board of health of Dracut, stating that more than twenty cases of typhoid fever had been reported in the village of Collinsville within the previous "week or two." The letter also stated that the water supply furnished to this community by the American Woolen Company appeared to be polluted, and a request was made that the State Board would aid the local board in investigating the cause of the epidemic.

An investigation was therefore made by the State Board of Health of the conditions existing at Collinsville, and the following letter was addressed to the board of health of Dracut: —

Nov. 11, 1899.

Investigations conducted by this Board, in compliance with a request stated in your letter of November 3 with reference to a serious epidemic of typhoid fever at Collinsville, show that the probable cause of the epidemic is the polluted condition of the water supply of the American Woolen Company in that village. Measures should therefore be taken at once by your board to prevent the further use of this water for drinking purposes.

The Board will cheerfully give any advice to your board or to the mill authorities with reference to a better source of supply, should you desire it.

An application was received from the treasurer of the American Woolen Company, November 13, requesting the advice of the State Board of Health in relation to a temporary supply of water for the village of Collinsville. The Board replied to this application as follows: —

Nov. 18, 1899.

In response to your communication of Nov. 13, 1899, as to a temporary arrangement for supplying water to Collinsville, the Board has caused the locality to be examined by one of its engineers, but does not find any source from which it will be practicable to obtain at once a suitable temporary supply of water to replace the source now used, which has evidently been the cause of so much sickness recently in the village.

It appears that your works at Collinsville are now being enlarged and provision made for a larger number of operatives and of tenement houses, so that it seems likely that a considerably larger quantity of water will be required in the near future than at present. Among the sources from which it may be possible to obtain a supply of good water is Long Pond, and there may be other sources in the neighborhood of the village from which a suitable water supply can be obtained.

Under the circumstances, the Board would advise that you employ, without delay, an engineer of experience in matters relating to water supply to make such investigations as may be necessary to secure a suitable supply of water for the village.

The Board will assist you in the investigations by making such analyses of water as may be necessary, and will give you further advice in the matter when the results of investigations are presented.

New Bedford. A communication was received, July 17, 1899, from the board of health of New Bedford, accompanied with samples of salt water taken from the harbor at low tide and high tide, and the opinion of the Board was requested with reference to the propriety of locating a public bathing place where these waters were taken. The Board replied to this communication as follows: —

Nov. 3, 1899.

In response to your request for advice as to the condition of the sea water at the proposed location of a public bath-house at the southerly end of the city of New Bedford, the Board has caused the location to be examined and has analyzed samples of the water sent in by you and other samples of sea water collected in this region.

Comparing the results of the analyses of samples collected at the proposed location of the bath-house with those collected near other shores in this region where the water is not likely to be polluted by sewage, it is seen that the quantity of free ammonia is slightly greater at the location of the bath-house than elsewhere, but otherwise the difference in the character of the samples is not marked. While the water of New Bedford harbor, especially immediately in front of the city, is evidently grossly polluted by sewage, the analyses do not show that at the time the samples were collected the sewage of New Bedford had a materially unfavorable influence upon the character of the water at the location of the bath-house; and, unless the conditions are very different at other times from what they were at the time these samples were collected, the water is not likely, in the opinion of the Board, to be noticeably affected by the sewage of New Bedford.

Uxbridge. An application was received, Jan. 27, 1898, for the advice of the Board with reference to preventing the pollution of Drabbletail Brook in that town by waste liquid from a creamery near the brook. The peculiar character of the drainage from this creamery necessitated a series of experiments, to determine the best method of disposal. The Board therefore entered upon these experiments, and subsequently replied to the application as follows: —

Nov. 3, 1899.

The State Board of Health received from you, early last year, a communication requesting its advice with reference to the prevention of the pollution of Drabbletail Brook, a stream which flows through a thickly populated portion of Uxbridge, by waste liquid from a creamery located near the brook.

The application was accompanied by plans, submitted to you by the owners of the creamery, which showed a proposed method of preventing the pollution of the brook by constructing a filter bed of sand, upon which it was proposed to purify the waste liquid from the creamery by filtration.

As soon as practicable after the application was received the Board caused the locality to be examined and samples of the waste liquid from the creamery to be analyzed. The analyses showed that the liquid contained a large amount of organic matter, of such a character that it was not practicable to tell, with the information available, whether or not it could be purified satisfactorily upon the proposed filter bed; and, as there appeared to be no other feasible method of disposing of the waste liquid from the creamery than by discharging it into the brook after purification, an investigation was begun to obtain the necessary information by experiment, making necessary a delay in replying to your application. In the mean time, the making of ice cream was begun at the creamery, and the character of the creamery waste was changed somewhat by the addition of large quantities of salt.

The experiments have been made by applying a liquid of similar chemical composition to the waste liquid from the Uxbridge creamery to small filters constructed of various materials, at various rates. The results of these investigations show that the waste liquids at present discharged from the creamery can be satisfactorily purified by filtration through sand. The rate at which a filter receiving these liquids can be operated and satisfactory results obtained is much less than with equal quantities of ordinary domestic sewage, and if too high a rate is used, the filters will become offensive in the summer season. It appears that the buttermilk is disposed of satisfactorily by the present method, and is kept from polluting the brook. If the buttermilk should be mingled with the other waste liquids, the difficulty of purifying them would be greatly increased and a much larger filter would be required.

Judging from the information available, the Board is of the opinion that the best method of preventing the pollution of the brook is to apply all of the waste liquids from the creamery, except the buttermilk, to a sand filter.

The plans submitted by you show a filter bed to be located on low land near the factory, which is to have an area of about 400 square feet and to contain coarse sand of a depth of from 2 to 2½ feet above a system of underdrains. Such information as has been obtained as to the quantity of waste liquids discharged from the creamery indicates that it is desirable to provide for present needs a filter having an area of as much as 600 square feet, to which addition can be made if a large increase in the quantity of waste liquid should take place. The depth of sand should be at least 4 feet, and, as it is necessary to apply the liquid to the filter intermittently, the area should be divided into two beds.

If a filter bed is constructed at the place proposed and with the modifications of your plan herein suggested, it will provide a satisfactory method of purifying the waste liquid from the creamery without causing offence in the neighborhood, if the liquid is applied to different parts of the beds and if the beds are used alternately and for periods of no more than two days at a time.

If the land required cannot be obtained by purchase, it may be possible to secure it by action of the town under the provisions of chapter 124 of the Acts of the year 1890.

WEST SPRINGFIELD. A communication was received, June 10, 1899, from the president of the Springfield Glazed Paper Company (a corporation doing business in West Springfield), stating that the outlet of a sewer near their mill in West Springfield had proved to be a nuisance. The State Board was therefore requested "to take such action as will cause the nuisance to be speedily abated." The Board sent the following communication to the selectmen of West Springfield, and so informed the president of the Springfield Glazed Paper Company: —

JULY 7, 1899.

A communication was received by this Board, on June 10, 1899, from the president of the Springfield Glazed Paper Company, relative to a nuisance caused by a sewer outlet near the factory of the company on the westerly bank of the Connecticut River, just below the West Springfield end of the old covered bridge from Springfield to West Springfield; and in response to this request the Board has caused the locality to be examined by one of its engineers.

From this examination it appears that the trouble is caused by the sewage from a large sewer in West Springfield which is discharged at the edge of the river, where the water is very shallow under ordinary conditions and the water in the stream has practically no current. Under these conditions the sewage remains in a large mass close to the river bank, and gives off an offensive odor. In a very dry season the bank of the river would be considerably exposed around the sewer outlet, and the nuisance from the sewage would be even worse than in an ordinary season.

It is practicable, in the opinion of the Board, to prevent this nuisance by extending a pipe from the sewer just above the present outlet to some point far enough out from the shore so that sewage may be discharged into the current of the river at all times, and be well diluted before it can be returned to the shore. If this pipe is made large enough to carry the flow of sewage under ordinary conditions, the excess of mingled sewage and storm water during storms can probably be allowed to overflow at the edge of the river without serious objection.

The discharge of sewage at this place in the present way is likely to become even more objectionable in the future than at present, and the Board would advise that suitable provision be made without delay for the proper disposal of the sewage.

ICE SUPPLIES.

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

HOLYOKE. A communication was received from the water commissioners of Holyoke, Jan. 2, 1899, asking the advice of the Board with reference to the proposed location of certain ice houses near Ashley Pond, one of the sources of water supply of the city, and the cutting of ice from that source for domestic use. Two plans for the location of the ice houses and such other buildings as were necessary accompanied the application. To this application the Board replied as follows: —

FEB. 18, 1899.

By plan No. 1 it is proposed to cut off from the water-shed of Ashley Pond a triangular tract of land comprising about 7½ acres near the southwesterly side of the pond, one-third of which is now covered with water to a depth of about 4 feet, being a portion of an arm of the pond. The southerly boundary of this tract is the Holyoke & Westfield Railroad, and it is proposed to fill the submerged portion of the tract with soil from the higher portions, and to arrange the surface drainage of all portions of the tract in such a way that it will flow toward channels along the railroad and be diverted from Ashley Pond. The water from a water-shed of 89 acres south of the railroad, which now flows through a culvert into the portion of the pond which it is proposed to fill, will be conveyed into Ashley Pond through a pipe 20 inches in diameter. The ice houses proposed will be located within this tract and the ice conveyed to them from the main portion of Ashley Pond along a channel cut in the ice which, according to the plan submitted, will be about 600 feet in length. The depth of the water in the portion of the pond in which this channel would be located ranges from 4 to 7 feet when the pond is full. A spur track about 300 feet in length is shown upon the plan, leading from the railroad to the proposed buildings.

Plan No. 2 provides for the location of the buildings near the southeasterly side of the pond; and, since the ground in this region slopes rapidly away from the pond, the buildings can be placed very close to the pond without being within its water-shed. Ice would be conveyed to these ice houses from Ashley Pond along a channel about 840 feet in length, having a depth ranging from 3½ feet to 7 feet, according to the plan. A spur track leading from the railroad to these ice houses could be laid inside of the present railroad location, and, according to the plans, would have an approximate length of about 1,400 feet. This track could be laid so as to slope either toward the railroad or toward the ice houses, apparently without materially affecting its cost.

The Board has caused a further examination of the region about Ashley Pond to be made by its engineer, and has carefully considered the plans submitted for removing and storing the ice. With regard to the use of Ashley Pond as a source of domestic ice supply for the inhabitants of Holyoke, the Board has already expressed its opinion in a previous communication relative to this subject.

If plan No. 1 should be carried out as proposed, water which might flow off the surface of the land upon which it is proposed to locate the ice houses and other buildings would be diverted from the water-shed of Ashley Pond; and, if the area is properly fenced, all trespass from it upon the water-shed of Ashley Pond could be prevented, but the underground drainage with such sewage from vaults or barns as might get into it would find its way into the pond. The cost of this plan would be large, principally because the filling of the arm of the pond would require the moving of several thousand cubic yards of material.

By plan No. 2 it will not be necessary to fill any portion of the pond, and the ice houses will be located outside the water-shed of the pond. The length of channel along which it will be necessary to convey the ice from the shores of Ashley Pond will apparently be no more than 250 feet greater than in the case of plan No. 1. The spur track, as shown upon the plan submitted, is considerably longer than in the case of plan No. 1, but it appears to be practicable to connect this track with the main track at a point somewhat nearer the ice houses. On the whole, the cost of carrying out this plan will probably be much less than in the case of plan No. 1, and by constructing a suitable fence the danger of pollution of the pond by trespassers from the buildings can be guarded against except at times of ice cutting.

By either plan it is proposed to cut and take ice from the main portion of Ashley Pond near its southerly end; and the Board is of the opinion that, if ice is allowed to be cut on the pond, it is necessary that pollution of the pond by those employed in the work, or by others, should be prevented by a very careful inspection by persons employed in the interests of the city.

The Board is of the opinion that the objections to plan No. 1 are such as to make the adoption of this plan inadmissible under the circumstances. Plan No. 2 is safer, because the ice houses and such other buildings as may be necessary will be located outside the water-shed of Ashley Pond, and all drainage will be in a direction away from the pond.

NORTH ADAMS. A communication was received from the board of health of North Adams, March 6, 1899, asking the advice of the State Board of Health relative to the use of ice from Hudson Brook in Clarksburg. The Board replied to this communication as follows: —

MAY 6, 1899.

The State Board of Health has carefully considered your application for advice as to the use of Hudson Brook, Clarksburg, as a source of ice supply and as to the quality of ice therefrom, and has caused the locality to be examined by its engineer and a sample of the ice from this pond sent in by you to be analyzed. The results of the analysis show that the quantity of organic matter was considerably larger than is usually found in ice, and an examination of the water-shed of the pond shows that little improvement has been made in its condition since a previous examination by the Board early last year. It appears that the ice from this source has been condemned in the past two years by your board, and in view of all the circumstances this Board can see no good reason why the decision should be reversed.

As stated in the former reply, the Hudson Brook Pond would appear to be a suitable source of ice supply, if care is taken to prevent its pollution from the few buildings situated in the immediate vicinity of the stream and its tributaries above the pond.

SPRINGFIELD. An application was received from the board of health of Springfield, Oct. 19, 1898, for the advice of the State Board in regard to the best method of preventing the pollution of a small brook, a tributary of Water Shop Pond, used as a source of ice supply in that city. The Board replied to this application as follows: —

JULY 7, 1899.

The State Board of Health received from you, in October last, an application for advice with reference to the prevention of the pollution of a small brook, a tributary of Water Shop Pond (a source of ice supply) in Springfield, by sewage from houses in the vicinity of Gunn Square, which are so situated that they cannot be connected with the present sewers of the city. At the time the application was submitted, it appears that about five houses discharged sewage into the brook referred to, but since that time several other houses have been built in this locality, and sewage from these houses is also discharged into the brook. From information furnished by you, it appears that the quantity of mingled sewage and water flowing from the sewer into the brook about the middle of last November amounted to about 75,000 gallons in twenty-four hours, but the sewage was very dilute.

Since the application was submitted a trench has been excavated in the sandy soil along the brook for a distance of about 700 feet, and during the latter portion of the winter the sewage was discharged into this trench, from which it appears to have filtered away through the ground, so that it was probably well purified before reaching Water Shop Pond. Surface water, however, finds its way into the ditch, and there are indications that at times of rain the mingled sewage and water has flowed through the ditch and out of it at its lower end.

It appears from the information submitted to the Board that the proposed intercepting sewer in the valley of Mill River, plans for which have already been prepared, will provide for the disposal of the sewage of the territory in the vicinity of Gunn Square in the future; and that, since this sewer is likely to be constructed before many years, a temporary method of purifying the sewage and preventing the pollution of the brook is all that is required at the present time.

The Board is informed that the trench already dug has been capable of disposing of the sewage except at times of heavy rain, and that the conditions are such that it is probable that, if surface water is kept out, the trench will be capable of receiving and purifying all of the sewage from the present sewer for a considerable time in the future; so that this method of disposing of the sewage appears to be a satisfactory expedient to adopt, pending the construction of the proposed intercepting sewer.

The Board would advise that the quantity of sewage be reduced as much as possible by keeping all surface water, so far as practicable, out of the sewer and out of the trench into which the sewage is discharged, and that the trench be separated into two parts, or another trench dug, so that the sewage can be applied to the trenches intermittently. It may also be necessary to remove from time to time the sludge that may collect in the bottom of the trenches, and the lower end should be effectually stopped up, so as to prevent sewage from escaping.

WARE. An application was received, Sept. 20, 1899, from the board of health of Ware, for the advice of the Board with reference to the use of a certain pond in that town as a source of ice supply. The Board replied to this application as follows: —

Nov. 3, 1899.

The State Board of Health has considered your application for advice with reference to a source of ice supply in the town of Ware, and has caused the pond from which the ice is taken and its surroundings to be examined by one of its engineers and samples of the water to be analyzed.

It appears that the pond is formed by flooding an area of about half an acre to a small depth, and the examinations show that the only sources from which the pond might be polluted at present are a house and barn situated near the brook a short distance above the pond. Drainage from the cow yard connected with the barn evidently finds its way into the brook, assisted by the flow of water from the water trough fed by a pipe from a spring; but it appears to be feasible to remove the cow yard to the other side of the barn, and prevent the direct contamination of the brook from this source. The sink drainage from the house flows into a cesspool located about 50 feet from the brook, and care must be taken to prevent the danger that any drainage may escape from this cesspool in such a way as to pollute the brook. If the danger of pollution of the pond by the cow yard or cesspool is prevented, the Board is of the opinion that this pond would be a suitable source of ice supply.

Attention has also been called to another pond, located on Muddy Brook, a short distance below the pond already referred to, which is threatened with contamination by the proposed deposit of night-soil in a pit not far from the pond. There is no doubt that the deposit of night-soil at this place would be a serious menace not only to the purity of the water of the ice pond but also of the water of the public water supply, which is drawn from the ground a short distance below this pond, and should be prevented.

Rules and Regulations for the Sanitary Protection of Sources of Water Supply.

The following rules and regulations were made by the Board June 20, 1899: —

Rules and Regulations for the Sanitary Protection of Waters used by the Metropolitan Water Board for the Water Supply of any City, Town or Water Company under the Authority of Chapter 488 of the Acts of 1895, and Acts in Amendment thereof, or Addition thereto.

The State Board of Health, acting under the authority of section 24 of chapter 488 of the Acts of the year 1895, hereby makes the following rules and regulations for the sanitary protection of all waters used by the Metropolitan Water Board for the water supply of any city, town or water company, under the authority of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, which shall remain in force until further order, and which may be hereafter from time to time amended or added to by the State Board of Health: —

1. No cesspool, privy or other place for the reception, deposit or storage of human excrement, and no urinal or water-closet not discharging into a sewer, shall be located, constructed or maintained within fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or within fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course, or other open waters the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board.

2. No human excrement shall be deposited or discharged in or into any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water com-

pany, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or into any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board; and no human excrement shall be kept in or deposited or discharged in or into any cesspool, privy or other receptacle situated within two hundred and fifty feet of high-water mark of any open waters so used by the Metropolitan Water Board, or within two hundred and fifty feet of high-water mark of any open waters flowing as aforesaid into waters so used by the Metropolitan Water Board, unless such cesspool, privy or other receptacle is so constructed that no portion of its contents can escape or be washed into any such waters.

3. No human excrement, or compost containing human excrement, or contents of any privy or cesspool or sewer, or other receptacle for the reception or storage of human excrement, shall be deposited or discharged upon or into the ground at any place from which any such excrement, compost or contents, or particles thereof, may flow or be washed or carried into any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or into any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board.

4. No house slops, sink waste, water which has been used for washing or cooking, or other polluted water, shall be discharged into any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or into any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board; no house slops, sink waste, water which has been used for washing or cooking, or other polluted water, shall be discharged into the ground within fifty feet, or upon the ground within two hundred and fifty feet, of high-water mark of any open waters so used by the Metropolitan Water Board, or into the ground within fifty feet, or upon the ground within two hundred and fifty feet, of high-water mark of any open waters flowing as aforesaid into waters so used by the Metropolitan Water Board.

5. No garbage, manure or putrescible matter whatsoever shall be put into any lake, pond, reservoir, stream, ditch, water course or other open waters,

used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or into any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board; and no garbage, manure or putrescible matter whatsoever shall, except in the cultivation and use of the soil in the ordinary methods of agriculture, be put upon the ground within two hundred and fifty feet of high-water mark of any open waters so used by the Metropolitan Water Board, or within two hundred and fifty feet of high-water mark of any open waters flowing as aforesaid into waters so used by the Metropolitan Water Board.

6. No stable, pig-sty, hen-house, barn-yard, hog-yard, hitching or standing place for horses, cattle or other animals, or other place where animal manure is deposited or accumulates, shall be located, constructed or maintained, any part of which is within fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or within fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board; and no stable or other place, as above enumerated, shall be located, constructed or maintained within two hundred and fifty feet of high-water mark of any open waters so used by the Metropolitan Water Board, or within two hundred and fifty feet of high water mark of any open waters flowing as aforesaid into waters so used by the Metropolitan Water Board, unless suitable and adequate provision is made to prevent any manure or other polluting matter from flowing or being washed into such open waters.

7. No interment shall, except by permission in writing by the Metropolitan Water Board, be made in any cemetery or other place of burial within fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or within fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board.

8. No lands, which were not under the control of cemetery authorities and used for cemetery purposes on July 1, 1899, from which the natural drainage flows into any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or into any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board, shall be taken or used for cemetery purposes until a plan and description of the lands which it is proposed to use for such purposes, sufficient for their identification, shall be presented to the State Board of Health, and until such taking or use shall be approved in writing by the State Board of Health.

9. No manufacturing refuse or waste products or polluting liquid, or other substance of a nature poisonous or injurious either to human beings or animals, or other putrescible organic matter whatsoever, shall be discharged directly into, or at any place from which it may flow or be washed or carried into, any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, or any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board.

10. No system of sewers or other works for the collection, conveyance, disposal or purification of domestic or manufacturing sewage or drainage, or any other putrescible organic matter whatsoever, shall, except in accordance with plans first approved in writing by the State Board of Health, be constructed or maintained at any place within the water-shed of any lake, pond, reservoir, stream, ditch, water course or other open waters used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto. No private or separate sewer shall be constructed or maintained having an outlet upon or in the ground within two hundred and fifty feet of high-water mark of any open waters so used by the Metropolitan Water Board, or within two hundred and fifty feet of high-water mark of any lake, pond, reservoir, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into any waters so used by the Metropolitan Water Board.

11. No public or private hospital, or other place intended for the recep-

tion or treatment of persons afflicted with a contagious or infectious disease, shall, until the location and construction thereof have been approved in writing by the State Board of Health, be located or constructed at any place within the water-shed of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto. No public or private hospital, or other place intended for the reception or treatment of persons afflicted with a contagious or infectious disease, shall be maintained at any place within such water-shed, unless all the provisions required by the State Board of Health for the purification or disposal of sewage, drainage or other polluting or organic matter, which may be discharged therefrom, have been complied with, and unless all orders issued from time to time by the State Board of Health in relation to the purification and disposal of sewage, drainage and other polluting or organic matter, which may be discharged therefrom, are fully complied with.

12. No tannery, currying shop or other establishment or place where the skins, wool, hair or fur of any animal are treated, shall, until the location and construction thereof have been approved in writing by the State Board of Health, be located or constructed at any place within the water-shed of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto. No tannery, currying shop or other establishment or place where the skins, wool, hair or fur of any animal are treated, shall be maintained at any place within such water-shed, unless all the provisions required by the State Board of Health for the purification or disposal of sewage, drainage or other polluting or organic matter, which may be discharged therefrom, have been complied with, and unless all orders issued from time to time by the State Board of Health in relation to the purification and disposal of sewage, drainage and other polluting or organic matter, which may be discharged therefrom, are fully complied with.

13. No slaughter house or other building for carrying on the business of slaughtering cattle, sheep or other animals, and no melting or rendering establishment, shall, until the location and construction thereof have been approved in writing by the State Board of Health, be located or constructed at any place within the water-shed of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water

Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto. No slaughter house or other building for carrying on the business of slaughtering cattle, sheep or other animals, and no melting or rendering establishment, shall be maintained at any place within such water-shed, unless all the provisions required by the State Board of Health for the purification or disposal of sewage, drainage or other polluting or organic matter, which may be discharged therefrom, have been complied with, and unless all orders issued from time to time by the State Board of Health in relation to the purification and disposal of sewage, drainage and other polluting or organic matter, which may be discharged therefrom, are fully complied with.

14. No person shall bathe in, and no person shall, unless permitted by a special regulation or by a written permit of the Metropolitan Water Board, fish in, or send, drive or put any animal into, the Wachusett reservoir, so called, the open channel of the Wachusett aqueduct, Sudbury reservoir, Hopkinton reservoir, Ashland reservoir, Farm Pond, Whitehall reservoir, Framingham reservoir No. 1, Framingham reservoir No. 2, Framingham reservoir No. 3, Lake Cochituate, Spot Pond, Chestnut Hill reservoir, or any other lake, pond, reservoir or stream used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto. No persons other than a member of the said Metropolitan Water Board, its officers, agents or employees, or public officers whose duties may so require, shall, unless so permitted by regulation or permit of the said Board, enter or go, in any boat, skiff, raft or other contrivance, on or upon the water of any of said reservoirs, or said lake, ponds or open channel, or of other such lakes, ponds or reservoirs, nor shall enter or go upon, or drive any animal upon the ice of, any of said waters or other such lakes, ponds, reservoirs or streams.

15. No person shall enter upon the Wachusett reservoir, so called, Sudbury reservoir, the open channel of the Wachusett aqueduct, Hopkinton reservoir, Ashland reservoir, Framingham reservoir No. 1, Framingham reservoir No. 2, Framingham reservoir No. 3, Farm Pond, Whitehall reservoir, Lake Cochituate, Spot Pond, Chestnut Hill reservoir, or any other lake, pond or reservoir used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, for the purpose of cutting or taking ice, or cut or take ice from any such

lake, pond or reservoir, without a written permit, signed by the Metropolitan Water Board, stating the time and place for which such permission is given.

16. All reports which may be made to any board of health, or to any health officer of any city or town, of cases of contagious or infectious diseases occurring within the water-shed of any lake, pond, reservoir, stream, ditch, water course or other open waters, used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, shall be open to the inspection at all reasonable times of the Metropolitan Water Board, its officers or agents.

17. Nothing contained in these rules shall prevent the Metropolitan Water Board from making or enforcing such further rules, regulations and orders, not inconsistent with these rules, as it may deem necessary for carrying out the provisions of chapter 488 of the Acts of the year 1895, and acts amendatory thereof and additional thereto.

By order of the Board, SAMUEL W. ABBOTT,
Secretary.

The following rules and regulations were made by the Board Aug. 3, 1899: —

Rules and Regulations for the Purpose of preventing the Pollution and securing the Sanitary Protection of the Waters of Stony Brook Reservoir and its Tributaries, used by the City of Cambridge as a Source of Water Supply.

The State Board of Health, acting under the authority of section 1 of chapter 510 of the Acts of the year 1897, and every other act thereto enabling, hereby makes the following rules and regulations for the purpose of preventing the pollution and securing the sanitary protection of the waters of Stony Brook reservoir and its tributaries, used by the city of Cambridge as a source of water supply, which shall remain in force until further order, and which may be hereafter from time to time amended or added to by the State Board of Health: —

1. No cesspool, privy or other place for the reception, deposit or storage of human excrement, and no urinal or water-closet not discharging into a sewer, shall be located, constructed or maintained within fifty feet of high-water mark of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or within fifty feet of high-water mark of any reservoir, lake, pond, stream, ditch, water course or other open

waters, the water of which flows directly or ultimately into said Stony Brook reservoir.

2. No human excrement shall be deposited or discharged in or into Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or into any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir; and no human excrement shall be kept in, or deposited or discharged in or into, any cesspool, privy or other receptacle situated within two hundred and fifty feet of high-water mark of said Stony Brook reservoir, or within two hundred and fifty feet of high-water mark of any open waters the water of which flows directly or ultimately into said Stony Brook reservoir, unless such cesspool, privy or other receptacle is so constructed that no portion of its contents can escape or be washed into any such waters.

3. No human excrement, or compost containing human excrement, or contents of any privy or cesspool or sewer, or other receptacle for the reception or storage of human excrement, shall be deposited or discharged upon or into the ground at any place from which any such excrement, compost or contents, or particles thereof, may flow or be washed or carried into Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or into any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir.

4. No house slops, sink waste, water which has been used for washing or cooking, or other polluted water, shall be discharged into Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or into any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir; no house slops, sink waste, water which has been used for washing or cooking, or other polluted water, shall be discharged into the ground within fifty feet, or upon the ground within two hundred and fifty feet, of high-water mark of said Stony Brook reservoir, or into the ground within fifty feet, or upon the ground within two hundred and fifty feet, of high-water mark of any open waters flowing as aforesaid into said Stony Brook reservoir.

5. No garbage, manure or putrescible matter whatsoever shall be put into Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or into any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately

into said Stony Brook reservoir; and no garbage, manure or putrescible matter whatsoever shall, except in the cultivation and use of the soil in the ordinary methods of agriculture, be put upon the ground within two hundred and fifty feet of high-water mark of said Stony Brook reservoir, or within two hundred and fifty feet of high-water mark of any open waters flowing as aforesaid into said Stony Brook reservoir.

6. No stable, pig-sty, hen-house, barn-yard, hog-yard, hitching or standing place for horses, cattle or other animals, or other place where animal manure is deposited or accumulates, shall be located, constructed or maintained, any part of which is within fifty feet of high-water mark of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or within fifty feet of high-water mark of any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir. No stable or other places, as above enumerated, shall be located, constructed or maintained within two hundred and fifty feet of high-water mark of said Stony Brook reservoir, or within two hundred and fifty feet of high-water mark of any open waters flowing as aforesaid into said Stony Brook reservoir, unless suitable and adequate provision is made to prevent any manure or other polluting matter from flowing or being washed into said reservoir or such open waters.

7. No interment shall, except by permission in writing by the Cambridge water board, be made in any cemetery or other place of burial, within fifty feet of high-water mark of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or within fifty feet of high-water mark of any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir.

8. No lands, which were not under the control of cemetery authorities and used for cemetery purposes on July 20, 1899, from which the natural drainage flows into Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or into any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir, shall be taken or used for cemetery purposes until a plan and description of the lands which it is proposed to use for such purposes, sufficient for their identification, shall be presented to the State Board of Health, and until such taking or use shall be approved in writing by the State Board of Health.

9. No manufacturing refuse or waste products or polluting liquid, or other substance of a nature poisonous or injurious either to human beings

or animals, or other putrescible organic matter whatsoever, shall be discharged directly into, or at any place from which it may flow or be washed or carried into, Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or into any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir.

10. No system of sewers or other works for the collection, conveyance, disposal or purification of domestic or manufacturing sewage or drainage, or any other putrescible organic matter whatsoever, shall, except in accordance with plans first approved in writing by the State Board of Health, be constructed or maintained at any place within the water-shed of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply. No private or separate sewer shall be constructed or maintained, having an outlet upon or in the ground within two hundred and fifty feet of high-water mark of said Stony Brook reservoir, or within two hundred and fifty feet of high-water mark of any reservoir, lake, pond, stream, ditch, water course or other open waters, the water of which flows directly or ultimately into said Stony Brook reservoir.

11. No public or private hospital, or other place intended for the reception or treatment of persons afflicted with a contagious or infectious disease, shall, until the location and construction thereof have been approved in writing by the State Board of Health, be located or constructed at any place within the water-shed of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply. No public or private hospital, or other place intended for the reception or treatment of persons afflicted with a contagious or infectious disease, shall be maintained at any place within such water-shed, unless all the provisions required by the State Board of Health for the purification or disposal of sewage, drainage or other polluting or organic matter, which may be discharged therefrom, have been complied with, and unless all orders issued from time to time by the State Board of Health in relation to the purification and disposal of sewage, drainage and other polluting or organic matter, which may be discharged therefrom, are fully complied with.

12. No tannery, currying shop, or other establishment or place where the skins, wool, hair or fur of any animal are treated, shall, until the location and construction thereof have been approved in writing by the State Board of Health, be located or constructed at any place within the water-shed of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply. No tannery, currying shop, or other

establishment or place where the skins, wool, hair or fur of any animal are treated, shall be maintained at any place within such water-shed, unless all the provisions required by the State Board of Health for the purification or disposal of sewage, drainage or other polluting or organic matter, which may be discharged therefrom, have been complied with, and unless all orders issued from time to time by the State Board of Health in relation to the purification and disposal of sewage, drainage and other polluting or organic matter, which may be discharged therefrom, are fully complied with.

13. No slaughter house or other building for carrying on the business of slaughtering cattle, sheep or other animals, and no melting or rendering establishment, shall, until the location and construction thereof have been approved in writing by the State Board of Health, be located or constructed at any place within the water-shed of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply. No slaughter house or other building for carrying on the business of slaughtering cattle, sheep or other animals, and no melting or rendering establishment, shall be maintained at any place within such water-shed, unless all the provisions required by the State Board of Health for the purification or disposal of sewage, drainage or other polluting or organic matter, which may be discharged therefrom, have been complied with, and unless all orders issued from time to time by the State Board of Health in relation to the purification and disposal of sewage, drainage and other polluting or organic matter, which may be discharged therefrom, are fully complied with.

14. No person shall bathe in, and no person shall, unless permitted by a special regulation or by a written permit of the Cambridge water board, fish in, or send, drive or put any animal into Stony Brook reservoir, so called, said reservoir being in the town of Weston and the City of Waltham, and used by the city of Cambridge as a source of water supply, nor into the reservoir known as the Hobbs Brook reservoir. No person other than a member of said Cambridge water board, its officers, agents or employees, or public officers whose duties may so require, shall, unless so permitted by regulation or permit of said Board, enter or go, in any boat, skiff, raft or other contrivance, on or upon the water of either of said reservoirs, nor shall enter or go upon, or drive any animal upon, the ice of said waters.

15. No person shall enter upon the Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, or the reservoir known as the Hobbs Brook reservoir, for the purpose of cutting or taking ice, or cut or take ice from either of said reservoirs, without a writ-

ten permit, signed by the Cambridge water board, stating the time and place for which such permission is given.

16. All reports which may be made to any board of health, or to any health officer of any city or town, of cases of contagious or infectious disease occurring within the water-shed of Stony Brook reservoir, so called, said reservoir being in the town of Weston and the city of Waltham, and used by the city of Cambridge as a source of water supply, shall be open to the inspection, at all reasonable times, of the Cambridge water board, its officers or agents.

By order of the Board, SAMUEL W. ABBOTT,
Secretary.

EXAMINATION OF WATER SUPPLIES.

EXAMINATION OF WATER SUPPLIES.

EXPLANATORY NOTE.

The systematic examination of the water supplies of Massachusetts was begun by the State Board of Health June 1, 1887, and has been continued up to the present time. The results of the investigations which were made during the first two years were published in the special report of the Board upon the Examination of Water Supplies (1890), and the results of examinations made in succeeding years have been published in the annual reports of the Board beginning with the twenty-second annual report (1890).

The special report upon the Examination of Water Supplies contains descriptions of each of the water supplies in the State existing at the date of that report, and the results of chemical and microscopical examinations of samples of water collected from the principal sources of supply. The annual reports, beginning with the report for the year 1890, contain descriptions of all new works and the important changes in existing works, together with the results of the chemical and microscopical examinations which have been made of the various sources of supply.

In the annual report for the year 1898 a brief description of the sources of supply was given in cases where a knowledge of the conditions and the surroundings of the source would assist materially in understanding and interpreting the analyses. In the present report the descriptions of sources of supply have been omitted except in a few cases where the sources are new and have not previously been described.

In certain cases, where a number of samples from one source have been analyzed during the year, and the results of the various analyses show no marked changes from time to time, the results of the analysis of each individual sample have been omitted and only the average of the results of all the analyses of the water of this source made during the year are given.

The average analyses of former years are generally omitted, except those of sources in which there has been some very marked change in the character of the water during the period covered by the examinations.

Microscopical examinations have been made of nearly all of the samples from surface water sources which have been examined chemically, and the methods employed have remained unchanged. The results of these examinations have been generally omitted in this report, except in cases where certain organisms which are known to have given trouble in water supplies by causing disagreeable tastes and odors have been found in considerable numbers.

In this report, as in former reports, an alphabetical arrangement by towns has been followed, the source of supply being tabulated under the name of the town supplied, except that the description and analyses of the sources used for the supply of the Metropolitan Water District are placed at the beginning. Waters not used as sources of supply are tabulated under the name of the towns in which they are situated. The analyses of samples collected from rivers not used directly as sources of water supply are given in a subsequent chapter on the "Examination of Rivers," and the results are tabulated alphabetically by the name of the river.

The method of making the chemical examinations has not been changed during the past year. All surface waters and such samples of ground water as contain suspended matter are filtered through filter-paper before determining the color, the residue on evaporation, the albuminoid ammonia in solution and the oxygen consumed. Some ground waters which are perfectly clear and colorless when drawn from the ground become turbid and colored on standing, in consequence of the oxidation of the iron which they contain. In these waters the residue on evaporation is determined without filtration, since this ~~iron is~~ an essential and not an accidental ingredient in the water. In the changes which accompany the oxidation of the iron in waters of this character, they become first cloudy (well described by the word *milky*), and finally deposit a precipitate of oxide of iron. In the cloudy condition they have a distinct color, which, while it does not have the same significance as in the case of surface waters, and is only a passing phenomenon, is, nevertheless, of interest, as showing a color which the water may assume while the oxidation of the iron is in progress. When the iron is all oxidized and precipitated the water may become colorless again. In some cases, however, the iron occurs in combination with organic matter, forming a much more stable body. In such cases the water is of a brown color when first drawn from the ground, and, while the iron begins to oxidize soon after the water is exposed to the air, the process goes on slowly, and the water may remain colored and iron continue to precipitate for a long time.

The color of the water is expressed by numbers, which increase with the amount of color. The standards used are natural waters, the color of which has been accurately determined by comparing them with the nesslerized ammonia standards which were described on page 531 of the special report upon the Examination of Water Supplies (1890), and on page 329 of the annual report for 1892. By using natural waters as standards for comparison, the apparent rather than the actual color is obtained, as a natural water nearly always has a greater or less turbidity, which gives the water the appearance of having a greater color than the water would have if there were no turbidity.

The rainfall during the year 1899 was unusually light, especially during the last nine months of the year, in consequence of which the flow of streams was very small and many storage reservoirs used as sources of water supply were drawn to a low level. The ground-water level was also much lower than is usual during an ordinary year.

Tables showing the daily rainfall at various places in the State, the average rainfall for a large number of years and the flow of some of the streams in the State, are given in a subsequent chapter, entitled "Water Supply Statistics and Flow of Streams."

EXAMINATION OF WATER SUPPLIES.

Water Supply of Metropolitan Water District.

During the year 1899 water was supplied from the Metropolitan Water Works to the following cities and towns: —

City or Town.	Population in 1895.
Boston,	496,920
Somerville,	52,200
Chelsea,	31,264
Malden,*	29,708
Arlington,*	6,515
Quincy,	20,712
Everett,	18,573
Medford,*	14,474
Melrose,	11,965
Watertown,	7,788
Revere,*	7,423
Winthrop,*	4,192
Belmont,	2,843
Nahant,*	865
Swampscott,*	3,259
Total population of cities and towns supplied,	708,701

* Partially supplied from local sources.

Water from the Nashua River has been drawn nearly every day in the year through the Wachusett Aqueduct into the Sudbury Reservoir, from which it is discharged into Framingham Reservoir No. 3 and thence sent to Chestnut Hill Reservoir and supplied to the district. After June 16 water was also drawn from Framingham Reservoir No. 2, and water from Lake Cochituate was used from July 28 to November 6. Spot Pond was used for the supply of Melrose from the beginning of the year until April 24, after which its use was discontinued.

A copy of the rules and regulations made by the State Board of Health for the sanitary protection of the waters used by the Metropolitan Water Board for the water supply of the district may be found on pages 110 to 116 of this volume.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from the Quinepoxet River in Holden.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25849	Jan. 4	V. slight.	Cons.	.36	3.50	1.40	.0000	.0160	.0106	.0054	.20	.0040	.0000	0.44	0.5
26138	Feb. 6	V. slight.	Slight.	.29	3.00	1.00	.0006	.0122	.0088	.0034	.20	.0080	.0001	0.36	0.6
26382	Mar. 8	V. slight.	V. slight.	.31	2.95	1.20	.0016	.0188	.0174	.0014	.17	.0130	.0001	0.38	0.5
26678	Apr. 5	V. slight.	Slight.	.28	2.10	0.95	.0000	.0170	.0146	.0024	.12	.0050	.0000	0.36	0.2
27016	May 3	V. slight.	Slight.	.60	3.10	1.60	.0016	.0234	.0174	.0060	.14	.0080	.0001	0.68	0.2
27327	June 5	V. slight.	Slight.	.48	2.75	1.50	.0088	.0260	.0200	.0060	.15	.0070	.0000	0.57	0.2
27716	July 10	Slight.	Cons.	.72	3.95	2.00	.0016	.0408	.0322	.0086	.16	.0060	.0002	1.05	0.5
27935	July 31	V. slight.	Slight.	.54	3.75	1.95	.0076	.0304	.0256	.0048	.20	.0030	.0000	0.64	0.6
28461	Sept. 1	Slight.	Slight.	.43	4.50	2.10	.0086	.0296	.0270	.0026	.28	.0000	.0001	0.57	0.8
28864	Oct. 2	Decided.	Cons.	.45	4.75	2.35	.0024	.0372	.0266	.0106	.22	.0000	.0004	0.60	0.8
29358	Nov. 10	Decided.	Cons.	.65	4.90	1.95	.0002	.0344	.0274	.0070	.27	.0040	.0004	0.88	0.8
29601	Dec. 7	Decided.	Slight.	.61	4.55	2.25	.0002	.0270	.0194	.0076	.25	.0020	.0001	0.65	0.8

Averages by Years.

-	1892	-	-	.62	3.70	1.49	.0014	.0194	.0158	.0036	.19	.0088	.0001	-	0.9
-	1894	-	-	.61	3.35	1.47	.0041	.0214	.0171	.0043	.29	.0027	.0001	0.58	0.7
-	1895	-	-	.77	4.47	1.97	.0020	.0289	.0239	.0050	.26	.0090	.0008	0.78	0.9
-	1896	-	-	.64	3.74	1.67	.0012	.0250	.0210	.0040	.19	.0045	.0000	0.71	0.4
-	1897	-	-	.77	3.38	1.78	.0032	.0275	.0232	.0043	.21	.0055	.0001	0.73	0.8
-	1898	-	-	.62	3.47	1.55	.0030	.0248	.0215	.0033	.21	.0037	.0001	0.60	0.8
-	1899	-	-	.48	3.65	1.69	.0028	.0261	.0206	.0055	.19	.0046	.0001	0.60	0.5

NOTE to analyses of 1899: Odor, generally faintly vegetable, occasionally unpleasant, becoming stronger on heating.——The samples were collected from the river, at Smith's Woolen Mill in Holden, and 1,000 feet above the boundary line between Holden and West Boylston. This river is one of the principal tributaries of the South Branch of the Nashua River above the point from which the metropolitan water supply is drawn.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Stillwater River in Sterling.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25850	Jan. 4	V. slight.	V. slight.	.30	2.75	1.00	.0004	.0098	.0094	.0004	.16	.0020	.0000	.35	0.5
26139	Feb. 6	V. slight.	V. slight.	.20	2.75	1.25	.0010	.0116	.0098	.0018	.15	.0010	.0001	.32	0.6
26383	Mar. 3	V. slight.	V. slight.	.22	2.65	0.75	.0012	.0120	.0110	.0010	.14	.0090	.0000	.33	0.5
26679	Apr. 5	V. slight.	V. slight.	.21	2.45	0.90	.0010	.0146	.0132	.0014	.13	.0000	.0000	.32	0.2
27017	May 3	V. slight.	V. slight.	.52	2.75	1.25	.0010	.0184	.0172	.0012	.16	.0060	.0001	.57	0.3
27328	June 5	V. slight.	Slight.	.35	2.40	1.25	.0014	.0196	.0160	.0036	.11	.0030	.0000	.51	0.3
27717	July 10	V. slight.	Slight.	.60	3.25	1.50	.0014	.0238	.0210	.0028	.12	.0020	.0001	.67	0.5
27936	July 31	V. slight.	Slight.	.37	3.50	1.60	.0032	.0234	.0176	.0058	.15	.0040	.0000	.47	0.6
28462	Sept. 1	V. slight.	Slight.	.31	4.45	1.60	.0122	.0220	.0188	.0032	.20	.0030	.0001	.43	0.6
28865	Oct. 2	Slight.	Slight.	.28	3.90	1.35	.0006	.0252	.0238	.0014	.20	.0010	.0000	.48	0.6
29359	Nov. 10	V. slight.	Slight.	.30	4.70	1.55	.0002	.0184	.0150	.0034	.29	.0240	.0000	.40	1.1
29602	Dec. 7	V. slight.	V. slight.	.22	3.35	1.40	.0000	.0132	.0116	.0016	.19	.0050	.0000	.39	0.8

Averages by Years.

-	1892	-	-	.44	3.38	1.18	.0001	.0131	.0109	.0022	.13	.0072	.0000	-	0.9
-	1894	-	-	.45	3.20	1.14	.0008	.0137	.0115	.0022	.18	.0017	.0000	.44	0.8
-	1895	-	-	.52	3.48	1.45	.0008	.0179	.0161	.0018	.19	.0051	.0000	.58	0.9
-	1896	-	-	.50	3.32	1.35	.0016	.0229	.0203	.0026	.16	.0035	.0000	.62	0.7
-	1897	-	-	.66	3.47	1.58	.0013	.0199	.0182	.0017	.17	.0037	.0000	.67	0.8
-	1898	-	-	.51	3.02	1.31	.0008	.0158	.0142	.0016	.16	.0026	.0001	.50	0.8
-	1899	-	-	.31	3.24	1.28	.0020	.0177	.0154	.0023	.17	.0050	.0000	.44	0.5

NOTE to analyses of 1899: Odor, generally faintly vegetable, occasionally unpleasant, becoming stronger on heating.——The samples were collected from the river, at a highway bridge about 1 mile above the boundary line between Sterling and West Boylston. The river is one of the principal tributaries of the South Branch of the Nashua River above the point from which the Metropolitan water supply is drawn.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from the South Branch of the Nashua River above Clinton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25818	Jan. 2	V. slight.	V. slight.	.33	3.40	1.25	.0006	.0160	.0140	.0020	.24	.0060	.0002	.42	0.8
26090	Jan. 31	V. slight.	V. slight.	.22	2.75	1.10	.0002	.0104	.0082	.0022	.13	.0020	.0001	.36	0.8
26359	Feb. 28	Slight.	Slight.	.21	2.90	1.10	.0014	.0116	.0092	.0024	.15	.0100	.0000	.29	0.6
26635	Apr. 3	Slight.	V. slight.	.20	2.70	1.15	.0008	.0158	.0138	.0020	.14	.0060	.0000	.32	0.3
26979	May 1	Slight.	Slight.	.34	3.10	1.15	.0034	.0196	.0172	.0024	.16	.0070	.0000	.42	0.5
27286	May 31	V. slight.	Slight.	.32	3.05	1.20	.0036	.0176	.0152	.0024	.18	.0050	.0000	.34	1.0
27657	July 5	Decided.	Cons.	.40	3.60	1.35	.0014	.0210	.0186	.0024	.17	.0030	.0001	.52	1.1
27937	July 31	V. slight.	V. slight.	.26	4.25	1.80	.0012	.0242	.0206	.0036	.17	.0050	.0000	.44	1.4
28423	Aug. 31	Slight.	Cons.	.30	4.55	1.80	.0020	.0196	.0170	.0026	.21	.0040	.0001	.45	0.8
28854	Oct. 2	Slight.	Slight.	.30	4.85	1.60	.0016	.0186	.0162	.0024	.25	.0040	.0001	.41	0.8
29202	Oct. 31	Slight.	Slight.	.31	4.55	1.35	.0026	.0270	.0246	.0024	.30	.0050	.0001	.37	1.8
29524	Nov. 28	Decided.	Slight.	.40	4.15	1.25	.0006	.0252	.0188	.0064	.26	.0070	.0001	.43	1.3

Averages by Years.

-	1894	-	-	.44	3.81	1.27	.0014	.0154	.0123	.0031	.25	.0042	.0000	.42	1.1
-	1895	-	-	.46	4.00	1.44	.0017	.0226	.0189	.0037	.26	.0090	.0000	.53	1.3
-	1896	-	-	.43	3.56	1.37	.0023	.0199	.0167	.0032	.18	.0045	.0000	.49	1.2
-	1897	-	-	.47	3.81	1.39	.0015	.0177	.0149	.0028	.21	.0057	.0000	.47	1.1
-	1898	-	-	.49	3.53	1.54	.0013	.0178	.0156	.0022	.20	.0052	.0000	.51	1.0
-	1899	-	-	.30	3.65	1.34	.0016	.0189	.0161	.0028	.20	.0053	.0001	.40	0.9

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes unpleasant. —— The samples were collected from the river, at the place where water is diverted for use in supplying the Metropolitan Water District.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Walker's Brook, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Suspended.					
	1899.														
25811	Jan. 2	Decided.	Cons.	.41	13.35	4.00	.0664	.0240	.0160	.0080	1.43	.2680	.0017	.46	4.4
26075	Jan. 31	Decided.	Slight.	.13	13.20	4.50	.1132	.0144	.0104	.0040	1.46	.2500	.0021	.29	4.6
26363	Feb. 28	Decided.	Slight.	.48	7.55	2.40	.0796	.0388	.0308	.0080	0.75	.0600	.0018	.60	2.5
26650	Apr. 3	Decided.	V. slight.	.51	9.75	3.20	.0792	.0248	.0188	.0060	0.88	.1500	.0014	.59	3.1
26985	May 1	V. slight.	V. slight.	.49	11.85	3.50	.1160	.0320	.0280	.0040	1.28	.2550	.0032	.54	4.0
27298	May 31	Decided.	Cons.	.36	14.00	4.20	.0616	.0440	.0284	.0156	1.62	.2000	.0090	.46	4.6
27661	July 5	Decided.	Cons.	.38	16.95	3.20	.0072	.0828	.0428	.0400	2.16	.0270	.0068	.71	5.9
27942	July 31	Decided.	Cons.	.30	16.85	4.00	.0924	.0700	.0528	.0172	1.70	.0300	.0048	.95	4.6
28422	Aug. 31	Decided.	Cons.	.60	18.15	4.85	.0060	.0975	.0520	.0455	2.11	.0620	.0100	.97	4.9
28851	Oct. 2	Decided.	Heavy.	.60	17.75	3.25	.0920	.0710	.0450	.0260	2.50	.0520	.0060	.64	6.0
29188	Oct. 31	Decided.	Cons.	.57	19.65	4.20	.0128	.0880	.0410	.0470	3.32	.0320	.0050	.55	6.3
29610	Nov. 28	Decided.	Slight.	.62	19.40	4.95	.1360	.0345	.0295	.0050	2.38	.1128	.0040	.66	6.7

Averages by Years.

-	1892	-	-	.49	16.84	4.35	.0307	.0274	.0225	.0048	2.58	.2975	.0037	-	5.7
-	1893	-	-	.38	14.05	3.94	.0337	.0257	.0180	.0077	1.96	.1878	.0020	.39	5.2
-	1894	-	-	.46	14.14	3.62	.0371	.0217	.0171	.0046	2.08	.1883	.0018	.47	4.9
-	1895	-	-	.57	14.71	3.79	.0292	.0256	.0214	.0042	2.04	.1768	.0035	.58	5.1
-	1896	-	-	.68	14.58	3.97	.0436	.0290	.0236	.0054	1.99	.1576	.0043	.68	5.0
-	1897	-	-	.72	14.70	4.20	.0679	.0268	.0245	.0023	2.01	.1544	.0055	.68	5.6
-	1898	-	-	.58	14.53	4.43	.0569	.0230	.0206	.0024	1.71	.2068	.0046	.56	5.1
-	1899	-	-	.50	14.87	3.85	.0719	.0518	.0330	.0188	1.80	.1248	.0046	.62	4.8

NOTE to analyses of 1899: Odor, generally faintly vegetable and unpleasant, sometimes musty, becoming stronger on heating. —— The samples were collected from the brook at the first road bridge below Maple Street, about 1 mile south of the centre of the city of Marlborough. This brook is one of the tributaries of Stony Brook above the Sudbury Reservoir.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Sudbury Reservoir, collected near the Surface.

[Parts per 100,000.]

Date of Collection.	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.
1899.												
January, .	.35	3.54	1.31	.0006	.0118	.0107	.0011	.20	.0140	.0000	.43	1.1
February, .	.26	3.42	1.24	.0021	.0115	.0093	.0022	.18	.0082	.0001	.38	0.9
March, . .	.24	3.12	1.17	.0042	.0128	.0108	.0020	.15	.0100	.0001	.33	0.7
April, . .	.24	3.30	1.17	.0035	.0121	.0108	.0013	.18	.0142	.0001	.33	0.7
May, . .	.21	3.00	1.02	.0012	.0144	.0126	.0018	.17	.0112	.0001	.31	0.7
June, . .	.19	3.31	1.16	.0006	.0154	.0122	.0032	.20	.0050	.0001	.32	0.8
July, . .	.12	3.19	0.98	.0004	.0163	.0142	.0021	.19	.0020	.0001	.33	1.0
August, . .	.10	3.19	1.00	.0002	.0149	.0133	.0016	.20	.0017	.0000	.33	0.9
September, .	.12	3.30	1.13	.0011	.0168	.0145	.0023	.21	.0013	.0000	.29	0.9
October, . .	.10	3.34	1.10	.0016	.0166	.0153	.0013	.23	.0020	.0000	.28	1.0
November, .	.13	3.34	1.05	.0022	.0156	.0137	.0019	.24	.0020	.0000	.27	1.1
December, .	.21	4.05	1.34	.0025	.0158	.0145	.0013	.25	.0042	.0001	.32	1.2
Average, .	.19	3.34	1.14	.0017	.0145	.0126	.0019	.20	.0063	.0001	.33	0.9

Odor, generally faintly vegetable, sometimes none. On heating, the odor of all of the samples became vegetable and sometimes unpleasant.——Each analysis is the average of analyses of samples collected weekly from the reservoir, near the gate-house, at a depth of 1 foot beneath the surface. For monthly record of height of water in this reservoir, see table on page 152.

*Microscopical Examination of Water from Sudbury Reservoir, collected near the Surface.**

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS.												
Diatomaceæ, ...	27	6	8	86	151	962	1,404	478	346	199	202	65
Asterionella, ...	18	4	6	61	34	261	219	97	123	81	140	34
Cyclotella, ...	2	0	0	1	3	79	506	70	20	46	41	19
Synedra, ...	1	1	2	12	70	156	42	30	30	14	4	4
Tabellaria, ...	0	0	0	8	43	459	708	263	141	38	8	6
Cyanophyceæ, ...	0	0	0	0	3	25	5	34	37	8	3	0
Anabæna, ...	0	0	0	0	3	25	4	26	36	8	3	0
Algæ, ...	5	0	0	1	13	108	18	19	79	26	6	5
Protococcus, ...	0	0	0	0	9	98	12	3	43	16	2	4

* The figures given in this table are averages of weekly examinations.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Sudbury Reservoir, collected near the Surface — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda,	0	0	0	2	0	0	0	1	0	0	0	0
Infusoria,	4	8	808	128	14	30	8	31	64	8	7	5
Dinobryon,	3	2	4	114	10	1	3	16	50	1	5	5
Monas,	0	0	800	2	0	1	0	2	0	0	0	0
Peridinium,	0	2	1	1	1	20	2	3	1	0	0	0
Vermes,	0	0	0	0	3	2	1	1	1	1	1	1
Crustacea,	pr.	pr.	pr.	0	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.
Bosmina,	0	pr.	0	0	0	0	0	0	0	0	pr.	0
Canthocamptus,	0	pr.	0	0	0	0	0	0	0	0	0	0
Cyclops,	pr.	0	pr.	0	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.
Daphnia,	pr.	0	0	0	pr.	pr.	pr.	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	3	2	8	14	9	7	8	10	8	8	8	4
TOTAL,	39	16	824	231	193	1,134	1,534	574	535	251	227	80

Chemical Examination of Water from Sudbury Reservoir, collected about Midway between the Surface and Bottom.

[Parts per 100,000.]

Date of Collection.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1899.												
January,	.42	5.29	1.81	.0053	.0145	.0138	.0007	.31	.0244	.0001	.49	1.9
February,	.30	4.22	1.66	.0050	.0111	.0099	.0012	.26	.0167	.0002	.42	0.5
March,	.27	3.89	1.29	.0085	.0117	.0106	.0011	.24	.0190	.0002	.36	1.1
April,	.25	3.80	1.36	.0071	.0114	.0106	.0008	.25	.0207	.0001	.33	0.9
May,	.21	3.17	1.16	.0024	.0130	.0118	.0012	.19	.0140	.0001	.32	0.8
June,	.19	3.36	1.20	.0039	.0130	.0107	.0023	.19	.0045	.0001	.32	0.7
July,	.12	3.14	1.00	.0018	.0148	.0129	.0019	.19	.0022	.0000	.31	0.9
August,	.10	3.37	1.06	.0010	.0141	.0129	.0012	.20	.0012	.0000	.32	0.9
September,	.12	3.05	1.17	.0011	.0160	.0143	.0017	.21	.0008	.0000	.29	1.0
October,	.10	3.36	1.18	.0026	.0159	.0144	.0015	.23	.0024	.0000	.23	1.1
November,	.13	3.45	1.11	.0024	.0159	.0140	.0019	.23	.0022	.0000	.26	1.1
December,	.21	4.15	1.32	.0027	.0152	.0140	.0012	.25	.0037	.0001	.32	1.3
Average,	.20	3.69	1.28	.0036	.0139	.0125	.0014	.23	.0093	.0001	.33	1.1

Odor, faintly vegetable or none. A faintly vegetable odor was developed in all of the samples on heating. —— Each analysis is the average of analyses of samples collected weekly from the reservoir, near the gate-house, at depths ranging from 22 to 27 feet beneath the surface. For monthly record of height of water in this reservoir, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Sudbury Reservoir, collected about Midway between the Surface and Bottom.*

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS.												
Diatomaceæ,	18	6	5	15	100	493	1,078	466	280	169	186	79
Asterionella,	6	4	4	27	35	201	286	92	81	47	121	36
Cyclotella,	8	1	0	1	1	32	229	46	9	30	27	22
Synedra,	3	2	0	5	18	66	14	9	19	10	3	6
Tabellaria,	1	0	0	6	36	190	538	276	132	45	10	3
Cyanophyceæ,	0	0	0	0	2	5	2	18	11	4	0	0
Anabæna,	0	0	0	0	2	5	1	15	11	4	0	0
Algæ,	0	0	0	0	27	24	10	14	38	21	9	7
ANIMALS.												
Rhizopoda,	0	0	1	1	0	0	0	0	0	0	0	0
Infusoria,	1	4	1	37	12	5	4	13	12	7	6	7
Dinobryon,	0	3	0	30	5	1	1	6	10	3	5	6
Vermes,	0	0	0	0	1	1	0	1	0	0	0	0
Crustacea,	pr.	0	0	0	pr.	0	pr.	pr.	pr.	pr.	pr.	pr.
Bosmina,	0	0	0	0	0	0	0	0	0	0	pr.	0
Cyclops,	pr.	0	0	0	pr.	0	pr.	pr.	pr.	pr.	pr.	pr.
Daphnella,	0	0	0	0	0	0	0	pr.	pr.	0	0	0
Miscellaneous, Zoöglœa,	4	6	8	10	6	6	5	10	7	9	7	4
TOTAL,	23	18	15	63	150	534	1,099	522	326	210	188	97

* The figures given in this table are averages of weekly examinations.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Sudbury Reservoir, collected near the Bottom.

[Parts per 100,000.]

Date of Collection.	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.
1899.												
January,	.42	5.74	1.92	.0064	.0143	.0138	.0005	.37	.0340	.0002	.50	2.2
February,	.31	5.05	1.70	.0060	.0119	.0109	.0010	.32	.0200	.0002	.42	1.7
March,	.27	4.14	1.40	.0079	.0116	.0103	.0013	.26	.0182	.0002	.37	1.3
April,	.24	3.97	1.47	.0065	.0110	.0105	.0005	.24	.0207	.0001	.33	0.9
May,	.20	3.27	1.11	.0036	.0114	.0100	.0014	.19	.0158	.0001	.31	0.6
June,	.19	3.22	1.16	.0052	.0108	.0095	.0013	.19	.0130	.0001	.31	0.8
July,	.13	3.22	1.08	.0055	.0138	.0127	.0011	.19	.0022	.0001	.32	0.9
August,	.11	3.31	1.06	.0033	.0137	.0125	.0012	.20	.0015	.0000	.33	.09
September,	.13	3.23	1.25	.0020	.0174	.0154	.0020	.21	.0006	.0000	.28	1.0
October,	.11	3.36	1.06	.0028	.0158	.0143	.0015	.23	.0022	.0001	.27	1.1
November,	.12	3.40	1.12	.0026	.0150	.0138	.0012	.23	.0027	.0000	.26	1.1
December,	.24	4.07	1.37	.0027	.0147	.0137	.0010	.26	.0040	.0001	.32	1.3
Average,	.21	3.83	1.31	.0046	.0134	.0123	.0011	.24	.0112	.0001	.33	1.1

Odor, generally faintly vegetable, sometimes none. On heating, the odor of all the samples was vegetable and sometimes also grassy.——Each analysis is the average of analyses of samples collected weekly from the reservoir, near the gate-house. For monthly record of height of water in this reservoir, see table on page 152.

*Microscopical Examination of Water from Sudbury Reservoir, collected near the Bottom.**

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS.												
Diatomaceæ,	11	13	3	28	42	129	686	295	230	193	150	62
Asterionella,	8	9	1	17	17	46	229	50	46	63	112	26
Cyclotella,	4	1	0	1	0	5	128	17	16	25	20	28
Tabellaria,	0	0	0	4	11	57	306	177	135	50	14	3
Cyanophyceæ,	0	0	0	0	0	0	0	14	13	7	0	0
Anabæna,	0	0	0	0	0	0	0	11	13	6	0	0
Algæ,	0	0	0	0	6	13	1	7	10	11	0	0

* The figures given in this table are averages of weekly examinations.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Sudbury Reservoir, collected near the Bottom — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda,	0	0	0	0	0	0	0	0	1	0	0	0
Infusoria,	0	1	1	18	2	3	2	10	12	7	8	3
Dinobryon,	0	0	1	14	0	2	1	7	10	2	7	2
Vermes,	0	0	0	0	0	0	0	0	1	0	0	0
Crustacea,	pr.	0	0	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.
Cyclops,	pr.	0	0	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.	pr.
Daphnia,	0	0	0	0	0	0	0	pr.	pr.	0	0	0
Miscellaneous, Zoöglœa,	5	7	8	10	10	8	10	14	9	11	7	4
TOTAL,	16	21	12	56	60	151	709	340	276	229	165	60

Chemical Examination of Water from Framingham Reservoir No. 3, Framingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25822	Jan. 2	Slight.	Slight.	.50	5.05	1.40	.0036	.0144	.0124	.0020	.29	.0180	.0002	.51	1.8
26082	Jan. 31	Slight.	V. slight.	.33	4.40	1.70	.0014	.0124	.0112	.0012	.22	.0220	.0001	.46	1.6
26348	Feb. 28	V. slight.	V. slight.	.32	4.15	1.40	.0040	.0120	.0110	.0010	.25	.0140	.0002	.44	1.4
26638	Apr. 3	V. slight.	V. slight.	.25	3.05	1.35	.0026	.0116	.0100	.0016	.18	.0120	.0001	.36	0.5
26971	May 1	V. slight.	Slight.	.22	3.10	1.15	.0004	.0146	.0116	.0030	.22	.0100	.0001	.30	0.6
27277	May 31	Slight.	Slight.	.21	2.90	1.30	.0014	.0148	.0124	.0024	.19	.0090	.0001	.30	0.6
27647	July 5	V. slight.	Slight.	.19	3.15	1.00	.0000	.0152	.0128	.0024	.19	.0020	.0001	.32	1.3
27925	July 31	V. slight.	Slight.	.12	3.55	1.20	.0000	.0182	.0148	.0034	.20	.0010	.0000	.34	1.0
28408	Aug. 31	V. slight	V. slight.	.15	3.55	1.40	.0002	.0168	.0142	.0026	.20	.0010	.0000	.30	1.0
28836	Oct. 2	Slight.	Slight.	.10	3.25	1.05	.0004	.0206	.0184	.0022	.22	.0020	.0000	.31	0.8
29194	Oct. 31	V. slight.	V. slight.	.11	3.35	1.10	.0014	.0170	.0152	.0018	.24	.0050	.0001	.28	1.0
29515	Nov. 28	V. slight.	Slight.	.11	3.55	1.35	.0028	.0152	.0138	.0014	.22	.0030	.0001	.26	1.1
Av...	....	....	....	.22	3.59	1.28	.0015	.0152	.0131	.0021	.22	.0082	.0001	.35	1.1

Odor, generally faintly vegetable, occasionally none. —— The samples were collected from the reservoir near the gate-house, at a depth of 8 feet beneath the surface. For monthly record of height of water in this reservoir, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Framingham Reservoir No. 3, Framingham.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	July.	Aug.	Oct.	Nov.	Nov.
Day of examination,	3	1	1	4	2	1	6	31	31	2	1	29
Number of sample,	25822	26082	26348	26638	26971	27277	27647	27925	28406	28836	29194	29515
PLANTS.												
Diatomaceæ,	52	17	33	34	228	36	488	686	258	250	100	80
Asterionella,	18	5	14	2	106	8	108	56	86	46	39	31
Cyclotella,	15	0	0	1	2	11	102	120	52	18	31	37
Melosira,	0	0	3	0	8	0	0	46	16	80	9	4
Synedra,	7	8	7	7	88	3	12	12	28	34	6	2
Tabellaria,	11	4	6	19	24	14	266	452	76	70	15	6
Cyanophyceæ,	0	0	0	0	0	39	4	32	37	4	7	0
Anabæna,	0	0	0	0	0	39	2	28	30	4	7	0
Algæ,	2	1	0	1	2	80	22	6	12	19	1	24
Protococcus,	0	0	0	0	0	52	20	0	0	0	0	23
ANIMALS.												
Infusoria,	1	0	0	28	31	7	10	10	9	31	6	4
Dinobryon,	1	0	0	22	22	6	0	4	0	14	1	3
Epistylis,	0	0	0	0	0	0	4	0	0	10	0	0
Vermes,	0	0	0	0	2	1	0	pr.	0	1	0	0
Crustacea,	0	0	0	0	pr.	pr.	pr.	pr.	0	0	0	0
Bosmina,	0	0	0	0	0	0	0	pr.	0	0	0	0
Cyclops,	0	0	0	0	pr.	0	pr.	0	0	0	0	0
Daphnia,	0	0	0	0	0	pr.	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	8	5	7	8	12	5	7	8	10	8	10	5
TOTAL,	63	23	40	71	275	148	531	742	326	318	124	113

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Indian Brook at Head of Hopkinton Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25826	Jan. 2	None.	V. slight.	0.73	4.35	2.10	.0002	.0164	.0158	.0006	.54	.0120	.0001	0.96	1.0
26086	Jan. 31	None.	V. slight.	0.71	4.35	2.10	.0000	.0154	.0148	.0006	.34	.0020	.0000	0.82	1.0
26353	Feb. 28	V. slight.	V. slight.	0.41	4.00	1.65	.0012	.0144	.0126	.0018	.37	.0110	.0002	0.51	1.1
26642	Apr. 3	V. slight.	V. slight	0.40	3.00	1.65	.0006	.0148	.0142	.0006	.25	.0050	.0000	0.54	0.4
26975	May 1	V. slight.	V. slight	1.50	4.50	2.65	.0008	.0314	.0300	.0014	.26	.0040	.0000	1.44	0.8
27281	May 31	Slight.	Slight.	1.18	4.65	2.65	.0052	.0368	.0327	.0041	.31	.0060	.0000	1.36	1.1
27651	July 5	Slight.	Cons.	0.84	5.85	2.50	.0198	.0414	.0330	.0084	.33	.0050	.0004	1.02	1.7
27931	July 31	Slight.	Slight	0.68	5.20	2.15	.0044	.0364	.0332	.0032	.45	.0030	.0001	0.75	1.3
28412	Aug. 31	Slight	V. slight.	0.50	4.40	2.15	.0010	.0388	.0350	.0038	.32	.0010	.0000	0.76	0.8
28840	Oct. 2	V. slight.	V. slight.	0.60	7.25	2.50	.0006	.0334	.0316	.0018	.87	.0010	.0000	1.02	1.8
29236	Nov. 4	V. slight.	V. slight.	1.00	10.90	3.80	.0008	.0516	.0458	.0058	.65	.0060	.0000	1.52	3.1
29519	Nov. 28	V. slight.	V. slight.	0.90	8.70	3.45	.0014	.0316	.0304	.0012	.54	.0020	.0000	1.26	2.3
Av...	....	....	....	0.79	5.55	2.45	.0030	.0302	.0274	.0028	.44	.0048	.0001	1.00	1.4

Odor, generally faintly vegetable, becoming stronger and occasionally unpleasant on heating. — The samples were collected from the brook at its entrance to Hopkinton Reservoir.

Chemical Examination of Water from Hopkinton Reservoir, collected near the Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25827	Jan. 2	V. slight	V. slight.	.56	3.90	2.10	.0010	.0181	.0152	.0029	.37	.0060	.0000	.70	0.8
26087	Jan. 31	Slight.	Slight.	.59	4.10	1.75	.0004	.0202	.0174	.0028	.36	.0060	.0001	.72	1.0
26354	Feb. 28	V. slight.	Slight.	.50	4.25	2.00	.0010	.0162	.0152	.0010	.33	.0080	.0001	.63	1.4
26643	Apr. 3	V. slight	V. slight.	.49	4.50	2.10	.0022	.0172	.0152	.0020	.32	.0060	.0000	.63	1.0
26976	May 1	V. slight	V. slight.	.40	2.80	1.40	.0016	.0176	.0156	.0020	.26	.0040	.0000	.50	0.3
27282	May 31	V. slight.	V. slight.	.40	2.75	1.60	.0018	.0164	.0152	.0012	.26	.0050	.0001	.49	0.5
27652	July 5	V. slight.	Slight	.30	2.90	1.35	.0010	.0160	.0146	.0014	.25	.0020	.0001	.45	1.1
27932	July 31	V. slight	V. slight.	.22	3.05	1.25	.0006	.0208	.0192	.0016	.23	.0030	.0000	.45	0.5
28413	Aug. 31	V. slight.	V. slight.	.20	3.35	1.70	.0006	.0180	.0166	.0014	.25	.0020	.0000	.40	0.8
28841	Oct. 2	V. slight.	V. slight.	.20	2.65	1.00	.0004	.0180	.0162	.0018	.26	.0010	.0000	.38	0.6
29198	Oct. 31	V. slight.	V. slight.	.20	2.70	1.15	.0016	.0164	.0156	.0008	.26	.0050	.0000	.35	0.5
29520	Nov. 28	V. slight	Slight.	.25	2.80	1.25	.0008	.0182	.0152	.0030	.25	.0010	.0001	.34	0.8

Averages by Years.

-	1894	-	-	.79	3.93	1.59	.0013	.0191	.0166	.0025	.40	.0040	.0001	.75	1.2
-	1895	-	-	.73	4.15	1.86	.0017	.0239	.0210	.0029	.40	.0048	.0000	.76	1.3
-	1896	-	-	.64	3.86	1.74	.0017	.0208	.0175	.0033	.32	.0040	.0001	.71	0.9
-	1897	-	-	.76	4.18	1.85	.0019	.0221	.0198	.0023	.37	.0059	.0001	.75	1.1
-	1898	-	-	.62	3.71	1.80	.0016	.0204	.0183	.0021	.35	.0030	.0000	.69	1.1
-	1899	-	-	.36	3.31	1.65	.0011	.0178	.0160	.0018	.28	.0041	.0000	.50	0.8

NOTE to analyses of 1899: Odor, generally faintly vegetable. — The samples were collected from the reservoir, near the dam. For monthly record of height of water in this reservoir, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Hopkinton Reservoir, collected near the Surface.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Aug.	Oct.	Nov	Nov.
Day of examination,	3	1	1	4	2	1	6	1	31	3	1	29
Number of sample,	25827	26087	26354	26643	26976	27282	27652	27932	28413	28841	29198	29520
PLANTS.												
Diatomaceæ,	27	19	2	3	80	104	80	63	224	180	87	160
Asterionella,	4	8	0	0	16	0	2	0	42	158	39	130
Cyclotella,	5	1	2	1	4	82	74	48	158	18	5	9
Cyanophyceæ,	2	0	1	1	0	16	24	27	12	11	1	0
Microcystis,	0	0	0	0	0	0	6	13	0	0	0	0
Algæ,	0	1	0	0	2	16	32	11	16	14	9	4
ANIMALS.												
Infusoria,	0	47	0	0	111	40	10	2	2	42	13	38
Ciliated infusorian,	0	0	0	0	0	0	0	0	0	10	0	0
Dinobryon,	0	45	0	0	108	36	8	1	0	2	0	34
Mallomonas,	0	0	0	0	0	0	2	1	1	10	0	0
Monas,	0	0	0	0	0	0	0	0	0	2	10	0
Peridinium,	0	2	0	0	2	0	0	0	1	14	1	0
Vermes,	1	1	2	5	5	2	0	1	0	0	0	0
Crustacea,	pr.	0	0	pr.	pr.	0	pr.	pr.	0	0	0	0
Bosmina,	0	0	0	0	0	0	pr.	0	0	0	0	0
Cyclops,	pr.	0	0	pr.	pr.	0	0	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	3	3	3	3	8	5	5	7	3	8	5	5
TOTAL,	83	71	8	12	206	183	151	111	257	255	115	207

Chemical Examination of Water from Hopkinton Reservoir, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25828	Jan. 2	Slight.	Heavy.	.56	3.60	2.00	.0010	.0216	.0154	.0062	.34	.0030	.0000	.71	0.8
26088	Jan. 31	V. slight	V. slight.	.59	3.85	1.70	.0030	.0176	.0156	.0020	.34	.0060	.0000	.71	1.0
26355	Feb. 28	Slight.	Cons.	.51	3.75	1.75	.0012	.0274	.0210	.0064	.34	.0080	.0001	.62	1.3
26644	Apr. 3	V. slight.	Slight.	.50	4.15	1.85	.0020	.0160	.0144	.0016	.31	.0080	.0000	.64	0.8
26977	May 1	V. slight.	Slight.	.38	3.00	1.15	.0020	.0130	.0120	.0010	.25	.0060	.0000	.47	0.5
27283	May 31	V. slight.	V. slight.	.40	2.40	1.15	.0026	.0126	.0122	.0004	.26	.0070	.0000	.46	0.5
27653	July 5	V. slight.	V. slight	.32	3.00	1.00	.0010	.0124	.0106	.0018	.26	.0040	.0001	.46	0.6
27933	July 31	V. slight.	V. slight.	.24	3.50	1.70	.0022	.0134	.0118	.0016	.23	.0040	.0000	.43	0.5
28414	Aug. 31	V. slight.	V. slight	.29	3.35	1.25	.0030	.0132	.0128	.0004	.26	.0090	.0001	.40	0.6
28842	Oct. 2	Slight.	Slight	.27	2.95	1.20	.0042	.0128	.0120	.0008	.27	.0060	.0001	.38	0.6
29199	Oct 31	V. slight.	V. slight.	.20	2.80	1.10	.0016	.0150	.0142	.0008	.26	.0020	.0001	.35	0.5
29521	Nov. 28	V. slight.	Slight.	.24	2.95	1.35	.0026	.0204	.0170	.0034	.24	.0020	.0001	.34	0.8

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Hopkinton Reservoir, collected near the Bottom — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
-	1895	-	-	.75	4.33	1.94	.0036	.0204	.0181	.0023	.41	.0064	.0001	.77	1.3
-	1896	-	-	.63	3.82	1.75	.0013	.0189	.0164	.0025	.35	.0050	.0001	.71	0.9
-	1897	-	-	.71	4.06	1.72	.0020	.0188	.0173	.0015	.37	.0078	.0001	.73	1.1
-	1898	-	-	.62	3.74	1.70	.0022	.0168	.0156	.0012	.35	.0057	.0000	.65	1.0
-	1899	-	-	.37	3.27	1.43	.0022	.0163	.0141	.0022	.28	.0054	.0000	.50	0.7

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none. An unpleasant odor was developed in some of the samples on heating.——The samples were collected from the reservoir, near the dam. For monthly record of height of water in this reservoir, see table on page 152.

Chemical Examination of Water from Cold Spring Brook, at Head of Ashland Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25823	Jan. 2	V. slight.	V. slight.	0.71	4.65	2.35	.0002	.0186	.0180	.0006	.31	.0060	.0000	0.86	1.0
26083	Jan. 31	V. slight.	V. slight.	0.72	4.00	2.10	.0002	.0192	.0184	.0008	.26	.0070	.0000	0.82	0.8
26350	Feb. 28	V. slight.	V. slight.	0.70	3.75	1.80	.0004	.0182	.0166	.0016	.22	.0040	.0000	0.74	0.6
26639	Apr. 3	V. slight.	V. slight.	0.51	2.50	1.35	.0002	.0176	.0152	.0024	.19	.0050	.0000	0.67	0.3
26972	May 1	V. slight.	V. slight.	1.08	3.80	2.30	.0028	.0310	.0300	.0010	.24	.0050	.0000	1.10	0.8
27278	May 31	Slight.	Slight.	0.98	3.75	2.05	.0024	.0280	.0262	.0018	.23	.0030	.0000	0.91	1.0
27648	July 5	V. slight.	V. slight.	0.52	3.70	1.25	.0014	.0238	.0200	.0038	.26	.0040	.0001	0.70	1.4
27928	July 31	V. slight.	V. slight.	0.40	4.10	1.65	.0012	.0232	.0218	.0014	.26	.0040	.0000	0.58	1.0
28409	Aug. 31	V. slight.	V. slight.	0.30	3.45	1.45	.0004	.0174	.0158	.0016	.24	.0140	.0001	0.32	1.1
28837	Oct. 2	V. slight.	V. slight.	0.35	5.20	1.75	.0028	.0210	.0200	.0010	.31	.0060	.0000	0.53	1.4
29195	Oct. 31	V. slight.	V. slight.	0.40	4.75	1.65	.0010	.0190	.0178	.0012	.32	.0050	.0001	0.48	1.3
29516	Nov. 28	V. slight.	Cons.	0.85	6.95	2.95	.0018	.0318	.0288	.0030	.33	.0080	.0000	1.06	2.0
Av...	....	....	....	0.63	4.22	1.89	.0012	.0224	.0207	.0017	.26	.0055	.0000	0.73	1.1

Odor, generally faintly vegetable, sometimes becoming stronger on heating.——The samples were collected from the brook, at its entrance into Ashland Reservoir.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Ashland Reservoir, collected near the Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25824	Jan. 2	Slight.	Slight.	.64	3.85	2.20	.0014	.0338	.0290	.0048	.33	.0010	.0000	.79	0.8
26084	Jan. 31	V. slight.	V. slight.	.61	3.80	1.85	.0002	.0188	.0176	.0012	.28	.0010	.0001	.76	0.8
26351	Feb. 28	V. slight.	V. slight.	.58	3.50	1.50	.0012	.0176	.0164	.0012	.26	.0070	.0000	.62	0.6
26640	Apr. 3	V. slight.	V. slight.	.40	2.40	1.00	.0006	.0156	.0136	.0020	.20	.0040	.0000	.51	0.3
26973	May 1	V. slight.	V. slight.	.46	3.00	1.40	.0004	.0204	.0170	.0034	.19	.0030	.0000	.55	0.3
27279	May 31	V. slight.	Slight.	.48	2.65	1.40	.0010	.0180	.0164	.0016	.22	.0040	.0000	.55	0.5
27649	July 5	V. slight.	V. slight.	.38	3.25	1.25	.0000	.0190	.0156	.0034	.22	.0000	.0000	.52	0.8
27929	July 31	V. slight.	V. slight.	.30	2.70	1.20	.0002	.0172	.0146	.0026	.21	.0040	.0000	.52	0.5
28410	Aug. 31	V. slight.	V. slight.	.30	3.65	1.90	.0000	.0190	.0160	.0030	.24	.0020	.0000	.43	0.5
28838	Oct. 2	V. slight.	V. slight.	.23	2.50	1.25	.0000	.0158	.0152	.0006	.22	.0030	.0000	.36	0.6
29196	Oct. 31	V. slight.	Slight.	.25	2.75	1.05	.0010	.0154	.0148	.0006	.20	.0020	.0001	.39	0.6
29517	Nov. 28	V. slight.	V. slight.	.35	3.40	1.45	.0024	.0162	.0152	.0010	.22	.0030	.0001	.40	0.8

Averages by Years.

-	1888	-	-	.72	3.83	1.70	.0007	.0277	-	-	.22	.0054	.0001	-	-
-	1889	-	-	.85	3.48	1.50	.0016	.0251	.0218	.0033	.23	.0068	.0002	-	-
-	1890	-	-	.61	3.67	1.40	.0008	.0222	.0191	.0031	.24	.0096	.0001	-	1.7
-	1891	-	-	.53	3.24	1.55	.0006	.0187	.0156	.0031	.20	.0062	.0001	-	0.9
-	1892	-	-	.64	3.60	1.52	.0002	.0200	.0168	.0032	.23	.0061	.0001	-	1.1
-	1893	-	-	.77	3.54	1.63	.0024	.0206	.0173	.0033	.23	.0048	.0001	.68	1.0
-	1894	-	-	.83	4.00	1.73	.0027	.0202	.0180	.0022	.29	.0045	.0001	.78	1.1
-	1895	-	-	.89	4.22	2.04	.0015	.0246	.0223	.0023	.32	.0052	.0000	.90	1.1
-	1896	-	-	.75	3.90	1.86	.0008	.0239	.0210	.0029	.27	.0024	.0000	.91	0.9
-	1897	-	-	.84	4.07	1.81	.0017	.0242	.0224	.0018	.31	.0027	.0000	.79	1.1
-	1898	-	-	.72	3.76	1.85	.0008	.0221	.0205	.0016	.29	.0082	.0000	.75	1.0
-	1899	-	-	.41	3.12	1.45	.0007	.0189	.0168	.0021	.23	.0028	.0000	.53	0.6

NOTE to analyses of 1899: Odor, generally faintly vegetable.—— The samples were collected from the reservoir, near the gate-house. For monthly record of height of water in this reservoir, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Ashland Reservoir, collected near the Surface.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Aug.	Oct.	Nov.	Nov.
Day of examination,	3	1	1	4	2	1	6	1	31	2	1	29
Number of sample,	25824	26084	26351	26640	26973	27279	27649	27929	28410	28838	29196	29517
PLANTS.												
Diatomaceæ,	47	24	3	5	45	106	200	506	608	374	177	102
Cyclotella,	4	6	0	1	4	92	78	36	130	16	32	27
Tabellaria,	42	14	0	0	32	8	118	470	478	352	138	33
Cyanophyceæ,	0	0	0	0	0	22	18	52	16	32	2	0
Anabæna,	0	0	0	0	0	20	16	24	2	30	0	0
Clathrocystis,	0	0	0	0	0	0	2	4	12	0	0	0
Microcystis,	0	0	0	0	0	0	6	24	2	2	0	0
Algæ,	0	0	1	0	2	102	100	0	8	8	6	39
Protococcus,	0	0	0	0	0	60	100	0	0	0	0	38
ANIMALS.												
Infusoria,	0	9	1	447	80	36	2	6	0	18	3	0
Dinobryon,	0	4	1	444	80	0	0	0	0	0	0	0
Epistylis,	0	0	0	0	0	16	0	0	0	0	0	0
Vorticella,	0	2	0	0	0	20	2	6	0	4	0	0
Vermes,	0	0	0	1	2	1	0	2	0	0	0	0
Crustacea, Cyclops,	0	0	0	0	0	pr.	pr.	0	0	0	0	0
Miscellaneous, Zoöglœa,	5	3	3	5	7	5	3	5	8	3	5	5
TOTAL,	52	36	8	458	136	272	323	571	640	435	193	145

Chemical Examination of Water from Ashland Reservoir, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25825	Jan. 2	V. slight	V. slight.	.64	4.00	2.00	.0006	.0198	.0180	.0018	.32	.0010	.0001	.74	0.8
26085	Jan. 31	V. slight.	V. slight.	.61	4.00	1.65	.0004	.0190	.0182	.0008	.29	.0010	.0000	.73	0.8
26352	Feb. 28	V. slight.	V. slight.	.59	3.40	1.55	.0010	.0184	.0176	.0008	.25	.0050	.0000	.67	0.8
26641	Apr. 3	V. slight.	V. slight	.42	2.65	1.05	.0006	.0154	.0144	.0010	.21	.0060	.0000	.55	0.3
26974	May 1	V. slight.	V. slight.	.45	2.95	1.70	.0006	.0142	.0130	.0012	.20	.0040	.0060	.53	0.2
27280	May 31	V. slight.	V. slight.	.46	2.75	1.50	.0014	.0142	.0132	.0010	.22	.0030	.0000	.48	0.5
27650	July 5	V. slight.	V. slight.	.38	2.50	1.05	.0024	.0128	.0104	.0024	.23	.0070	.0000	.50	0.5
27930	July 31	V. slight.	V. slight.	.38	2.70	1.20	.0028	.0138	.0132	.0006	.21	.0070	.0002	.50	0.8
28411	Aug. 31	V. slight.	V. slight.	.38	3.25	1.85	.0004	.0154	.0142	.0012	.22	.0050	.0000	.44	0.5
28839	Oct. 2	Slight.	Slight.	.31	2.50	1.15	.0022	.0152	.0144	.0008	.21	.0070	.0000	.41	0.6
29197	Oct. 31	V. slight.	Slight.	.28	2.80	1.05	.0014	.0158	.0150	.0008	.23	.0030	.0000	.36	0.8
29518	Nov. 28	V. slight.	Slight.	.32	3.30	1.40	.0030	.0176	.0158	.0018	.24	.0020	.0001	.39	0.8

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Ashland Reservoir, collected near the Bottom — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1888	-	-	.72	4.02	1.70	.0025	.0261	-	-	.28	.0059	.0001	-	-
-	1889	-	-	.86	3.55	1.49	.0023	.0224	.0198	.0026	.22	.0086	.0002	-	-
-	1890	-	-	.66	3.97	1.54	.0017	.0199	.0168	.0031	.23	.0120	.0001	-	1.6
-	1896	-	-	.73	4.07	1.89	.0012	.0213	.0186	.0027	.26	.0039	.0000	.88	1.0
-	1897	-	-	.86	4.30	1.94	.0022	.0223	.0207	.0016	.31	.0047	.0001	.78	1.2
-	1898	-	-	.69	3.84	1.87	.0015	.0203	.0191	.0012	.29	.0037	.0001	.73	1.0
-	1899	-	-	.43	3.07	1.39	.0014	.0160	.0148	.0012	.24	.0042	.0000	.52	0.6

Note to analyses of 1899: Odor, generally faintly vegetable. —— The samples were collected from the reservoir, near the gate-house. For monthly record of height of water in this reservoir, see table on page 152.

Chemical Examination of Water from Sudbury River, at Head of Framingham Reservoir No. 2.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25819	Jan. 2	V. slight.	Slight.	.54	4.05	1.75	.0002	.0134	.0120	.0014	.30	.0110	.0001	.64	1.0
26080	Jan. 31	V. slight.	Slight.	.51	4.05	1.60	.0014	.0156	.0136	.0020	.30	.0080	.0001	.66	0.8
26346	Feb. 28	V. slight.	V. slight.	.50	3.50	1.75	.0012	.0166	.0158	.0008	.27	.0050	.0000	.60	0.8
26636	Apr. 3	V. slight.	V. slight.	.88	2.75	1.35	.0010	.0150	.0142	.0008	.21	.0050	.0000	.49	0.3
26969	May 1	V. slight.	V. slight.	.73	3.75	1.85	.0020	.0277	.0249	.0028	.25	.0060	.0000	.85	0.5
27275	May 31	Slight.	Slight.	.56	3.75	1.90	.0028	.0250	.0210	.0040	.26	.0020	.0001	.64	1.0
27645	July 5	Slight.	Slight.	.46	4.20	1.45	.0018	.0320	.0256	.0064	.28	.0070	.0001	.56	1.6
27923	July 31	V. slight.	V. slight.	.44	4.40	1.55	.0020	.0376	.0352	.0024	.31	.0040	.0001	.59	1.0
28406	Aug. 31	Slight.	V. slight.	.38	3.45	1.05	.0022	.0314	.0266	.0048	.26	.0030	.0000	.50	0.5
28834	Oct. 2	Slight.	V. slight.	.27	2.95	1.15	.0010	.0258	.0248	.0010	.24	.0040	.0000	.42	0.6
29192	Oct. 31	V. slight	V. slight.	.23	3.05	1.20	.0002	.0148	.0140	.0008	.27	.0020	.0000	.33	0.6
29513	Nov. 28	V. slight.	V. slight.	.45	6.85	2.35	.0018	.0242	.0230	.0012	.44	.0050	.0001	.70	2.2
Av...	....	....	....	.45	3.90	1.58	.0015	.0233	.0209	.0024	.28	.0052	.0000	.58	0.9

Odor of the first two samples, none; of the others, vegetable, becoming stronger and occasionally mouldy or grassy on heating. —— The samples were collected from the river, near the old dam at the upper end of Framingham Reservoir No. 2, at a depth of 1 foot beneath the surface.

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Framingham Reservoir No. 2.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25820	Jan. 2	V. slight.	V. slight	0.52	4.15	1.70	.0004	.0140	.0132	.0008	.32	.0110	.0001	.64	0.8
26081	Jan. 31	Slight.	V. slight.	0.49	3.35	1.40	.0000	.0158	.0140	.0018	.30	.0070	.0000	.65	0.8
26347	Feb. 28	V. slight.	V. slight.	0.49	3.35	1.50	.0012	.0156	.0150	.0006	.27	.0110	.0000	.60	0.8
26637	Apr. 3	V. slight.	V. slight.	0.37	2.90	1.40	.0002	.0135	.0124	.0011	.22	.0050	.0000	.49	0.3
26970	May 1	V. slight	V. slight.	0.50	2.75	1.50	.0012	.0224	.0194	.0030	.23	.0050	.0000	.66	0.3
27276	May 31	Slight.	Slight.	0.57	3.55	1.80	.0014	.0216	.0204	.0012	.25	.0030	.0000	.68	0.6
27646	July 5	Slight.	Slight.	0.35	3.75	1.45	.0000	.0248	.0202	.0046	.26	.0020	.0000	.49	1.3
27924	July 31	V. slight.	V. slight.	0.44	3.80	1.65	.0002	.0242	.0228	.0014	.25	.0020	.0000	.54	0.8
28407	Aug. 31	Slight.	Slight.	0.38	3.75	1.70	.0006	.0276	.0222	.0054	.27	.0030	.0000	.48	0.5
28835	Oct. 2	V. slight.	V. slight.	0.25	2.75	1.00	.0006	.0204	.0180	.0024	.24	.0010	.0000	.41	0.6
29193	Oct. 31	V. slight.	V. slight.	0.20	3.15	1.25	.0006	.0162	.0148	.0014	.27	.0040	.0000	.35	0.6
29514	Nov. 28	V. slight.	V. slight.	0.22	3.40	1.40	.0010	.0168	.0148	.0020	.25	.0010	.0001	.36	0.8

Averages by Years.

-	1888	-	-	1.08	4.63	2.01	.0005	.0300	-	-	.30	.0102	.0001	-	-
-	1889	-	-	1.04	3.42	1.26	.0015	.0296	.0252	.0044	.29	.0075	.0002	-	-
-	1890	-	-	0.77	4.58	1.83	.0010	.0235	.0191	.0044	.28	.0128	.0001	-	1.7
-	1891	-	-	0.72	4.02	1.68	.0004	.0230	.0194	.0036	.24	.0105	.0001	-	1.0
-	1892	-	-	0.89	4.35	1.92	.0004	.0231	.0192	.0039	.29	.0082	.0001	-	1.3
-	1893	-	-	0.98	4.28	1.86	.0010	.0219	.0190	.0029	.31	.0054	.0001	.81	1.2
-	1894	-	-	1.12	4.36	2.05	.0008	.0216	.0193	.0023	.33	.0058	.0000	.93	1.3
-	1895	-	-	1.03	4.65	2.05	.0015	.0244	.0211	.0033	.34	.0090	.0001	.98	1.2
-	1896	-	-	0.74	4.08	1.87	.0011	.0233	.0200	.0033	.30	.0051	.0001	.84	0.9
-	1897	-	-	0.96	4.53	2.04	.0013	.0252	.0229	.0023	.32	.0067	.0001	.89	1.1
-	1898	-	-	0.89	4.47	2.19	.0022	.0241	.0220	.0021	.29	.0054	.0001	.93	1.1
-	1899	-	-	0.40	3.39	1.48	.0006	.0194	.0173	.0021	.26	.0046	.0000	.53	0.7

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes becoming stronger on heating. —— The samples were collected from the reservoir, near the gate-house, at a depth of 8 feet beneath the surface. For monthly record of height of water in this reservoir, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Framingham Reservoir No. 2.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	July.	Aug.	Oct.	Nov.	Nov.
Day of examination,	3	1	1	4	2	1	6	31	31	2	1	29
Number of sample,	25830	26081	26347	26637	26970	27276	27646	27924	28407	28835	29193	29514
PLANTS.												
Diatomaceæ,	10	28	7	50	52	30	154	202	220	180	40	28
Cyclotella,	2	1	1	0	2	4	128	176	200	26	4	10
Tabellaria,	4	2	1	12	6	0	4	4	8	104	24	10
Cyanophyceæ,	0	0	0	0	0	0	25	14	50	1	0	0
Anabæna,	0	0	0	0	0	0	24	8	40	0	0	0
Algæ,	0	0	0	0	2	40	220	22	66	26	1	0
Protococcus,	0	0	0	0	0	40	200	0	30	0	0	0
ANIMALS.												
Infusoria,	0	0	0	6	7	14	6	12	250	6	8	0
Epistylis,	0	0	0	0	1	10	0	8	0	0	0	0
Mallomonas,	0	0	0	0	0	0	0	0	236	0	0	0
Vorticella,	0	0	0	0	0	0	4	0	10	0	0	0
Vermes,	0	0	0	0	0	0	0	0	2	0	2	0
Crustacea, Bosmina,	0	0	0	0	0	0	pr.	0	0	0	0	0
Miscellaneous, Zoöglœa,	3	3	5	5	7	10	7	10	10	7	7	5
TOTAL,	13	32	12	61	68	94	412	260	598	222	58	33

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from Lake Cochituate in Wayland.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25821	Jan. 2	Slight.	Cons.	.37	5.25	1.90	.0020	.0462	.0314	.0148	.55	.0100	.0002	.62	2.2
26091	Jan. 31	Slight.	Slight.	.46	6.40	2.40	.0012	.0304	.0234	.0070	.51	.0110	.0001	.68	2.2
26349	Feb. 28	V. slight.	Slight.	.33	5.00	2.00	.0036	.0218	.0176	.0042	.40	.0180	.0001	.54	1.8
26645	Apr. 3	Slight.	Slight.	.31	4.65	1.95	.0010	.0184	.0150	.0034	.38	.0110	.0000	.48	1.4
26978	May 1	V. slight	Slight.	.26	4.65	1.65	.0016	.0220	.0180	.0040	.38	.0150	.0003	.42	1.4
27287	May 31	V. slight.	Slight.	.20	4.95	1.60	.0046	.0284	.0236	.0048	.42	.0110	.0002	.37	1.7
27655	July 5	V. slight.	V. slight.	.15	4.05	1.15	.0008	.0158	.0146	.0012	.43	.0060	.0002	.43	1.7
27926	July 31	None.	V. slight.	.09	4.35	1.30	.0004	.0162	.0158	.0004	.39	.0050	.0001	.36	1.8
28415	Aug. 31	V. slight.	V. slight.	.10	4.60	1.95	.0004	.0180	.0168	.0012	.38	.0020	.0000	.34	1.6
28846	Oct. 2	V. slight.	Cons.	.09	4.10	1.30	.0012	.0216	.0194	.0022	.44	.0060	.0000	.33	1.7
29200	Oct. 31	V. slight.	V. slight.	.10	4.40	1.35	.0016	.0220	.0200	.0020	.42	.0060	.0001	.32	1.7
29606	Nov. 28	Slight.	Slight.	.22	4.45	1.65	.0056	.0176	.0156	.0020	.43	.0070	.0002	.31	1.7

Averages by Years.

-	1888	-	-	.19	4.90	1.24	.0033	.0217	-	-	.43	.0127	.0003	-	-
-	1889	-	-	.33	5.08	1.62	.0025	.0210	.0177	.0033	.46	.0208	.0003	-	-
-	1890	-	-	.21	4.74	1.03	.0016	.0184	.0149	.0035	.49	.0206	.0003	-	2.1
-	1891	-	-	.24	4.66	1.44	.0017	.0182	.0145	.0037	.42	.0212	.0002	-	1.8
-	1892	-	-	.15	4.61	1.35	.0018	.0168	.0133	.0035	.48	.0152	.0001	-	2.0
-	1893	-	-	.21	4.64	1.58	.0015	.0168	.0138	.0030	.46	.0098	.0002	.39	2.0
-	1894	-	-	.20	4.76	1.59	.0008	.0163	.0137	.0026	.51	.0070	.0001	.37	2.1
-	1895	-	-	.25	5.08	1.68	.0015	.0178	.0153	.0025	.51	.0112	.0001	.42	2.1
-	1896	-	-	.28	4.89	1.65	.0012	.0176	.0145	.0031	.50	.0122	.0001	.45	1.9
-	1897	-	-	.31	5.11	1.73	.0012	.0202	.0172	.0030	.52	.0092	.0001	.44	2.1
-	1898	-	-	.30	4.92	1.79	.0016	.0203	.0178	.0030	.47	.0066	.0001	.45	2.1
-	1899	-	-	.22	4.74	1.68	.0020	.0232	.0193	.0039	.43	.0090	.0001	.43	1.7

NOTE to analyses of 1899: Odor of the first three samples, disagreeable; of the others, faintly vegetable, becoming stronger and sometimes also grassy on heating.——The samples were collected from the gate-house. For monthly record of height of water in this lake, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Lake Cochituate in Wayland.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	July.	Aug.	Oct.	Nov.	Nov.
Day of examination, ...	3	1	1	4	2	1	6	31	31	3	1	28
Number of sample, ...	25821	26091	26349	26645	26978	27287	27655	27926	28415	28846	29200	29506
PLANTS.												
Diatomaceæ, ...	50	14	6	23	70	3,200	4	410	20	50	182	698
Asterionella, ...	50	9	3	8	26	2,392	0	398	2	28	146	356
Cyclotella, ...	0	0	1	2	2	448	4	0	0	2	0	0
Melosira, ...	0	0	0	7	0	24	0	0	0	12	28	330
Tabellaria, ...	0	4	1	4	0	312	0	12	0	0	4	10
Cyanophyceæ, ...	140	40	26	0	0	34	20	33	78	126	106	12
Anabæna, ...	0	0	0	0	0	32	14	12	26	24	4	6
Aphanizomenon, ...	140	40	25	0	0	0	0	0	0	62	0	0
Merismopœdia, ...	0	0	0	0	0	0	0	0	14	0	102	0
Microcystis, ...	0	0	0	0	0	0	4	18	38	36	0	0
Algæ, ...	0	0	0	0	18	5	24	2	18	8	4	10
ANIMALS.												
Rhizopoda, Actinophrys, . .	0	0	0	1	0	0	0	0	0	0	0	0
Infusoria, ...	186	64	9	41	25	42	88	1	1	8	36	20
Ciliated infusorian, . . .	40	15	0	0	0	0	0	0	0	0	0	0
Cryptomonas, ...	74	15	1	1	0	0	0	0	0	2	0	0
Dinobryon, ...	8	9	3	5	20	38	88	0	0	0	34	6
Peridinium, ...	22	16	1	23	1	0	0	0	0	2	2	2
Synura, ...	38	5	1	1	0	0	0	0	0	4	0	0
Vermes, ...	2	0	pr.	pr.	0	3	pr.	1	0	3	0	0
Crustacea, ...	pr.	pr.	pr.	pr.	0	0	0	pr.	pr.	pr.	0	0
Bosmina, ...	0	0	0	0	0	0	0	0	pr.	0	0	0
Cyclops, ...	pr.	pr.	pr.	pr.	0	0	0	pr.	pr.	pr.	0	0
Daphnia, ...	0	0	pr.	0	0	0	0	0	0	0	0	0
Entomostra canova, . . .	0	0	pr.	0	0	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa, . . .	3	5	5	7	17	7	3	7	7	10	5	8
TOTAL, ...	381	123	46	72	130	3,291	139	454	124	205	333	748

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from the Terminal Chamber of the Sudbury Aqueduct at Chestnut Hill Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25857	Jan. 5	V. slight.	V. slight.	.45	4.75	1.50	.0036	.0148	.0144	.0004	.27	.0230	.0001	.51	1.7
26117	Feb. 2	V. slight.	V. slight.	.33	4.30	1.55	.0016	.0110	.0104	.0006	.24	.0120	.0002	.41	1.4
26410	Mar. 6	V. slight.	V. slight.	.28	4.10	1.65	.0028	.0104	.0094	.0010	.23	.0190	.0002	.36	1.3
26654	Apr. 3	Slight.	Slight.	.27	3.75	1.30	.0020	.0128	.0122	.0006	.19	.0100	.0008	.35	0.8
26990	May 1	V. slight.	V. slight.	.20	3.75	1.20	.0016	.0128	.0117	.0011	.18	.0050	.0002	.30	0.8
27300	May 31	V. slight.	Slight.	.22	3.55	1.20	.0026	.0132	.0120	.0012	.21	.0080	.0000	.32	0.8
27665	July 5	Slight.	Slight.	.21	3.10	1.15	.0014	.0138	.0132	.0006	.17	.0020	.0000	.32	1.1
27943	July 31	V. slight.	Slight.	.12	4.05	1.75	.0036	.0176	.0146	.0030	.25	.0020	.0000	.32	1.0
28434	Aug. 31	V. slight.	V. slight.	.15	4.15	1.65	.0022	.0174	.0154	.0020	.21	.0010	.0000	.34	1.0
28903	Oct. 5	V. slight.	Slight.	.20	3.05	1.40	.0008	.0160	.0152	.0008	.24	.0020	.0000	.38	1.0
29214	Nov. 1	V. slight.	Slight.	.25	3.30	1.35	.0010	.0164	.0158	.0006	.24	.0030	.0002	.33	0.8
29523	Nov. 28	Slight.	V. slight.	.20	3.40	1.05	.0020	.0154	.0144	.0010	.25	.0010	.0001	.26	1.3
Av...	....	....	....	.24	3.77	1.40	.0021	.0143	.0132	.0011	.22	.0073	.0001	.35	1.1

Odor, generally faintly vegetable, sometimes none.

Microscopical Examination of Water from the Terminal Chamber of the Sudbury Aqueduct at Chestnut Hill Reservoir.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Aug.	Oct.	Nov.	Nov.
Day of examination,	9	3	8	4	3	1	6	1	31	6	2	29
Number of sample,	25857	26117	26410	26654	26990	27300	27665	27943	28434	28903	29214	29523
PLANTS.												
Diatomaceæ,	28	32	10	43	298	34	752	548	100	308	108	85
Asterionella,	7	13	0	22	90	5	268	32	30	26	40	26
Cyclotella,	10	0	0	0	2	1	232	64	16	32	41	38
Melosira,	0	0	0	0	66	4	20	0	0	86	10	13
Synedra,	8	5	5	3	94	5	6	34	8	18	3	7
Tabellaria,	2	8	2	14	33	19	224	408	44	184	12	1
Cyanophyceæ,	0	0	0	0	2	0	29	12	0	2	1	0
Anabæna,	0	0	0	0	2	0	28	6	0	2	0	0
Algæ,	0	0	1	1	1	16	30	10	8	8	2	0

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from the Terminal Chamber of the Sudbury Aqueduct at Chestnut Hill Reservoir — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Aug.	Oct.	Nov.	Nov.
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	1	0	0	0	0	0	0	0	0
Infusoria,	0	5	0	21	48	5	0	6	10	2	6	3
Codonella,	0	0	0	0	14	0	0	0	0	0	0	2
Dinobryon,	0	5	0	17	26	2	0	2	0	0	4	0
Vermes,	0	1	0	0	2	2	0	1	0	2	0	0
Crustacea,	0	0	0	0	pr.	pr.	0	pr.	pr.	0	pr.	pr.
Cyclops,	0	0	0	0	pr.	pr.	0	pr.	0	0	pr.	pr.
Daphnella,	0	0	0	0	0	pr.	0	pr.	0	0	0	0
Daphnia,	0	0	0	0	0	0	0	0	pr.	0	pr.	0
Miscellaneous, Zoöglœa,	3	3	7	5	12	7	10	12	25	12	8	5
TOTAL,	31	41	18	71	361	64	821	587	143	334	125	93

Chemical Examination of Water from Spot Pond, Stoneham

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25816	Jan. 2	Slight.	Slight.	0.04	4.75	1.85	.0004	.0264	.0224	.0040	.41	.0020	.0002	.56	1.7
26112	Feb. 2	Slight.	V. slight.	0.38	4.85	2.00	.0006	.0260	.0208	.0052	.40	.0030	.0001	.63	1.8
26345	Feb. 28	Slight.	V. slight.	0.41	4.50	2.10	.0006	.0278	.0218	.0060	.42	.0060	.0001	.62	1.7
26634	Apr. 3	Slight.	V. slight.	0.57	4.60	1.80	.0028	.0260	.0212	.0048	.42	.0110	.0001	.60	1.4
26991	May 2	Decided.	Cons.	0.38	4.85	2.10	.0004	.0348	.0204	.0144	.36	.0040	.0000	.52	1.4
27272	May 31	Slight.	Cons.	0.40	5.00	2.25	.0002	.0380	.0242	.0138	.42	.0020	.0000	.54	2.5
27638	July 5	Decided.	Cons.	1.15	3.30	0.65	.0188	.0128	.0084	.0044	.21	.0020	.0000	.28	1.0
27920	July 31	Slight.	Slight.	0.16	2.65	0.75	.0130	.0110	.0094	.0016	.21	.0010	.0000	.19	0.8
28418	Aug. 31	Slight.	Slight.	0.20	7.40	2.25	.0004	.0294	.0242	.0052	.42	.0020	.0000	.45	2.3
28845	Oct. 2	Decided.	Cons.	0.11	7.30	2.00	.0004	.0352	.0288	.0064	.38	.0040	.0000	.38	3.0
29218	Nov. 1	Slight.	Slight.	0.18	8.45	2.10	.0128	.0280	.0200	.0080	.42	.0020	.0000	.29	3.6
29505	Nov. 28	Decided.	V. slight.	0.21	10.15	2.15	.0294	.0193	.0170	.0023	.44	.0020	.0001	.31	4.0
Av...	....	....	....	0.33	5.65	1.83	.0066	.0262	.0199	.0063	.38	.0034	.0000	.44	2.1

Odor, generally distinctly disagreeable, sometimes vegetable or unpleasant. On heating, the odor of some of the samples became offensive. The water of Spot Pond was drawn down to an unusually low level during the work of removing the mud from the bottom of the pond. For monthly record of height of water in this pond, see table on page 152.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from Spot Pond, Stoneham.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Feb	Apr.	May.	May.	July.	July.	Sept.	Oct.	Nov.	Nov.
Day of examination,	3	3	28	3	3	31	5	31	1	3	2	28
Number of sample,	25816	26112	26345	26634	26991	27272	27638	27920	28418	28845	29218	29505
PLANTS.												
Diatomaceæ,	194	83	16	30	553	1,028	54	4	180	896	602	25
Asterionella,	56	32	0	6	8	0	44	0	2	2	0	5
Cyclotella,	116	37	6	0	0	4	8	0	0	2	4	0
Melosira,	0	0	7	6	84	48	0	0	128	826	586	20
Synedra,	16	10	4	10	380	944	2	1	46	62	4	0
Tabellaria,	6	4	0	2	80	32	6	3	4	4	6	0
Cyanophyceæ,	0	0	3	0	0	22	0	0	212	100	0	0
Anabæna,	0	0	0	0	0	20	0	0	10	0	0	0
Aphanizomenon,	0	0	3	0	0	0	6	0	200	98	0	0
Algæ,	10	45	8	36	84	136	2	0	26	36	6	26
Raphidium,	8	39	8	36	16	136	0	0	22	36	6	0
Selenastrum,	2	6	0	0	68	0	0	0	0	0	0	0
ANIMALS.												
Rhizopoda, Difflugia,	0	0	0	0	0	0	0	0	1	0	0	0
Infusoria,	4,000	8,004	7,001	4,002	9,062	8,025	0	0	188	508	66	75
Chlamydomonas,	4,000	8,000	7,000	4,000	9,000	8,000	0	0	160	500	6	0
Cryptomonas,	0	3	1	0	50	20	0	0	0	0	0	0
Dinobryon,	0	0	0	2	12	0	0	0	0	0	44	70
Vermes,	0	0	0	0	0	2	0	0	1	0	4	0
Crustacea, Cyclops,	0	0	pr.	pr.	0	0	0	0	pr.	pr.	0	pr.
Miscellaneous, Zoöglœa,	5	3	3	10	60	80	120	160	35	30	10	7
TOTAL,	4,209	8,135	7,033	4,078	9,759	9,293	176	164	623	1,572	688	133

METROPOLITAN WATER DISTRICT.

Chemical Examination of Water from the High Service Reservoir at Middlesex Fells.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
28485	Sept. 5	V. slight.	V. slight.	.18	5.35	1.60	.0012	.0170	.0162	.0008	.22	.0030	.0000	.27	0.9
28486	Sept. 5	V. slight.	V. slight.	.12	4.75	1.35	.0004	.0160	.0150	.0010	.22	.0080	.0000	.31	0.9

Odor, none, becoming very faintly vegetable on heating.——The first sample was collected from the reservoir, near the intake; the second, from the reservoir, on the opposite side from the intake. The samples were collected a short time after the reservoir was filled, and before any water from it had been used for the supply of the district.

Chemical Examination of Water from a Faucet at the State House, Boston.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25809	Jan. 2	Slight.	V. slight.	.46	5.55	1.75	.0020	.0158	.0130	.0028	.33	.0300	.0001	.49	2.0
26110	Feb. 2	V. slight	V. slight	.33	4.10	1.35	.0012	.0124	.0102	.0022	.28	.0200	.0001	.42	1.4
26360	Mar. 1	V. slight.	V. slight.	.30	4.15	1.35	.0014	.0114	.0108	.0006	.26	.0220	.0002	.39	1.3
26630	Apr. 3	V. slight.	Slight.	.21	3.20	1.25	.0010	.0108	.0106	.0002	.21	.0190	.0002	.34	0.8
26995	May 2	V. slight	V. slight.	.18	3.45	1.10	.0004	.0108	.0092	.0016	.22	.0300	.0001	.30	1.0
27303	June 2	V. slight.	Slight.	.18	3.15	1.05	.0000	.0108	.0092	.0016	.21	.0130	.0000	.25	1.0
27637	July 5	Slight.	Slight.	.20	3.40	1.40	.0000	.0150	.0126	.0024	.20	.0070	.0000	.37	1.0
27938	Aug. 1	V. slight	V. slight.	.13	3.30	1.20	.0006	.0146	.0126	.0020	.24	.0060	.0000	.31	1.0
28417	Aug. 31	Slight.	V. slight	.20	3.80	1.55	.0000	.0162	.0154	.0008	.22	.0030	.0001	.37	1.1
28852	Oct. 3	Slight.	V. slight.	.21	3.70	1.45	.0006	.0168	.0160	.0008	.23	.0040	.0000	.38	0.8
29187	Oct. 31	Slight.	V. slight	.24	3.15	1.15	.0002	.0150	.0140	.0010	.24	.0030	.0000	.34	1.0
29503	Nov. 28	V. slight.	V. slight.	.18	3.45	1.05	.0000	.0136	.0132	.0004	.22	.0070	.0000	.26	1.3

*Averages by Years.**

-	1888	-	-	.38	4.94	1.53	.0012	.0215	-	-	.40	.0183	.0002	-	-
-	1889	-	-	.51	4.71	1.43	.0005	.0199	.0176	.0023	.42	.0272	.0002	-	-
-	1890	-	-	.35	4.70	1.25	.0003	.0169	.0148	.0021	.42	.0241	.0001	-	2.2
-	1891	-	-	.37	4.39	1.63	.0005	.0161	.0136	.0025	.37	.0227	.0001	-	1.7
-	1892	-	-	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
-	1893	-	-	.61	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.60	1.8
-	1894	-	-	.69	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
-	1895	-	-	.72	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
-	1896	-	-	.49	4.29	1.67	.0005	.0165	.0142	.0023	.37	.0155	.0001	.56	1.4
-	1897	-	-	.65	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
-	1898	-	-	.41	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
-	1899	-	-	.23	3.70	1.30	.0006	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1

* Previous to 1897 these samples were collected from a faucet at the Institute of Technology. The character of the water at this place, however, does not differ materially from that of the water drawn from the faucet at the State House.

Note to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of some of the samples became stronger.

METROPOLITAN WATER DISTRICT.

Microscopical Examination of Water from a Faucet at the State House, Boston.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Aug.	Oct.	Oct.	Nov.
Day of examination,	2	2	1	3	3	2	5	1	31	3	31	28
Number of sample,	25809	26110	26360	26680	26995	27303	27637	27938	28417	28852	29187	29503
PLANTS.												
Diatomaceæ,	55	28	16	13	186	64	310	326	138	262	208	62
Asterionella,	23	4	6	6	64	22	102	30	20	24	58	33
Cyclotella,	11	0	0	0	0	8	74	12	40	20	6	10
Melosira,	0	0	0	0	8	6	6	0	12	68	44	9
Synedra,	6	4	5	1	50	2	6	38	6	32	10	5
Tabellaria,	14	19	2	4	26	18	118	246	52	114	88	5
Cyanophyceæ,	0	0	0	0	0	34	1	10	12	2	0	0
Anabæna,	0	0	0	0	0	34	0	4	12	2	0	0
Algæ,	0	0	0	0	0	2	64	2	5	8	14	10
Protococcus,	0	0	0	0	0	0	64	0	0	0	0	9
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	1	0	0	0	0	0	0	0	0	0
Infusoria,	1	4	4	6	10	0	0	0	2	2	20	12
Dinobryon,	0	0	4	8	8	0	0	0	0	0	20	12
Vermes, Polyarthra,	0	0	0	0	0	0	0	0	0	0	0	1
Crustacea, Cyclops,	0	0	0	0	0	0	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	3	3	0	5	5	12	7	7	15	8	5	3
TOTAL,	59	35	21	24	201	112	382	345	172	282	247	88

Table showing Monthly Heights, in Feet, above Tide-marsh Level of the Water in the Lakes and Storage Reservoirs of the Metropolitan Water Works, from which Samples of Water were collected during the Year 1899.

	Sudbury Reservoir. Stone Crest, 259.97.	Framingham Reservoir No. 3. Stone Crest, 185.50.	Hopkinton Reservoir. Flash Boards, 305.00.	Ashland Reservoir. Flash Boards, 225.23.	Framingham Reservoir No. 2. Flash Boards, 177.12.	Lake Cochituate. High Water, 144.36.	Spot Pond.
1899.							
Jan. 1,	258.39	185.00	304.12	224.55	176.20	143.38	151.78
Feb. 1,	258.10	184.96	304.20	224.49	176.19	143.11	149.43
March 1,	258.86	185.14	300.55	220.87	176.46	141.20	147.44
April 1,	259.39	185.16	301.92	221.43	176.46	143.45	143.27
May 1,	259.97	185.10	304.22	224.37	176.17	143.79	143.67
June 1,	259.78	186.30	305.04	225.24	177.70	144.34	141.43
July 1,	258.28	185.20	304.82	225.18	176.22	144.37	141.28
Aug. 1,	255.25	185.02	304.61	223.87	175.80	144.11	141.38
Sept. 1,	252.17	183.47	304.29	222.05	176.73	142.39	141.44
Oct. 1,	252.28	177.80	301.47	212.14	176.72	140.58	139.85
Nov. 1,	251.25	185.35	285.27	196.32	177.00	138.75	139.40
Dec. 1,	250.36	184.00	280.25	193.88	175.95	139.15	139.38

WATER SUPPLY OF ABINGTON AND ROCKLAND.

Chemical Examination of Water from Big Sandy Pond, Pembroke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26127	Feb. 5	V. slight.	V. slight.	.14	3.35	1.25	.0000	.0150	.0136	.0014	.64	.0020	.0001	.29	0.6
27022	May 7	V. slight.	V. slight.	.10	3.20	1.15	.0012	.0154	.0134	.0020	.57	.0040	.0000	.22	0.3
28065	Aug. 6	V. slight.	V. slight.	.07	3.75	1.00	.0006	.0132	.0130	.0002	.67	.0010	.0000	.20	0.6
29239	Nov. 5	V. slight.	V. slight.	.08	3.65	1.55	.0006	.0178	.0164	.0014	.67	.0010	.0000	.20	0.3
Av...	....	....	....	.10	3.49	1.24	.0006	.0153	.0141	.0012	.64	.0020	.0000	.23	0.4

Odor, generally faintly vegetable. —— The samples were collected from a faucet in the pumping station.

WATER SUPPLY OF ADAMS FIRE DISTRICT, ADAMS.

Chemical Examination of Water from Bassett Brook Reservoir, Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26310	Feb. 21	None.	V. slight.	.00	3.75	1.00	.0000	.0020	.0018	.0002	.07	.0230	.0000	.07	2.7
27182	May 22	V. slight.	V. slight.	.04	2.95	0.65	.0000	.0040	.0040	.0000	.08	.0170	.0000	.14	1.7
28282	Aug. 19	V. slight.	V. slight.	.03	5.45	0.55	.0000	.0046	.0038	.0008	.06	.0080	.0000	.12	3.3
29436	Nov. 18	V. slight.	Slight.	.08	2.60	1.00	.0000	.0064	.0052	.0012	.10	.0140	.0000	.16	1.4
Av...	....	....	....	.04	3.69	0.80	.0000	.0042	.0037	.0005	.08	.0155	.0000	.12	2.3

Odor, faintly vegetable or none. —— The samples were collected from a faucet supplied with water from the reservoir.

ADAMS.

Chemical Examination of Water from Dry Brook Reservoir in Adams and Cheshire.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26309	Feb. 21	None.	V. slight.	.10	6.05	1.65	.0010	.0046	.0042	.0004	.08	.0190	.0001	.22	3.9
27183	May 22	V. slight.	Slight.	.14	5.50	1.25	.0000	.0098	.0084	.0014	.07	.0040	.0000	.29	3.6
28283	Aug. 19	V. slight.	V. slight.	.09	11.25	2.60	.0024	.0094	.0086	.0008	.21	.0080	.0000	.24	6.6
29437	Nov. 18	V. slight.	V. slight.	.31	6.20	2.25	.0006	.0122	.0118	.0004	.10	.0050	.0000	.52	3.3
Av...	....	....	....	.16	7.25	1.94	.0010	.0090	.0083	.0007	.11	.0090	.0000	.32	4.3

Odor of the first two samples, none, becoming very faintly vegetable on heating; of the last two, very faintly vegetable, becoming distinctly vegetable on heating. — The samples were collected from a faucet supplied with water from the reservoir.

Water Supply of Amesbury. — Powow Hill Water Company.

Chemical Examination of Water from the Wells of the Powow Hill Water Company.

[Parts per 100,000.]

	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxgen Consumed.	Hardness.	Iron.
			Free.	Albu-minoid.		Nitrates.	Nitrites.			
Averages of four samples collected in July, August, September and October, 1899.	.01	20.15	.0044	.0017	1.10	.0012	.0000	.08	8.9	.0060
	.05	9.32	.0005	.0022	0.57	.0477	.0001	.02	4.0	.0150

Odor, none. — The first analysis is the average of the analyses of four samples collected from the tubular wells near Market Street; the last is the average of the analyses of four samples collected from the tubular wells near Main Street.

WATER SUPPLY OF ANDOVER.

Chemical Examination of Water from Haggett's Pond, Andover.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25932	Jan. 11	None.	V. slight.	.21	8.30	1.30	.0010	.0144	.0138	.0006	.31	.0000	.0000	.38	1.8
26689	Apr. 10	V. slight.	V. slight.	.22	8.50	1.25	.0012	.0146	.0144	.0002	.30	.0080	.0000	.37	0.8
28911	Oct. 6	V. slight.	V. slight.	.10	12.45	2.45	.0008	.0152	.0132	.0020	.38	.0000	.0000	.25	2.1
Av...	....	....	....	.18	6.42	1.67	.0010	.0147	.0138	.0009	.33	.0027	.0000	.33	1.4

Odor, none, becoming faintly vegetable on heating. —— The samples were collected from a faucet at the pumping station.

WATER SUPPLY OF ARLINGTON.

(See also *Metropolitan Water District*, pages 127 to 152.)

The low-service district of Arlington was supplied during the year from the Metropolitan Water Works, the high-service district being supplied from the driven wells at East Lexington.

Chemical Examination of Water from Tubular Wells at East Lexington.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26041	Jan. 25	Decided.	Cons.	.40	8.20	.0212	.0108	.47	.0010	.0000	.20	4.0	.1700
26599	Mar. 28	Decided.	Slight.	.50	9.00	.0272	.0116	.47	.0000	.0001	.18	4.0	.1700
27302	June 1	Slight.	Slight.	.58	6.30	.0188	.0132	.43	.0080	.0000	.35	2.6	.0830
27865	July 24	Decided.	V. slight.	.70	9.50	.0268	.0096	.52	.0040	.0000	.23	4.4	.0850
28775	Sept. 27	Decided.	Cons.	.70	9.30	.0292	.0114	.56	.0160	.0000	.27	4.2	.1000
29497	Nov. 27	Decided.	Cons.	.50	9.50	.0268	.0104	.55	.0110	.0001	.21	4.2	.3800

Averages by Years.

-	1895	-	-	.17	9.90	.0097	.0075	.52	.0045	.0001	.18	5.5	.0958
-	1896	-	-	.24	9.88	.0090	.0102	.54	.0052	.0001	.21	5.3	.0742
-	1897	-	-	.45	9.05	.0167	.0102	.55	.0042	.0000	.22	4.7	.0993
-	1898	-	-	.47	8.72	.0190	.0118	.52	.0014	.0000	.24	4.0	.1342
-	1899	-	-	.56	8.63	.0250	.0120	.50	.0067	.0000	.24	3.9	.1647

NOTE to analyses of 1899: Odor of the fourth sample, faintly unpleasant; of the others, none, becoming faintly vegetable or unpleasant on heating. —— The samples were collected from a faucet at the pumping station.

ASHBURNHAM.

WATER SUPPLY OF ASHBURNHAM.

Chemical Examination of Water from the Ashburnham Storage Reservoir.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
								Albuminoid.							
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27540	June 20	Decided.	V. slight.	.24	3.80	1.20	.0006	.0388	.0292	.0096	.12	.0000	.0000	.27	1.1

Odor, faintly mouldy and unpleasant.

WATER SUPPLY OF ATHOL. — ATHOL WATER COMPANY.

Chemical Examination of Water from the Large Reservoir in Phillipston.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
								Albuminoid.							
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
26598	Mar. 28	V. slight.	V. slight.	0.34	2.50	1.00	.0020	.0188	.0160	.0028	.09	.0070	.0000	0.46	0.3
27619	June 28	Decided.	Heavy.	0.52	3.25	1.70	.0020	.1090	.0360	.0730	.11	.0000	.0000	0.75	0.6
28743	Sept. 25	V. slight.	V. slight.	1.00	5.50	2.75	.0020	.0266	.0242	.0024	.16	.0050	.0001	1.30	0.9
29795	Dec. 27	V. slight.	V. slight.	0.86	5.45	2.60	.0222	.0222	.0210	.0012	.19	.0070	.0001	1.02	1.0

Odor, generally faintly vegetable.

Microscopical Examination.

An insignificant number of organisms was found in each of these samples, except in the June sample, which contained 14,800 *Anabæna Oscillaroide*s per cubic centimeter.

ATHOL.

Chemical Examination of Water from Bucknam Brook Reservoir, Athol.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26597	Mar. 28	None.	None.	.20	2.55	0.80	.0006	.0074	.0070	.0004	.09	.0050	.0000	.31	0.3
27620	June 28	V. slight.	Cons.	.32	2.85	1.25	.0016	.0232	.0164	.0068	.10	.0000	.0000	.65	0.6
28742	Sept. 25	Decided.	Cons.	.66	4.65	2.20	.0012	.0360	.0310	.0050	.20	.0020	.0000	.96	0.8
29794	Dec. 27	V. slight.	V. slight.	.39	4.30	1.70	.0002	.0160	.0148	.0012	.19	.0020	.0001	.65	1.0
Av...	....	....	....	.39	3.59	1.49	.0009	.0206	.0173	.0033	.14	.0022	.0000	.64	0.7

Odor of the first and last samples, none; of the others, faintly vegetable, becoming stronger on heating.

Water Supply of Attleborough.

The advice of the State Board of Health to the water commissioners of Attleborough, relative to the quality of the water supplied to that town, may be found on pages 5 and 6 of this volume.

Chemical Examination of Water from the Well of the Attleborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25885	Jan. 9	None.	V. slight.	.00	3.60	.0000	.0012	.34	.0080	.0000	.03	2.0	.0010
26155	Feb. 6	None.	None.	.00	4.30	.0000	.0018	.33	.0090	.0001	.04	2.1	.0030
26450	Mar. 10	None.	None.	.00	4.70	.0000	.0012	.31	.0140	.0000	.04	2.0	.0010
26764	Apr. 14	None.	None.	.02	3.90	.0000	.0014	.28	.0120	.0000	.04	1.6	.0030
27053	May 9	None.	None.	.00	3.70	.0000	.0010	.30	.0160	.0000	.04	1.3	.0030
27457	June 15	None.	V. slight.	.00	2.40	.0000	.0022	.29	.0110	.0000	.04	1.8	.0020
27723	July 11	None.	None.	.00	3.90	.0000	.0024	.27	.0090	.0000	.04	1.3	.0030
28262	Aug. 16	None.	V. slight.	.00	4.40	.0000	.0026	.28	.0070	.0000	.06	1.7	.0040
28576	Sept. 12	None.	None.	.00	3.80	.0000	.0014	.30	.0160	.0000	.02	2.0	.0070
28942	Oct. 10	None.	V. slight.	.00	4.30	.0000	.0034	.31	.0090	.0000	.04	2.2	.0030
29274	Nov. 7	None.	None.	.06	4.00	.0002	.0028	.32	.0140	.0000	.07	2.3	.0020
29645	Dec. 12	None.	None.	.07	3.60	.0002	.0042	.33	.0070	.0000	.06	1.7	.0020
Av...	....	....	....	.01	3.88	.0000	.0021	.30	.0110	.0000	.04	1.8	.0028

Odor, none. —— Nos. 25885, 26155 and 27723 were collected from the well; the others, from a faucet at the pumping station, while pumping.

AVON.

WATER SUPPLY OF AVON.

Chemical Examination of Water from the Well of the Avon Water Works.

[Parts per 100,000.]

	Color.	Residue on Evaporation.	Ammonia. Free	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
Average of five samples collected in June, July, August, September and October, 1899.	.01	3.50	.0001	.0008	.36	.0224	.0000	.02	0.9	.0038

Odor, none.

WATER SUPPLY OF AYER.

Chemical Examination of Water from the Well of the Ayer Water Works.

[Parts per 100,000.]

	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
Average of six samples collected in May, June, July, August, September and October, 1899.	.01	5.85	.0001	.0012	.46	.0415	.0000	.03	2.3	.0022

Odor, none.

WATER SUPPLY OF BARRE. — BARRE WATER COMPANY.

Chemical Examination of Water from the Reservoir of the Barre Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25844	Jan. 4	V. slight.	V. slight.	.13	2.60	1.00	.0002	.0096	.0094	.0002	.12	.0180	.0000	.24	1.0
26680	Apr. 5	None.	V. slight.	.10	2.50	1.10	.0006	.0106	.0102	.0004	.09	.0130	.0000	.21	0.3
27677	July 6	V. slight.	V. slight.	.03	2.80	1.05	.0024	.0190	.0144	.0046	.10	.0020	.0000	.26	0.6
28882	Oct. 4	Slight.	Slight.	.05	3.75	1.50	.0056	.0368	.0326	.0042	.14	.0020	.0000	.29	1.8
Av...	....	....	....	.08	2.91	1.16	.0022	.0190	.0166	.0024	.11	.0087	.0000	.25	0.9

Odor, faintly vegetable or none. —— The first sample was collected from a faucet on the main pipe line; the others, from the reservoir.

Water Supply of Belmont.

(See *Metropolitan Water District*, pages 127–152.)

Water Supply of Beverly.

(See *Salem.*)

Water Supply of Billerica.

Chemical Examination of Water from the Wells of the Billerica Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26407	Mar. 7	V. slight.	V. slight.	.01	5.70	.0000	.0008	.23	.0050	.0000	.05	2.1	.0070
26629	Mar. 30	V. slight.	None.	.00	5.40	.0000	.0010	.25	.0090	.0000	.02	2.0	.0010
26931	Apr. 24	V. slight.	V. slight.	.04	5.50	.0000	.0006	.25	.0070	.0000	.02	2.0	.0100
27228	May 22	V. slight.	Slight.	.03	5.40	.0000	.0014	.24	.0100	.0000	.03	1.8	.0070
27626	June 28	V. slight.	V. slight.	.03	5.50	.0000	.0016	.25	.0090	.0000	.03	1.8	.0130
27918	July 26	None.	None.	.00	5.50	.0000	.0006	.26	.0130	.0000	.03	2.0	.0010
28466	Sept. 1	V. slight.	V. slight.	.03	5.80	.0000	.0012	.25	.0080	.0000	.04	2.0	.0070
28792	Sept. 25	V. slight.	V. slight.	.02	5.80	.0004	.0014	.23	.0090	.0000	.05	1.7	.0060
29208	Oct. 30	V. slight	V. slight.	.05	6.10	.0008	.0010	.24	.0070	.0000	.05	2.0	.0190
29481	Nov. 22	V. slight.	Slight.	.04	5.80	.0002	.0016	.26	.0070	.0000	.07	2.2	.0250
29812	Dec. 26	Slight.	V. slight.	.05	5.60	.0006	.0014	.23	.0070	.0000	.04	2.2	.0180
Av..*	....	....	....	.03	5.65	.0002	.0012	.24	.0084	.0000	.04	2.0	.0101

Odor, none. —— The samples were collected from a faucet at the pumping station.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Blackstone.

The advice of the State Board of Health to the town of Blackstone, relative to a proposed water supply for that town, may be found on pages 7 and 8 of this volume. The results of analyses of samples of water collected from various sources in the town and vicinity are given in the following tables: —

BLACKSTONE.

Chemical Examination of Water from Various Surface Water Sources in Blackstone and Vicinity.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
29584	Dec. 5	Slight.	Cons.	.36	2.35	1.35	.0010	.0344	.0262	.0082	.25	.0010	.0000	.47	0.8
29585	Dec. 5	V. slight.	V. slight.	.57	3.65	1.40	.0010	.0156	.0144	.0012	.27	.0010	.0000	.60	0.5
29586	Dec. 5	V. slight.	V. slight.	.63	4.05	1.75	.0024	.0200	.0178	.0022	.29	.0010	.0000	.73	0.5
29587	Dec. 5	V. slight.	V. slight.	.68	4.70	1.90	.0012	.0226	.0204	.0022	.30	.0010	.0000	.85	1.0

Odor of the first two samples, none, becoming faintly vegetable on heating; of the third, none, becoming distinctly fishy on heating; of the last, faintly vegetable, becoming distinctly vegetable on heating. —— The first sample was collected from the outlet of the upper pond on Ironstone Brook in South Smithfield, R. I.; the second, from the westerly branch of Ironstone Brook, at the point where it joins the southerly branch; the third, from Emerson Brook, in Uxbridge, at the outlet of Lee's Pond; the last, from Fox Brook, in Blackstone, at the outlet of Crane's Ice Pond, about 1¾ miles above the mouth of the brook.

Chemical Examination of Water from Springs in Uxbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29623	Dec. 11	None.	V. slight.	.02	2.70	.0000	.0006	.25	.0730	.0000	.01	0.5	.0030
29624	Dec. 11	None.	V. slight.	.00	3.20	.0000	.0000	.27	.0030	.0000	.01	1.1	.0030

Odor, none. —— The first sample was collected from a spring at the base of a bluff just south of the confluence of Ironstone Brook and Blackstone River; the last, from a spring just below the site of an old dam near the mouth of Ironstone Brook.

Water Supply of Boston.

(See *Metropolitan Water District*, pages 127–152.)

WATER SUPPLY OF BRAINTREE.

Chemical Examination of Water from the Filter-gallery of the Braintree Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25839	Jan. 4	None.	None.	.05	5.10	.0014	.0054	.87	.0260	.0000	.11	2.0	.0050
26102	Feb. 1	None.	None.	.03	5.80	.0014	.0082	.90	.0620	.0001	.10	2.2	.0020
26372	Mar. 1	None.	None.	.06	5.50	.0026	.0046	.86	.0280	.0000	.10	2.1	.0030
26673	Apr. 5	None.	None.	.04	5.00	.0014	.0038	.76	.0510	.0000	.08	1.7	.0040
27009	May 3	None.	None.	.03	5.00	.0000	.0022	.78	.0830	.0001	.07	1.4	.0070
27340	June 6	None.	None.	.04	5.00	.0016	.0046	.76	.0240	.0000	.10	1.7	.0050
27683	July 6	None.	None.	.03	4.70	.0008	.0040	.78	.0120	.0000	.11	1.7	.0030
28033	Aug. 2	None.	V. slight.	.01	5.40	.0000	.0024	.81	.0350	.0000	.08	2.0	.0050
28488	Sept. 5	None.	None.	.07	5.40	.0034	.0054	.79	.0100	.0000	.12	1.6	.0130
28900	Oct. 5	None.	V. slight.	.05	5.10	.0034	.0060	.82	.0380	.0000	.07	2.0	.0050
29215	Nov. 2	None.	None.	.03	5.30	.0036	.0054	.78	.0260	.0001	.10	2.3	.0030
29583	Dec. 5	None.	None.	.05	5.10	.0050	.0056	.84	.0410	.0000	.09	2.0	.0060
Av.	....	....	....	.04	5.20	.0020	.0044	.81	.0363	.0000	.09	1.9	.0051

Odor, none. — Nos. 25839, 26102, 26372, 26673 and 28900 were collected from the filter-gallery; the others, from a faucet at the pumping station.

Chemical Examination of Water from Little Pond, Braintree.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26101	Feb. 1	Slight.	V. slight.	.80	4.75	2.50	.0022	.0248	.0216	.0032	.85	.0080	.0001	.50	1.1
26672	Apr. 5	Slight.	Slight.	.22	3.25	1.25	.0008	.0176	.0158	.0018	.63	.0080	.0001	.35	0.6
27339	June 6	V. slight.	Cons.	.20	3.35	1.25	.0006	.0236	.0186	.0050	.64	.0000	.0000	.40	0.6
28032	Aug. 2	V. slight.	Cons.	.16	3.85	1.30	.0004	.0236	.0198	.0038	.73	.0000	.0001	.39	1.0
28487	Sept. 5	Slight.	Slight.	.18	4.30	1.75	.0006	.0300	.0286	.0014	.74	.0010	.0000	.38	0.6
28899	Oct. 5	V. slight.	Slight.	.11	3.60	1.00	.0006	.0246	.0220	.0026	.74	.0010	.0000	.38	1.0
29582	Dec. 5	Slight.	Cons.	.18	4.10	1.45	.0030	.0274	.0218	.0056	.74	.0030	.0000	.39	1.3
Av.	....	....	....	.19	3.89	1.50	.0012	.0245	.0212	.0033	.72	.0030	.0000	.40	0.9

Odor, generally faintly vegetable, becoming stronger on heating.

BLACKSTONE.

Chemical Examination of Water from Various Surface Water Sources in Blackstone and Vicinity.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
29584	Dec. 5	Slight.	Cons.	.36	2.85	1.35	.0010	.0344	.0262	.0082	.25	.0010	.0000	.47	0.3
29585	Dec. 5	V. slight.	V. slight.	.57	3.65	1.40	.0010	.0156	.0144	.0012	.27	.0010	.0000	.60	0.5
29586	Dec. 5	V. slight.	V. slight.	.63	4.05	1.75	.0024	.0200	.0178	.0022	.29	.0010	.0000	.73	0.5
29587	Dec. 5	V. slight.	V. slight.	.68	4.70	1.90	.0012	.0226	.0204	.0022	.30	.0010	.0000	.85	1.0

Odor of the first two samples, none, becoming faintly vegetable on heating; of the third, none, becoming distinctly fishy on heating; of the last, faintly vegetable, becoming distinctly vegetable on heating. —The first sample was collected from the outlet of the upper pond on Ironstone Brook in South Smithfield, R. I.; the second, from the westerly branch of Ironstone Brook, at the point where it joins the southerly branch; the third, from Emerson Brook, in Uxbridge, at the outlet of Lee's Pond; the last, from Fox Brook, in Blackstone, at the outlet of Crane's Ice Pond, about 1¾ miles above the mouth of the brook.

Chemical Examination of Water from Springs in Uxbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29623	Dec. 11	None.	V. slight.	.02	2.70	.0000	.0006	.25	.0730	.0000	.01	0.5	.0030
29624	Dec. 11	None.	V. slight.	.00	3.20	.0000	.0000	.27	.0030	.0000	.01	1.1	.0030

Odor, none.—The first sample was collected from a spring at the base of a bluff just south of the confluence of Ironstone Brook and Blackstone River; the last, from a spring just below the site of an old dam near the mouth of Ironstone Brook.

Water Supply of Boston.

(See *Metropolitan Water District*, pages 127–152.)

WATER SUPPLY OF BRAINTREE.

Chemical Examination of Water from the Filter-gallery of the Braintree Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25839	Jan. 4	None.	None.	.05	5.10	.0014	.0054	.87	.0260	.0000	.11	2.0	.0050
26102	Feb. 1	None.	None.	.03	5.80	.0014	.0032	.90	.0620	.0001	.10	2.2	.0020
26372	Mar. 1	None.	None.	.06	5.50	.0026	.0046	.86	.0280	.0000	.10	2.1	.0030
26673	Apr. 5	None.	None.	.04	5.00	.0014	.0038	.76	.0510	.0000	.08	1.7	.0040
27009	May 3	None.	None.	.03	5.00	.0000	.0022	.78	.0830	.0001	.07	1.4	.0070
27340	June 6	None.	None.	.04	5.00	.0016	.0046	.76	.0240	.0000	.10	1.7	.0050
27683	July 6	None.	None.	.03	4.70	.0008	.0040	.78	.0120	.0000	.11	1.7	.0030
28033	Aug. 2	None.	V. slight.	.01	5.40	.0000	.0024	.81	.0350	.0000	.08	2.0	.0050
28488	Sept. 5	None.	None.	.07	5.40	.0034	.0054	.79	.0100	.0000	.12	1.6	.0130
28900	Oct. 5	None.	V. slight.	.05	5.10	.0034	.0060	.82	.0380	.0000	.07	2.0	.0050
29215	Nov. 2	None.	None.	.03	5.30	.0036	.0054	.78	.0260	.0001	.10	2.3	.0030
29583	Dec. 5	None.	None.	.05	5.10	.0050	.0056	.84	.0410	.0000	.09	2.0	.0060
Av...	....	....	....	.04	5.20	.0020	.0044	.81	.0363	.0000	.09	1.9	.0051

Odor, none. —— Nos. 25839, 26102, 26372, 26673 and 28900 were collected from the filter-gallery; the others, from a faucet at the pumping station.

Chemical Examination of Water from Little Pond, Braintree.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation. Total.	Loss on Ignition.	Ammonia. Free.	Albuminoid. Total.	Dissolved.	Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
26101	Feb. 1	Slight.	V. slight.	.30	4.75	2.50	.0022	.0248	.0216	.0032	.85	.0080	.0001	.50	1.1
26672	Apr. 5	Slight.	Slight.	.22	3.25	1.25	.0008	.0176	.0158	.0018	.63	.0080	.0001	.35	0.6
27339	June 6	V. slight.	Cons.	.20	3.35	1.25	.0006	.0236	.0186	.0050	.64	.0000	.0000	.40	0.6
28032	Aug. 2	V. slight.	Cons.	.16	3.85	1.30	.0004	.0236	.0198	.0038	.73	.0000	.0001	.39	1.0
28487	Sept. 5	Slight.	Slight.	.18	4.30	1.75	.0006	.0300	.0286	.0014	.74	.0010	.0000	.38	0.6
28899	Oct. 5	V. slight.	Slight.	.11	3.60	1.00	.0006	.0246	.0220	.0026	.74	.0010	.0000	.38	1.0
29582	Dec. 5	Slight.	Cons.	.18	4.10	1.45	.0030	.0274	.0218	.0056	.74	.0030	.0000	.39	1.3
Av...	....	....	....	.19	3.89	1.50	.0012	.0245	.0212	.0033	.72	.0030	.0000	.40	0.9

Odor, generally faintly vegetable, becoming stronger on heating.

BRIDGEWATER AND EAST BRIDGEWATER.

WATER SUPPLY OF BRIDGEWATER AND EAST BRIDGEWATER. — THE BRIDGEWATERS WATER COMPANY.

Chemical Examination of Water from the Wells of the Bridgewaters Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27218	May 24	V. slight.	Cons., white floc.	.20	7.00	.0000	.0010	.42	.0030	.0000	.02	2.0	.0200
27577	June 26	Decided.	Cons., white floc.	.17	9.30	.0010	.0014	.42	.0020	.0000	.04	2.5	:0700
27866	July 23	Slight, milky.	V. slight.	.10	6.10	.0010	.0010	.44	.0050	.0000	.03	2.0	.0200
28335	Aug. 23	Slight, milky.	Slight, rusty.	.11	8.60	.0018	.0020	.39	.0030	.0000	.06	2.6	.0900
28721	Sept. 25	Slight, milky.	Slight.	.22	7.20	.0010	.0082	.50	.0620	.0001	.27	2.0	.0150
29118	Oct. 24	Decided, milky.	Cons., rusty.	.15	8.50	.0010	.0006	.43	.0040	.0000	.01	2.9	.0550
Av...	....	....	....	.16	7.78	.0010	.0024	.43	.0132	.0000	.07	2.8	.0450

Odor, none. —— The samples were collected from a faucet at the pumping station.

WATER SUPPLY OF BROCKTON.

Chemical Examination of Water from Salisbury Brook at its Entrance to the Storage Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25845	Jan. 4	None.	V. slight.	0.60	3.95	1.75	.0000	.0182	.0120	.0012	.40	.0010	.0000	0.64	1.0
26157	Feb. 6	None.	V. slight.	0.49	3.70	1.50	.0004	.0128	[illegible]	.0016	.37	.0040	.0002	0.56	0.8
26367	Mar. 1	V. slight	V. slight.	0.43	3.05	1.35	.0000	.0126	.0122	.0004	.24	.0010	.0000	0.54	0.5
26670	Apr. 5	V. slight.	Slight.	0.44	2.45	1.30	.0002	.0148	.0134	.0014	.26	.0050	.0000	0.56	0.2
27002	May 3	Slight.	Slight.	0.50	2.65	1.45	.0012	.0194	.0180	.0014	.24	.0030	.0000	0.58	0.3
27333	June 6	Slight.	Slight.	0.42	2.50	1.35	.0006	.0216	.0184	.0032	.30	.0010	.0000	0.55	0.2
27672	July 6	Slight.	Cons.	0.56	3.15	1.90	.0004	.0252	.0206	.0046	.30	.0000	.0000	0.61	0.2
28029	Aug. 2	Slight.	Slight.	0.52	3.75	1.50	.0004	.0220	.0206	.0014	.36	.0030	.0001	0.53	0.2
28489	Sept. 5	Slight.	Slight.	0.46	3.35	1.45	.0028	.0296	.0248	.0048	.33	.0000	.0000	0.38	0.2
28884	Oct. 4	V. slight.	V. slight.	0.71	8.50	3.65	.0004	.0352	.0340	.0012	.36	.0020	.0000	1.41	2.3
29207	Nov. 1	V. slight.	Slight.	1.70	7.75	4.00	.0006	.0458	.0442	.0016	.47	.0030	.0000	2.04	1.3
29570	Dec. 5	None.	V. slight.	1.08	5.35	2.85	.0002	.0258	.0244	.0014	.41	.0010	.0000	1.22	1.3
Av...	....	....	....	0.66	4.18	1.96	.0006	.0232	.0212	.0020	.34	.0020	.0000	0.80	0.7

Odor, generally faintly vegetable, sometimes becoming stronger on heating.

BROCKTON.

Chemical Examination of Water from Salisbury Brook Storage Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25846	Jan. 4	V. slight.	V. slight.	.60	4.15	1.75	.0000	.0180	.0168	.0012	.41	.0010	.0000	.73	0.8
26158	Feb. 6	V. slight.	V. slight.	.50	3.30	1.55	.0006	.0160	.0136	.0024	.34	.0020	.0001	.58	1.0
26368	Mar. 1	V. slight.	V. slight.	.42	3.25	1.50	.0010	.0148	.0144	.0004	.34	.0040	.0000	.53	0.3
26671	Apr. 5	V. slight.	Slight.	.32	1.90	1.00	.0000	.0132	.0122	.0010	.28	.0010	.0000	.38	0.2
27003	May 3	V. slight.	V. slight.	.35	2.30	1.15	.0012	.0176	.0150	.0026	.22	.0010	.0000	.50	0.0
27334	June 6	Slight.	Slight.	.40	2.45	1.20	.0002	.0188	.0162	.0026	.31	.0010	.0000	.55	0.2
27673	July 6	Slight.	Cons.	.49	2.30	1.00	.0000	.0202	.0176	.0026	.29	.0020	.0000	.58	0.3
28030	Aug. 2	Slight.	Cons.	.44	2.80	1.10	.0000	.0224	.0180	.0044	.31	.0010	.0000	.58	0.2
28490	Sept. 5	Slight.	Slight.	.46	3.45	1.55	.0020	.0316	.0232	.0084	.30	.0020	.0000	.52	0.2
28885	Oct. 4	Slight.	Cons.	.44	3.85	1.60	.0008	.0340	.0256	.0084	.33	.0010	.0000	.57	0.8
29208	Nov. 1	Slight.	Slight.	.56	4.60	1.60	.0012	.0362	.0268	.0094	.32	.0010	.0000	.67	0.8
29571	Dec. 5	Slight.	V. slight.	.77	4.55	1.80	.0014	.0290	.0256	.0034	.36	.0010	.0000	.77	1.0

Averages by Years.

-	1888	-	-	.76	3.76	1.61	.0031	.0369	-	-	.31	.0066	.0001	-	-
-	1889	-	-	.78	2.79	1.01	.0028	.0306	.0218	.0088	.30	.0048	.0002	-	-
-	1890	-	-	.75	4.07	1.98	.0016	.0274	.0219	.0055	.32	.0063	.0001	-	0.9
-	1891	-	-	.62	3.15	1.45	.0010	.0213	.0169	.0044	.28	.0061	.0001	-	0.6
-	1892	-	-	.55	3.41	1.37	.0004	.0213	.0168	.0045	.36	.0030	.0000	-	0.7
-	1893	-	-	.67	3.59	1.70	.0007	.0237	.0196	.0041	.40	.0019	.0001	.65	0.7
-	1894	-	-	.81	3.71	1.63	.0012	.0228	.0188	.0040	.44	.0021	.0000	.66	0.7
-	1895	-	-	.80	3.75	1.86	.0009	.0263	.0224	.0039	.43	.0018	.0000	.74	0.9
-	1896	-	-	.64	3.59	1.55	.0007	.0224	.0186	.0038	.38	.0022	.0000	.66	0.6
-	1897	-	-	.85	3.80	1.72	.0011	.0236	.0195	.0041	.44	.0020	.0000	.75	0.8
-	1898	-	-	.73	3.72	1.92	.0009	.0237	.0207	.0030	.37	.0012	.0000	.79	0.8
-	1899	-	-	.48	3.24	1.40	.0007	.0226	.0187	.0039	.31	.0015	.0000	.58	0.5

Note to analyses of 1899: Odor, generally faintly vegetable, becoming stronger and occasionally fishy or oily on heating. —— The samples were collected from the reservoir, near the gate-house, 1 foot beneath the surface.

BROCKTON.

Microscopical Examination of Water from Salisbury Brook Storage Reservoir.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	5	7	2	6	4	7	7	8	6	5	2	6
Number of sample,	25846	26158	26368	26671	27008	27334	27678	28080	28490	28885	29208	29571
PLANTS.												
Diatomaceæ,	43	8	13	61	64	254	930	1,656	442	740	400	57
Asterionella,	10	0	8	4	7	60	88	116	240	296	40	30
Cyclotella,	0	0	0	7	0	0	18	100	0	0	8	0
Melosira,	0	0	0	0	3	0	0	0	10	50	116	20
Synedra,	33	6	1	23	17	30	326	1,200	80	8	44	6
Tabellaria,	0	0	4	23	36	160	498	240	112	386	188	0
Algæ,	1	0	0	1	1	5	44	122	13	52	8	32
Staurastrum,	0	0	0	0	0	0	20	80	4	0	0	0
ANIMALS.												
Infusoria,	13	49	85	157	32	20	28	38	115	1,162	1,736	15
Cercomonas,	0	0	0	11	0	0	0	0	0	0	0	0
Dinobryon,	0	26	39	142	19	0	0	0	106	1,126	1,720	2
Monas,	0	0	0	0	0	0	0	18	0	0	0	0
Peridinium,	7	12	39	2	4	12	28	0	0	2	0	4
Uroglena,	0	0	0	1	1	0	0	0	0	18	12	0
Vermes,	1	1	2	2	5	4	4	7	2	10	4	3
Crustacea,	0	0	0	0	0	0	0	pr.	0	pr.	pr.	0
Bosmina,	0	0	0	0	0	0	0	pr.	0	0	0	0
Cyclops,	0	0	0	0	0	0	0	pr.	0	0	pr	0
Daphnia,	0	0	0	0	0	0	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	3	5	8	10	0	12	15	25	5	15	10	3
TOTAL,	61	63	108	231	102	295	1,021	1,848	577	1,979	2,158	110

WATER SUPPLY OF BROOKLINE.

The advice of the State Board of Health to the town of Brookline, relative to enlarging the yield of the present sources of water supply of that town, may be found on pages 8 to 10 of this volume.

BROOKLINE.

Chemical Examination of Water from a Faucet at the Low-service Pumping Station of the Brookline Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25969	Jan. 17	None.	None.	.03	7.80	.0016	.0036	.55	.0220	.0001	.11	4.2	.0010
26230	Feb. 20	None.	None.	.00	8.50	.0016	.0028	.55	.0320	.0001	.11	4.3	.0010
26470	Mar. 13	None.	None.	.05	8.00	.0014	.0036	.52	.0170	.0001	.10	3.9	.0010
26707	Apr. 10	None.	None.	.05	7.20	.0010	.0030	.48	.0140	.0001	.13	3.6	.0010
27125	May 16	None.	None.	.01	8.20	.0020	.0030	.54	.0410	.0001	.09	4.2	.0020
27520	June 20	None.	None.	.02	9.30	.0018	.0030	.56	.0400	.0002	.08	4.6	.0020
27797	July 17	None.	None.	.04	8.60	.0016	.0024	.57	.0380	.0002	.08	4.2	.0010
28212	Aug. 14	None.	None.	.02	9.80	.0026	.0028	.56	.0410	.0000	.09	3.8	.0020
28648	Sept. 18	None.	None.	.03	9.40	.0020	.0026	.59	.0430	.0002	.09	4.3	.0020
29085	Oct. 17	None.	None.	.04	8.70	.0026	.0038	.60	.0320	.0003	.11	4.3	.0050
29371	Nov. 13	None.	None.	.01	9.10	.0028	.0042	.60	.0370	.0003	.08	4.2	.0050
29688	Dec. 18	None.	None.	.03	9.20	.0028	.0032	.63	.0210	.0005	.06	4.3	.0030

Averages by Years.

-	1888	-	-	.04	6.76	.0002	.0049	.52	.0326	.0000	-	-	-
-	1894	-	-	.02	9.01	.0010	.0017	.65	.0308	.0001	.06	4.5	.0035
-	1895	-	-	.02	9.15	.0005	.0026	.60	.0361	.0000	.07	4.4	.0022
-	1896	-	-	.03	8.48	.0007	.0031	.57	.0302	.0000	.10	4.6	.0018
-	1897	-	-	.03	9.02	.0015	.0041	.56	.0358	.0000	.10	4.6	.0012
-	1898	-	-	.07	8.85	.0012	.0041	.56	.0321	.0001	.13	4.3	.0032
-	1899	-	-	.03	8.65	.0020	.0032	.56	.0315	.0002	.09	4.2	.0022

Note to analyses of 1899: Odor, none.

CLINTON AND LANCASTER.

WATER SUPPLY OF CLINTON AND LANCASTER.

Chemical Examination of Water from a Faucet supplied from the Clinton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28515	Sept. 5	V. slight.	V. slight.	.10	3.75	1.00	.0004	.0070	.0068	.0002	.15	.0040	.0001	.19	1.0

Odor, none.

Chemical Examination of Water from Various Sources of Water Supply in Sterling.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28512	Sept. 5	None.	Slight.	.10	4.35	1.15	.0002	.0032	.0032	.0000	.16	.0030	.0000	.13	1.0
28513	Sept. 5	V. slight.	V. slight.	.13	4.10	1.10	.0012	.0122	.0108	.0014	.16	.0060	.0000	.19	1.0
28514	Sept. 5	V. slight.	V. slight.	.32	4.00	1.55	.0006	.0190	.0170	.0020	.19	.0060	.0001	.47	0.8

Odor of the first two samples, very faintly vegetable or none; of the last, decidedly unpleasant. ——The first sample was collected from Spring Brook; the second, from Spring Basin; the last, from Heywood Brook.

WATER SUPPLY OF CAMBRIDGE.

Chemical Examination of Water from Fresh Pond, Cambridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25841	Jan. 3	Slight.	Slight.	.30	6.90	1.85	.0026	.0220	.0198	.0022	.58	.0360	.0006	.45	3.3
26099	Feb. 1	Slight.	Slight.	.26	7.15	2.55	.0004	.0220	.0190	.0030	.52	.0400	.0001	.45	3.0
26364	Mar. 1	V. slight.	V. slight.	.23	7.00	2.40	.0004	.0176	.0170	.0006	.54	.0530	.0001	.41	3.1
26663	Apr. 4	Slight.	Slight.	.27	7.10	1.75	.0008	.0190	.0188	.0002	.58	.0680	.0001	.39	3.1
27000	May 1	V. slight.	Cons.	.20	6.80	2.25	.0046	.0220	.0174	.0046	.50	.0660	.0006	.36	3.3
27310	June 5	V. slight.	Cons.	.20	6.70	1.95	.0034	.0226	.0162	.0064	.52	.0400	.0005	.38	2.9
27662	July 5	V. slight.	Cons.	.18	6.75	1.95	.0014	.0246	.0160	.0086	.50	.0280	.0007	.37	3.3
28040	Aug. 2	V. slight.	Slight.	.18	7.10	2.50	.0016	.0328	.0274	.0054	.60	.0240	.0005	.43	3.1
28522	Sept. 6	Slight.	Cons.	.15	6.75	2.05	.0010	.0564	.0294	.0270	.60	.0080	.0005	.44	2.7
28877	Oct. 3	Slight.	Slight.	.10	6.75	1.50	.0040	.0324	.0252	.0072	.60	.0140	.0006	.31	3.0
29185	Oct. 31	V. slight.	V. slight.	.10	7.10	2.05	.0108	.0240	.0212	.0028	.59	.0130	.0006	.35	3.0
29495	Nov. 27	V. slight.	Slight.	.24	6.75	1.85	.0270	.0254	.0200	.0054	.63	.0090	.0010	.31	3.0

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Free.	Albuminoid Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1888	-	-	.17	11.14	1.79	.0182	.0206	-	-	1.10	.0261	.0007	-	-
-	1889	-	-	.11	9.86	1.83	.0145	.0220	.0170	.0050	0.90	.0334	.0008	-	-
-	1890	-	-	.11	8.90	1.34	.0098	.0221	.0168	.0053	0.83	.0303	.0004	-	4.1
-	1891	-	-	.15	7.94	1.80	.0095	.0235	.0162	.0073	0.75	.0333	.0004	-	3.8
-	1892	-	-	.16	7.23	1.57	.0086	.0210	.0161	.0049	0.67	.0249	.0003	-	3.4
-	1893	-	-	.27	6.66	1.82	.0106	.0202	.0165	.0037	0.58	.0235	.0006	.40	3.2
-	1894	-	-	.30	6.98	1.81	.0063	.0199	.0162	.0037	0.66	.0183	.0007	.41	3.1
-	1895	-	-	.35	7.43	2.15	.0054	.0245	.0189	.0055	0.69	.0221	.0004	.47	3.3
-	1896	-	-	.29	7.63	2.10	.0020	.0220	.0175	.0045	0.72	.0372	.0006	.42	3.4
-	1897	-	-	.36	7.87	2.20	.0046	.0220	.0176	.0044	0.66	.0265	.0006	.42	3.5
-	1898	-	-	.35	7.07	2.27	.0069	.0232	.0187	.0045	0.60	.0320	.0006	.46	3.2
-	1899	-	-	.20	6.90	2.05	.0048	.0267	.0206	.0061	0.56	.0332	.0005	.39	3.1

NOTE to analyses of 1899: Odor, generally faintly vegetable, becoming stronger and sometimes also grassy or unpleasant on heating.—— The samples were collected from the pump well at the pumping station.

CAMBRIDGE.

Microscopical Examination of Water from Fresh Pond, Cambridge.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Nov.
Day of examination,	4	2	2	6	3	5	6	2	7	5	1	27
Number of sample,	25841	26099	26364	26663	27000	27310	27662	28040	28522	28877	29185	29495
PLANTS.												
Diatomaceæ,	634	226	20	174	1,184	662	150	406	8	66	274	2,048
Asterionella,	222	11	2	13	218	144	20	4	0	2	80	1,312
Cyclotella,	2	7	0	3	0	0	0	0	0	12	22	78
Fragilaria,	32	0	0	4	36	24	80	0	0	0	0	126
Melosira,	80	23	4	131	732	32	10	0	0	24	68	418
Stephanodiscus,	32	0	2	0	38	146	14	4	0	6	0	0
Synedra,	46	32	5	11	144	172	6	386	0	22	82	50
Tabellaria,	220	153	5	11	16	144	20	8	8	0	20	62
Cyanophyceæ,	10	17	12	0	0	116	204	388	928	314	8	5
Anabæna,	0	0	0	0	0	32	114	304	920	280	8	0
Aphanizomenon,	10	17	12	0	0	78	66	80	0	30	0	4
Microcystis,	0	0	0	0	0	0	18	0	0	0	0	0
Algæ,	18	10	3	0	6	20	40	50	28	26	36	178
Protococcus,	0	0	0	0	0	0	0	0	24	0	30	156
ANIMALS.												
Infusoria,	8	14	3	1	88	14	6	14	20	18	14	6
Cryptomonas,	0	6	0	0	42	0	0	4	12	6	0	0
Monas,	0	0	0	0	40	0	0	0	4	0	0	0
Vorticella,	0	0	0	0	10	4	0	0	0	0	0	0
Vermes,	2	0	0	0	0	2	0	2	4	16	0	0
Anurea,	2	0	0	0	0	2	0	2	0	10	0	0
Crustacea,	0	0	0	0	pr.	pr.	0	0	0	pr.	pr.	pr.
Cyclops,	0	0	0	0	pr.	pr.	0	0	0	0	pr.	pr.
Daphnia,	0	0	0	0	0	pr.	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	5	8	10	6	25	8	12	8	6	15	5	5
TOTAL,	677	275	48	183	1,303	822	412	868	994	455	337	2,242

CAMBRIDGE.

Chemical Examination of Water from Stony Brook Storage Reservoir, Waltham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25832	Jan. 3	V. slight.	V. slight.	.33	5.80	2.25	.0002	.0240	.0224	.0016	.40	.0320	.0002	.50	2.2
26098	Feb. 1	Slight.	V. slight.	.38	5.50	1.65	.0010	.0226	.0214	.0012	.42	.0300	.0001	.55	2.1
26376	Mar. 1	Slight.	V. slight.	.30	5.10	1.95	.0064	.0172	.0160	.0012	.40	.0220	.0002	.45	2.0
26659	Apr. 4	V. slight.	V. slight.	.29	4.75	1.85	.0002	.0174	.0156	.0018	.31	.0220	.0001	.41	1.7
26980	May 2	V. slight.	V. slight.	.41	4.50	1.65	.0006	.0236	.0214	.0022	.34	.0140	.0003	.55	1.6
27309	June 5	Slight.	V. slight.	.42	5.35	2.00	.0002	.0202	.0178	.0024	.39	.0100	.0003	.53	2.0
27636	July 5	Slight.	Slight.	.31	4.75	1.65	.0000	.0252	.0216	.0036	.42	.0100	.0002	.47	2.2
27949	Aug. 1	V. slight.	V. slight.	.20	5.00	1.60	.0044	.0246	.0220	.0026	.44	.0040	.0001	.48	2.0
28464	Sept. 5	V. slight.	Slight.	.14	4.75	2.00	.0002	.0240	.0216	.0024	.34	.0260	.0000	.35	2.
28855	Oct. 3	Slight.	V. slight	.20	5.20	1.50	.0032	.0228	.0206	.0022	.42	.0040	.0000	.38	2.2
29184	Oct. 31	Slight.	Slight.	.12	5.10	1.75	.0010	.0222	.0204	.0018	.43	.0030	.0004	.36	2.2
29493	Nov. 27	V. slight.	Slight.	.27	5.35	1.75	.0000	.0218	.0184	.0034	.43	.0040	.0001	.44	2.3

Averages by Years.

-	1888	-	-	.78	5.15	1.93	.0031	.0285	-	-	.34	.0169	.0002	-	-
-	1889	-	-	.87	4.59	1.47	.0032	.0280	.0249	.0031	.38	.0162	.0003	-	-
-	1890	-	-	.61	5.86	2.02	.0016	.0222	.0182	.0040	.37	.0208	.0002	-	2.3
-	1891	-	-	.56	4.99	1.86	.0016	.0213	.0183	.0030	.34	.0163	.0001	-	1.9
-	1892	-	-	.72	5.43	1.79	.0015	.0241	.0202	.0039	.37	.0208	.0001	-	2.2
-	1893	-	-	.66	5.32	1.97	.0020	.0235	.0196	.0039	.44	.0208	.0001	.60	2.1
-	1894	-	-	.73	5.61	2.08	.0018	.0211	.0189	.0022	.46	.0174	.0001	.64	2.1
-	1895	-	-	.84	5.90	2.41	.0015	.0280	.0235	.0045	.49	.0253	.0001	.79	2.2
-	1896	-	-	.61	5.98	2.08	.0026	.0250	.0219	.0031	.49	.0219	.0001	.65	2.2
-	1897	-	-	.69	6.40	2.32	.0026	.0273	.0236	.0037	.47	.0204	.0002	.66	2.4
-	1898	-	-	.69	5.67	2.40	.0014	.0246	.0220	.0026	.46	.0182	.0002	.66	2.1
-	1899	-	-	.28	5.10	1.80	.0014	.0221	.0199	.0022	.39	.0151	.0002	.46	2.0

Note to analyses of 1899: Odor, generally faintly vegetable, becoming stronger and sometimes also unpleasant or mouldy on heating. —— The samples were collected from the reservoir, near the surface at the dam.

CAMBRIDGE.

Chemical Examination of Water from the Upper Basin on Hobbs Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26631	Apr. 1	V. slight.	V. slight.	.47	3.95	1.65	.0044	.0190	.0158	.0032	.28	.0210	.0001	.54	1.1
26981	May 1	Slight.	Slight.	.50	4.40	1.90	.0044	.0284	.0228	.0056	.25	.0110	.0002	.67	1.3
27316	June 5	Decided.	Cons.	.47	4.60	2.15	.0024	.0308	.0244	.0064	.28	.0020	.0000	.77	1.7
27642	July 5	Decided.	Cons.	.40	5.00	1.85	.0002	.0322	.0264	.0058	.30	.0030	.0000	.65	1.8
28018	Aug. 2	Decided.	Slight.	.26	5.20	2.15	.0008	.0290	.0240	.0050	.37	.0020	.0000	.62	1.8
28478	Sept. 5	Decided.	Cons.	.24	5.45	2.25	.0084	.0504	.0378	.0126	.36	.0030	.0000	.62	1.8
28861	Oct. 3	Decided.	Cons.	.24	5.50	2.00	.0000	.0428	.0320	.0108	.36	.0000	.0000	.62	1.7
29224	Nov. 3	Decided.	Slight.	.19	5.30	2.30	.0004	.0360	.0312	.0048	.37	.0020	.0000	.68	2.0
29551	Dec. 1	Decided.	Cons.	.31	6.00	2.30	.0010	.0364	.0286	.0078	.37	.0010	.0000	.61	2.0
Av...	....	....	....	.34	5.04	2.06	.0024	.0339	.0270	.0069	.33	.0050	.0000	.64	1.7

Odor, generally vegetable or unpleasant. A fishy odor was developed on heating the samples collected in July and December. —— The samples were collected from the basin, near its outlet into the lower basin.

Microscopical Examination of Water from the Upper Basin on Hobbs Brook.

[Number of organisms per cubic centimeter.]

	1899. Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.
Day of examination,	3	2	6	5	2	6	4	3	1
Number of sample,	26631	26981	27316	27642	28018	28478	28861	29224	29551
PLANTS.									
Diatomaceæ,	8	288	380	602	200	144	442	196	130
Cyclotella,	0	6	220	130	32	0	70	2	2
Synedra,	8	166	100	460	160	126	364	170	82
Tabellaria,	0	96	34	2	4	12	6	0	40
Cyanophyceæ,	0	0	0	2	120	0	4	0	0
Aphanizomenon,	0	0	0	0	116	0	0	0	0
Algæ,	0	2	216	78	24	0	24	0	4
Protococcus,	0	0	200	40	0	0	0	0	0

CAMBRIDGE.

Microscopical Examination of Water from the Upper Basin on Hobbs Brook — Concluded.

[Number of organisms per cubic centimeter.]

	1899.								
	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.									
Rhizopoda, Actinophrys,	0	0	0	0	0	0	1	0	0
Infusoria,	10	82	140	122	144	8	116	40	88
Chlamydomonas,	0	0	6	100	60	0	100	20	28
Codonella,	0	32	0	0	pr.	0	0	0	0
Cryptomonas,	0	2	8	10	40	0	0	2	0
Dinobryon,	0	16	96	0	24	0	0	16	58
Halteria,	0	20	0	0	pr.	0	2	0	0
Monas,	6	10	30	4	0	0	0	0	0
Peridinium,	4	0	0	6	12	8	10	2	2
Vermes,	1	8	2	1	4	0	0	4	6
Crustacea, Cyclops,	0	pr.	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	100	100	30	20	35	30	5	3
TOTAL,	17	478	838	835	512	187	617	245	231

Chemical Examination of Water from the Lower Basin on Hobbs Brook, at Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26632	Apr. 1	Slight.	V. slight.	.08	3.00	1.20	.0012	.0156	.0110	.0046	.23	.0210	.0002	.24	0.6
26982	May 1	Slight.	V. slight.	.20	5.10	1.85	.0010	.0278	.0238	.0040	.32	.0210	.0002	.50	1.7
27317	June 5	Slight.	Slight.	.20	4.50	1.60	.0020	.0238	.0210	.0028	.35	.0080	.0002	.45	1.8
27648	July 5	Slight.	Cons.	.12	5.10	1.50	.0048	.0288	.0250	.0038	.34	.0030	.0001	.45	2.0
28019	Aug. 2	Slight.	Slight.	.11	5.00	1.50	.0020	.0228	.0218	.0010	.39	.0040	.0000	.46	1.7
28479	Sept. 5	Slight.	Cons.	.10	4.70	1.50	.0050	.0272	.0258	.0014	.35	.0020	.0000	.38	1.8
28859	Oct. 3	Decided.	Cons.	.09	5.25	1.75	.0008	.0272	.0246	.0026	.35	.0050	.0000	.37	2.0
29222	Nov. 3	Slight.	Slight.	.10	4.60	1.55	.0010	.0270	.0252	.0018	.38	.0010	.0000	.34	2.2
29552	Dec. 1	Decided.	Cons.	.07	4.65	1.55	.0006	.0256	.0208	.0048	.36	.0020	.0000	.34	1.8
Av...	....	....	....	.12	4.66	1.56	.0020	.0251	.0221	.0030	.34	.0074	.0001	.39	1.7

Odor, generally faintly vegetable, occasionally unpleasant, sometimes becoming stronger, and in November faintly oily, on heating.

CAMBRIDGE.

Microscopical Examination of Water from the Lower Basin on Hobbs Brook, at Surface

[Number of organisms per cubic centimeter.]

	1899.								
	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	3	2	6	5	2	6	4	3	1
Number of sample,	26632	26982	27317	27643	28019	28479	28859	29222	29552
PLANTS.									
Diatomaceæ,	7	240	190	1,144	40	296	204	414	146
Cyclotella,	0	32	34	1,004	6	12	56	22	0
Melosira,	0	0	0	0	4	12	10	70	0
Synedra,	7	188	92	130	24	272	118	312	110
Tabellaria,	0	16	58	8	6	0	14	6	26
Cyanophyceæ,	0	0	2	0	2	0	0	0	0
Algæ,	7	62	100	56	68	8	15	10	6
Protococcus,	0	24	80	40	80	0	0	0	0
ANIMALS.									
Infusoria,	192	59	508	96	16	4	93	172	56
Chlamydomonas,	0	0	500	84	12	0	80	80	22
Cryptomonas,	1	2	0	12	0	0	0	0	0
Dinobryon,	171	44	0	0	0	0	6	84	20
Vermes,	0	2	2	0	0	0	10	0	10
Anuræa,	0	0	1	0	0	0	4	0	10
Crustacea, Cyclops,	0	0	pr.	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	5	12	25	12	8	3	20	5	60
TOTAL,	211	375	825	1,308	134	311	342	601	278

Chemical Examination of Water from the Lower Basin on Hobbs Brook, at Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26633	Apr. 1	V. slight.	V. slight.	.33	4.85	1.95	.0034	.0180	.0164	.0016	.35	.0300	.0002	.48	1.7
26983	May 1	V. slight.	Slight.	.20	5.00	1.75	.0004	.0200	.0178	.0022	.31	.0180	.0002	.39	1.8
27318	June 5	Slight.	Slight.	.21	4.95	1.90	.0006	.0222	.0180	.0042	.34	.0070	.0002	.46	1.8
27644	July 5	Slight.	Slight.	.12	5.00	1.50	.0004	.0286	.0202	.0084	.37	.0080	.0001	.39	2.1
28020	Aug. 2	Slight.	Slight.	.14	4.95	1.75	.0002	.0210	.0178	.0032	.39	.0080	.0000	.44	1.8
28529	Sept. 7	V. slight.	Slight.	.13	4.90	1.65	.0044	.0258	.0228	.0030	.35	.0120	.0000	.35	2.0
28860	Oct. 3	Slight.	Slight.	.06	4.85	1.40	.0000	.0228	.0204	.0024	.36	.0030	.0000	.40	2.0
29223	Nov. 8	Slight.	Slight.	.08	4.60	1.80	.0000	.0232	.0200	.0032	.36	.0010	.0000	.32	2.0
29553	Dec. 1	Slight.	Slight.	.07	4.65	1.40	.0020	.0212	.0188	.0024	.35	.0010	.0001	.31	2.0
Av....	....	....	....	.15	4.86	1.68	.0013	.0225	.0191	.0034	.35	.0087	.0001	.39	1.9

Odor, generally vegetable, and sometimes unpleasant or disagreeable. On heating, the odor of several of the samples became fishy or oily.

WATER SUPPLY OF CANTON.

Chemical Examination of Water from the Springdale Well of the Canton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27320	June 5	None.	None.	.00	4.30	.0000	.0004	.35	.0280	.0000	.02	0.8	.0080
27778	July 15	V. slight.	V. slight.	.02	4.10	.0000	.0000	.35	.0030	.0000	.04	0.6	.0090
28060	Aug. 5	None.	None.	.03	3.30	.0000	.0006	.36	.0020	.0000	.02	1.0	.0010
28532	Sept. 8	V. slight.	Slight.	.03	4.80	.0000	.0010	.35	.0050	.0000	.02	1.1	.0500
28879	Oct. 3	None.	None.	.00	3.80	.0000	.0006	.34	.0020	.0000	.03	0.8	.0010
Av...	....	....	....	.01	4.06	.0000	.0005	.35	.0080	.0000	.03	0.9	.0138

Odor, none.

Chemical Examination of Water from the Well near Henry's Spring, Canton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27821	June 5	V. slight.	V. slight.	.16	4.20	.0000	.0052	.39	.0150	.0000	.21	1.0	.0090
27777	July 15	V. slight.	V. slight.	.26	5.90	.0008	.0070	.37	.0080	.0000	.36	1.8	.0090
28059	Aug. 5	None.	V. slight.	.30	6.40	.0010	.0092	.42	.0070	.0000	.30	2.2	.0100
28531	Sept. 8	V. slight.	V. slight.	.29	5.80	.0006	.0080	.43	.0060	.0000	.31	2.0	.0200
28878	Oct. 3	Slight.	Slight.	.30	8.30	.0008	.0080	.41	.0170	.0000	.29	2.9	.0180
Av...	....	....	....	.26	6.10	.0006	.0075	.40	.0106	.0000	.29	2.0	.0132

Odor, none. A faintly unpleasant odor was developed in the third sample, on heating.

WATER SUPPLY OF CHESHIRE. — CHESHIRE WATER COMPANY.

The advice of the State Board of Health to the Cheshire Water Company, with reference to obtaining an additional supply of water from Kitchen Brook in that town, may be found on page 10 of this volume. Analyses of samples of water from this source and from the present sources of supply are given in the following table: —

CHESHIRE.

Chemical Examination of Water from Thunder and Kitchen Brooks, in Cheshire.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28242	Aug. 16	None.	V. slight.	.00	6.10	0.55	.0006	.0028	.0028	.0000	.07	.0050	.0000	.08	3.8
28356	Aug. 23	None.	V. slight.	.01	6.90	0.60	.0004	.0044	.0038	.0006	.07	.0050	.0000	.09	3.9
28243	Aug. 16	None.	V. slight.	.00	6.45	0.50	.0000	.0012	.0012	.0000	.05	.0050	.0001	.08	3.8
28355	Aug. 23	None.	V. slight.	.00	6.85	0.65	.0004	.0024	.0020	.0004	.05	.0050	.0000	.05	3.8

Odor of No. 28355, very faintly vegetable; of the others, none. —— The first two samples were collected from Thunder Brook, at outlet of reservoir of Cheshire Water Company; the last two, from Kitchen Brook, at site of proposed reservoir.

Water Supply of Chicopee.

Chemical Examination of Water from Cooley Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25835	Jan. 3	V. slight.	Cons.	.48	3.40	1.00	.0006	.0128	.0072	.0056	.12	.0040	.0000	.43	0.8
26004	Jan. 23	Slight.	Slight.	.31	3.55	1.25	.0014	.0244	.0216	.0028	.13	.0050	.0000	.36	0.6
26900	Apr. 24	V. slight.	V. slight.	.70	3.75	1.45	.0002	.0118	.0102	.0016	.13	.0010	.0001	.54	0.3
27882	July 24	V. slight.	V. slight.	.20	4.20	1.15	.0026	.0122	.0078	.0044	.09	.0020	.0004	.23	1.0
29119	Oct. 24	Slight.	V. slight.	.64	4.30	1.25	.0006	.0184	.0158	.0026	.09	.0040	.0000	.54	0.8
Av.*	....	....	....	.48	3.93	1.24	.0011	.0152	.0120	.0032	.11	.0029	.0001	.42	0.7

Odor, faintly vegetable or none. On heating, the odor of all of the samples was faintly vegetable.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Dingle Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25834	Jan. 3	V. slight.	Slight.	.05	5.10	1.80	.0036	.0098	.0062	.0036	.26	.1920	.0003	.09	1.7

Odor, none, becoming very faintly vegetable on heating.

CHICOPEE.

Chemical Examination of Water from Morton Brook Reservoir, Chicopee.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25836	Jan. 3	V. slight.	V. slight.	.05	2.95	0.65	.0002	.0038	.0032	.0006	.14	.0070	.0000	.05	0.5
26005	Jan. 23	V. slight.	V. slight.	.02	3.50	1.05	.0006	.0100	.0078	.0022	.13	.0050	.0000	.10	0.6
26901	Apr. 24	V. slight.	Slight.	.05	3.45	1.00	.0002	.0022	.0020	.0002	.14	.0070	.0000	.05	0.2
27883	July 24	V. slight.	V. slight.	.05	3.70	0.85	.0006	.0034	.0032	.0002	.11	.0040	.0000	.07	0.5
29120	Oct. 24	V. slight	V. slight.	.10	3.80	0.90	.0008	.0058	.0056	.0002	.09	.0060	.0000	.09	0.8
Av.*	....	....	....	.06	3.54	0.90	.0005	.0046	.0041	.0005	.12	.0057	.0000	.07	0.5

Odor of the first sample, faintly unpleasant, becoming faintly vegetable on heating; of the others, none.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Water Supply of Cohasset. — Cohasset Water Company.

Chemical Examination of Water from the Tubular Wells of the Cohasset Water Company, situated West of the Main Village.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
26128	Feb. 6	Slight.	V. slight, clayey.	.03	11.70	.0000	.0014	1.72	.0170	.0000	.06	5.9	.0060
26754	Apr. 12	V. slight.	None.	.04	13.30	.0008	.0018	1.76	.0180	.0000	.06	5.9	.0060
27304	June 2	V. slight.	None.	.05	13.00	.0000	.0014	1.74	.0180	.0000	.02	5.7	.0060
28062	Aug. 7	V. slight, milky.	V. slight.	.07	12.40	.0000	.0012	1.79	.0420	.0000	.01	5.6	.0120

Averages by Years.

-	1888	-	-	.01	15.20	.0001	.0021	1.50	.0311	.0003	-	-	-
-	1893	-	-	.16	17.14	.0001	.0007	1.64	.0263	.0001	.04	8.6	.0451
-	1894	-	-	.17	17.94	.0004	.0016	1.77	.0204	.0000	.03	8.4	.0743
-	1895	-	-	.19	17.22	.0002	.0015	1.89	.0211	.0000	.03	8.3	.0689
-	1896	-	-	.16	16.10	.0004	.0018	2.05	.0118	.0000	.09	7.9	.0652
-	1897	-	-	.19	15.30	.0005	.0023	2.12	.0267	.0000	.04	6.7	.0383
-	1898	-	-	.07	14.31	.0004	.0019	1.75	.0234	.0000	.03	6.3	.0195
-	1899	-	-	.05	12.60	.0002	.0014	1.75	.0237	.0000	.04	5.8	.0085

Note to analyses of 1899: Odor, none.—— The samples were collected from a faucet at the pumping station, and represent water from the original source of supply.

COHASSET.

Chemical Examination of Water from the Tubular Wells of the Cohasset Water Company in Ellms Meadow.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27305	June 2	None.	None.	.02	9.90	.0000	.0010	1.51	.0670	.0000	.02	4.6	.0030
28061	Aug. 7	None.	None.	.02	10.70	.0000	.0006	1.56	.0950	.0000	.01	4.0	.0010
29027	Oct. 9	None.	None.	.00	10.20	.0000	.0024	1.26	.0430	.0000	.02	4.4	.0029
29622	Dec. 12	None.	None.	.02	14.60	.0000	.0010	1.49	.0740	.0000	.02	6.4	.0050
Av.	....	....	....	.01	11.35	.0000	.0012	1.45	.0697	.0000	.02	4.8	.0027

Odor, none.——The samples were collected from a faucet in the pumping station at Ellms Meadow, and represent the new source of supply.

Water Supply of Concord and Lincoln.

Chemical Examination of Water from Sandy Pond, Lincoln.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26156	Feb. 6	V. slight.	V. slight.	.10	2.60	1.00	.0000	.0124	.0110	.0014	.29	.0010	.0001	.25	1.0
26633	Apr. 10	V. slight.	V. slight.	.10	2.30	0.90	.0006	.0096	.0094	.0002	.21	.0030	.0000	.22	0.6
27390	June 12	None.	Slight.	.05	2.25	0.85	.0000	.0110	.0098	.0012	.20	.0040	.0000	.19	0.5
28041	Aug. 3	None.	V. slight.	.05	3.05	0.90	.0006	.0124	.0118	.0006	.31	.0040	.0001	.20	1.3
28058	Aug. 7	V. slight.	V. slight.	.05	2.65	1.00	.0004	.0126	.0118	.0008	.28	.0040	.0000	.15	0.6
28949	Oct. 10	V. slight.	V. slight.	.02	2.75	1.10	.0004	.0112	.0106	.0006	.28	.0010	.0000	.15	0.8
Av.*	....	....	....	.06	2.55	0.96	.0003	.0113	.0105	.0008	.25	.0026	.0000	.20	0.8

Odor, generally faintly vegetable. A grassy odor was developed in some of the samples on heating. —— No. 28949 was collected from the pond, and the others from a faucet at the pumping station.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

WATER SUPPLY OF COTTAGE CITY. — COTTAGE CITY WATER COMPANY.

Chemical Examination of Water from the Springs of the Cottage City Water Company

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27349	June 7	None.	None	.01	4.60	.0000	.0006	.95	.0120	.0000	.01	0.5	.0030
27687	July 5	None.	V. slight.	.03	3.90	.0000	.0004	.89	.0080	.0000	.02	0.6	.0030
28042	Aug. 2	None.	None.	.02	4.20	.0000	.0008	.94	.0080	.0000	.03	0.5	.0030
28523	Sept. 6	None.	V. slight.	.00	4.40	.0006	.0008	.92	.0120	.0000	.02	0.5	.0200
28914	Oct. 3	None.	V. slight.	.02	4.00	.0006	.0014	.95	.0100	.0000	.04	0.5	.0060
Av...	....	....	....	.02	4.22	.0002	.0008	.93	.0100	.0000	.02	0.5	.0070

Odor, none. —— The samples were collected from a faucet in the pumping station.

WATER SUPPLY OF DANVERS AND MIDDLETON.

Chemical Examination of Water from Middleton Pond, Middleton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26591	Mar. 28	V. slight	V. slight	.70	3.50	1.80	.0000	.0196	.0188	.0008	.31	.0010	.0001	.80	0.6
27332	June 6	V. slight.	V. slight.	.55	3.25	1.60	.0000	.0160	.0146	.0014	.31	.0040	.0000	.72	1.1
28473	Sept. 5	V. slight.	V. slight.	.40	3.65	1.95	.0092	.0184	.0178	.0006	.30	.0030	.0000	.55	0.5
29579	Dec. 5	Slight.	Slight.	.30	3.15	1.35	.0006	.0186	.0164	.0022	.28	.0010	.0000	.51	1.0
Av...	....	....	....	.49	3.39	1.67	.0024	.0181	.0169	.0012	.30	.0022	.0000	.64	0.8

Odor of the first two samples, vegetable; of the last two, none. —— The samples were collected from a faucet at the pumping station.

DARTMOUTH.

The advice of the State Board of Health to Alvin F. Waite and James T. Smith of Dartmouth, relative to a proposed water supply for the summer settlement known as Salter's Point in Dartmouth, may be found on pages 10 and 11 of this volume.

The advice of the Board to Franklyn Howland of New Bedford, relative to the quality of the water of a well used as the water supply of Bay View in the town of Dartmouth, may be found on pages 11 and 12 of this volume. Analyses of samples of water collected from the sources under consideration are given in the following table: —

DARTMOUTH.

Chemical Examination of Water from a Well at Bay View and from a Well at Salter's Point in the Town of Dartmouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
27827	July 18	None.	None.	.00	16.60	.0000	.0010	3.08	.7300	.0001	.04	4.6	.0010
27828	July 18	None.	None.	.00	8.00	.0000	.0008	0.96	.1160	.0000	.06	2.1	.0010

Odor, none. —— The first sample was collected from a well on the premises of Franklyn Howland in Bay View, used for the supply of several houses; the last, from a well on the premises of Waite and Smith, at Salter's Point, and used for the supply of a number of houses at that place.

WATER SUPPLY OF DEDHAM. — DEDHAM WATER COMPANY.

Chemical Examination of Water from the Wells of the Dedham Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25838	Jan. 4	None.	None.	.01	10.00	.0006	.0042	0.86	.2200	.0000	.02	4.0	.0030
26103	Feb. 1	None.	V. slight.	.00	10.10	.0012	.0072	0.92	.1900	.0000	.04	4.3	.0080
26385	Mar. 6	None.	None.	.01	9.00	.0006	.0018	0.83	.2240	.0000	.04	4.0	.0010
26682	Apr. 7	None.	V. slight.	.00	8.60	.0026	.0209	0.74	.1400	.0000	.08	3.5	.0020
26999	May 3	None.	None.	.00	8.60	.0000	.0006	0.74	.1900	.0000	.03	3.8	.0030
27346	June 7	None.	None.	.00	7.70	.0000	.0020	0.64	.1220	.0000	.04	3.1	.0020
27668	July 6	None.	None.	.02	7.50	.0008	.0044	0.59	.0980	.0000	.05	2.9	.0010
28023	Aug. 2	None.	None.	.02	11.50	.0004	.0014	1.00	.2960	.0000	.02	3.9	.0030
28084	Aug. 7	None.	V. slight.	.03	9.70	.0002	.0012	0.84	.2600	.0000	.04	3.5	.0010
28469	Sept. 5	Decided, clayey.	Slight, clayey.	.02	12.00	.0000	.0014	0.92	.3680	.0000	.08	3.3	.0230
28876	Oct. 4	None.	None.	.00	12.30	.0000	.0008	1.15	.3500	.0000	.02	4.3	.0030
29213	Nov. 1	None.	None.	.01	11.50	.0000	.0010	1.09	.2700	.0003	.02	4.7	.0020
29619	Dec. 12	None.	None.	.03	8.70	.0018	.0046	0.68	.1200	.0000	.04	3.3	.0020

Averages by Years.

-	1892	-	-	.00	10.65	.0000	.0006	0.95	.2982	.0000	-	4.4	.0007
-	1893	-	-	.00	10.14	.0000	.0024	0.92	.2325	.0000	.08	4.2	.0000
-	1894	-	-	.01	10.18	.0000	.0017	0.86	.2008	.0000	.03	4.0	.0018
-	1895	-	-	.02	9.92	.0009	.0015	0.85	.1768	.0000	.04	3.9	.0000
-	1896	-	-	.01	9.30	.0001	.0028	0.82	.1205	.0000	.04	3.9	.0012
-	1897	-	-	.01	9.42	.0008	.0031	0.84	.1750	.0000	.03	4.3	.0015
-	1898	-	-	.02	9.48	.0005	.0033	0.82	.1895	.0000	.05	3.9	.0020
-	1899*	-	-	.01	9.72	.0007	.0042	0.84	.2142	.0000	.04	3.7	.0043

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

NOTE to analyses of 1899: Odor, none. —— No. 26385 was collected from a faucet in the pumping station; No. 28084, from a faucet in the town; No. 28876, from a 6-inch driven well situated near the large well; the others, from the well.

Water Supply of East Bridgewater.

(See *Bridgewater*.)

Water Supply of Easthampton.

Chemical Examination of Water from Bassett Brook, Easthampton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26562	Mar. 23	V. slight.	Slight.	.11	2.90	1.25	.0008	.0066	.0042	.0024	.09	.0070	.0000	.17	0.5
27560	June 24	Slight.	Slight.	.21	4.25	1.00	.0018	.0114	.0098	.0016	.12	.0090	.0002	.20	1.0
28782	Sept. 27	V. slight.	V. slight.	.55	4.60	2.10	.0006	.0166	.0160	.0006	.12	.0010	.0000	.75	1.3
29590	Dec. 6	V. slight.	None.	.20	3.55	0.90	.0004	.0072	.0066	.0006	.11	.0010	.0000	.27	1.1
Av...	....	....	....	.27	3.82	1.31	.0009	.0104	.0091	.0013	.11	.0045	.0000	.35	1.0

Odor of the first sample, none; of the third, faintly unpleasant; of the others, faintly vegetable. —— The first two samples were collected from the reservoir, and the last two from a faucet.

Water Supply of North Easton Village District, Easton.

Chemical Examination of Water from the Well of the North Easton Village District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27350	June 6	None.	None.	.01	4.60	.0000	.0008	.44	.0500	.0000	.02	1.3	.0030
27690	July 6	None.	V. slight.	.00	3.90	.0000	.0018	.43	.0280	.0000	.01	1.3	.0000
28063	Aug. 7	None.	V. slight.	.00	4.20	.0002	.0006	.41	.0170	.0000	.02	1.7	.0010
28521	Sept. 6	None.	None.	.02	4.40	.0000	.0018	.43	.0120	.0000	.03	1.3	.0030
28933	Oct. 9	None.	V. slight.	.05	4.30	.0000	.0016	.40	.0240	.0000	.02	1.3	.0030
Av...	....	....	....	.02	4.28	.0000	.0013	.42	.0262	.0000	.02	1.4	.0020

Odor, none. —— The samples were collected from a faucet at the pumping station.

Water Supply of Everett.

(See *Metropolitan Water District*, pages 127–152.)

FAIRHAVEN.

WATER SUPPLY OF FAIRHAVEN. — FAIRHAVEN WATER COMPANY.

Chemical Examination of Water from the Tubular Wells of the Fairhaven Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27541	June 21	None.	None.	.10	4.70	.0006	.0022	.63	.0300	.0000	.11	1.3	.0130
27870	July 21	None.	None.	.21	5.30	.0000	.0072	.63	.0250	.0001	.33	1.1	.0080
28295	Aug. 17	V. slight	None.	.14	5.10	.0000	.0046	.67	.0290	.0000	.27	1.3	.0020
28637	Sept. 16	V. slight.	None.	.09	4.30	.0000	.0038	.66	.0340	.0000	.18	1.3	.0100
29013	Oct. 12	V. slight	None.	.44	7.00	.0008	.0100	.74	.0260	.0002	.62	1.6	.0170
Av.	....	....	....	.20	5.28	.0003	.0056	.67	.0288	.0001	.30	1.3	.0100

Odor in July, very faintly vegetable, becoming distinctly vegetable on heating; at other times, none. A faintly vegetable odor was developed in the August sample, on heating.——The samples were collected from a faucet in the pumping station.

WATER SUPPLY OF FALL RIVER.

Chemical Examination of Water from North Watuppa Lake.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25952	Jan. 15	V. slight.	V. slight.	.30	3.30	1.70	.0004	.0168	.0158	.0010	.54	.0020	.0000	.54	0.5
26231	Feb. 16	Slight.	Slight.	.28	3.65	1.50	.0010	.0164	.0152	.0012	.56	.0060	.0001	.48	0.6
26461	Mar. 13	Slight.	Slight.	.28	3.25	1.40	.0004	.0172	.0154	.0018	.50	.0080	.0001	.42	0.3
26704	Apr. 10	Slight.	Cons.	.29	3.10	1.50	.0006	.0200	.0178	.0022	.37	.0040	.0001	.45	0.4
27098	May 15	V. slight.	V. slight.	.29	3.05	1.20	.0004	.0180	.0160	.0020	.43	.0060	.0001	.46	0.3
27471	June 19	Slight.	Cons.	.22	2.65	1.15	.0010	.0206	.0188	.0018	.48	.0010	.0000	.44	0.2
27784	July 17	Slight.	Cons.	.12	3.90	1.60	.0040	.0252	.0182	.0070	.48	.0010	.0000	.29	0.3
28184	Aug. 11	Slight.	Slight.	.12	3.75	1.80	.0042	.0198	.0162	.0036	.52	.0000	.0000	.40	0.3
28642	Sept. 18	V. slight.	Slight.	.11	2.90	1.40	.0006	.0232	.0206	.0026	.47	.0000	.0000	.36	0.3
29026	Oct. 16	Slight.	V. slight.	.09	3.15	1.10	.0008	.0224	.0198	.0026	.45	.0010	.0001	.34	0.6
29365	Nov. 13	Decided.	Slight.	.13	3.40	1.35	.0006	.0252	.0220	.0032	.48	.0010	.0000	.34	0.5
29781	Dec. 20	V. slight.	V. slight.	.14	3.35	1.40	.0010	.0242	.0208	.0034	.51	.0010	.0001	.34	0.5

FALL RIVER.

Chemical Examination of Water from North Watuppa Lake — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
-	1888	-	-	.17	3.18	0.93	.0004	.0158	-	-	.52	.0057	.0001	-	-
-	1892	-	-	.08	2.95	0.86	.0012	.0130	.0107	.0023	.52	.0117	.0001	-	0.5
-	1896	-	-	.22	3.32	1.14	.0011	.0160	.0137	.0023	.61	.0041	.0000	.35	0.7
-	1897	-	-	.23	3.50	1.17	.0010	.0144	.0138	.0006	.63	.0032	.0000	.35	0.7
-	1898	-	-	.31	3.45	1.44	.0011	.0194	.0171	.0023	.58	.0024	.0000	.44	0.8
-	1899	-	-	.20	3.29	1.42	.0012	.0207	.0180	.0027	.48	.0026	.0000	.40	0.5

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of the samples collected in March and April became fishy.

Microscopical Examination of Water from North Watuppa Lake.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	17	14	11	16	20	18	14	19	17	14	21
Number of sample,	25952	26231	26461	26704	27098	27471	27784	28184	28642	29026	29365	29731
PLANTS.												
Diatomaceæ,	107	19	80	124	284	22	4	10	2	9	13	49
Cyclotella,	76	3	10	66	260	10	2	0	0	0	2	29
Cyanophyceæ,	0	0	1	2	0	14	18	68	46	3	0	0
Anabæna,	0	0	0	0	0	0	12	6	0	0	0	0
Microcystis,	0	0	0	2	0	14	4	60	46	3	0	0
Algæ,	0	1	0	0	24	2	52	0	12	6	0	50
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	0	0	0	2	0	0	0	0	0
Infusoria,	6	8	444	138	4	0	2	2	0	0	0	0
Dinobryon,	3	8	435	132	0	0	0	0	0	0	0	0
Vermes, Polyarthra,	0	0	0	2	0	0	0	0	0	0	0	0
Crustacea,	pr.	0	0	pr.	pr.	0	pr.	pr.	0	0	pr.	pr.
Cyclops,	pr.	0	0	pr.	pr.	0	0	pr.	0	0	pr.	pr.
Daphnia,	0	0	0	0	0	0	pr.	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	5	5	10	20	10	10	50	20	3	3	8	5
TOTAL,	118	33	535	286	322	48	128	100	63	21	21	104

FALL RIVER.

Chemical Examination of Water from South Watuppa Lake.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25953	Jan. 15	Slight.	Slight.	.30	3.65	1.85	.0002	.0210	.0194	.0016	.58	.0010	.0001	.58	0.5
26232	Feb. 16	V. slight.	Slight.	.33	4.60	1.50	.0020	.0214	.0184	.0030	.67	.0070	.0001	.55	1.1
26462	Mar. 13	Slight.	Slight.	.28	3.40	1.40	.0002	.0184	.0160	.0024	.46	.0080	.0000	.46	0.3
26705	Apr. 10	Slight.	Slight.	.30	3.30	1.40	.0010	.0238	.0192	.0046	.47	.0040	.0001	.47	0.4
27099	May 15	V. slight.	V. slight.	.30	3.80	1.70	.0022	.0352	.0330	.0022	.58	.0090	.0001	.51	0.5
27472	June 19	Slight.	Cons.	.24	3.25	1.25	.0004	.0214	.0166	.0048	.48	.0000	.0000	.43	0.3
27785	July 17	V. slight.	Slight.	.19	4.85	1.50	.0016	.0208	.0182	.0026	.66	.0030	.0001	.43	1.8
28185	Aug. 11	V. slight.	V. slight.	.10	5.25	1.60	.0076	.0176	.0160	.0016	.73	.0000	.0000	.40	1.7
28643	Sept. 18	V. slight.	Slight.	.16	3.15	1.10	.0010	.0210	.0202	.0008	.49	.0010	.0000	.30	0.5
29025	Oct. 16	Slight.	V. slight.	.10	5.40	1.45	.0012	.0212	.0204	.0008	.70	.0010	.0001	.41	1.6
29366	Nov. 18	Decided.	Slight.	.17	5.40	1.40	.0018	.0218	.0194	.0024	.71	.0020	.0000	.31	1.4
29681	Dec. 18	Slight.	Slight.	.17	5.90	1.60	.0006	.0210	.0198	.0012	.76	.0010	.0000	.41	1.7
Av...	....	....	....	.22	4.33	1.48	.0016	.0220	.0197	.0023	.61	.0031	.0000	.44	1.0

Odor, generally faintly vegetable, sometimes none. On heating, the odor of most of the samples was vegetable, and in February, March and April, fishy.

Microscopical Examination of Water from South Watuppa Lake.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	17	14	11	16	20	18	14	19	17	14	19
Number of sample,	25953	26232	26462	26705	27099	27472	27785	28185	28643	29025	29366	29681
PLANTS.												
Diatomaceæ,	162	3	41	182	139	4	2	28	4	11	6	35
Cyclotella,	124	2	8	72	108	3	0	4	0	3	2	18
Synedra,	24	1	22	50	10	0	0	8	1	1	1	1
Tabellaria,	8	0	10	50	0	0	2	2	2	2	3	0
Cyanophyceæ,	0	0	0	0	0	15	68	42	1	18	0	0
Anabæna,	0	0	0	0	0	0	3	18	0	15	0	0
Merismopœdia,	0	0	0	0	0	11	56	0	0	0	0	0
Microcystis,	0	0	0	.0	0	4	8	18	1	3	0	0
Algæ,	0	1	1	0	2	17	86	62	15	0	0	0
Protococcus,	0	0	0	0	0	8	86	60	15	0	0	0

FALL RIVER.

Microscopical Examination of Water from South Watuppa Lake — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	2	0	0	0	0	0	0	0	0
Infusoria,	7	92	207	140	0	0	4	0	6	0	4	3
Dinobryon,	0	92	197	118	0	0	3	0	6	0	4	0
Vermes,	0	0	0	0	0	0	0	0	1	0	1	0
Crustacea, Cyclops,	0	0	0	0	0	pr.	0	0	0	0	pr.	pr.
Miscellaneous, Zoöglœa,	5	3	8	20	10	10	5	10	3	3	3	5
TOTAL,	174	99	257	344	161	46	165	142	30	32	14	43

Chemical Examination of Water from the Tributaries of North Watuppa Lake.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26580	Mar. 27	V. slight.	V. slight	1.14	3.65	2.20	.0016	.0200	.0184	.0016	.31	.0010	.0000	1.18	0.2
27208	May 23	V. slight.	Slight.	3.00	6.70	4.75	.0052	.0476	.0436	.0040	.49	.0010	.0000	3.12	0.8
26581	Mar. 27	Slight.	Slight.	0.20	6.00	2.20	.0038	.0188	.0170	.0018	.68	.0480	.0008	0.82	1.7
27209	May 23	Slight.	Cons.	0.05	4.75	1.00	.0040	.0179	.0132	.0047	.75	.0180	.0001	0.13	1.0
26582	Mar. 27	None.	V. slight.	0.50	4.20	1.80	.0016	.0234	.0218	.0016	.40	.0130	.0001	0.86	0.5
27210	May 23	V. slight.	V. slight.	1.00	5.50	2.20	.0020	.0278	.0262	.0016	.49	.0250	.0000	1.10	1.0
26583	Mar. 27	None.	V. slight.	0.81	3.10	1.95	.0000	.0148	.0140	.0008	.33	.0030	.0000	0.79	0.0
27211	May 23	V. slight	V. slight.	1.90	5.20	3.05	.0036	.0308	.0296	.0012	.46	.0010	.0000	2.10	0.3
26584	Mar. 27	None.	V. slight	0.39	5.50	2.25	.0010	.0288	.0246	.0042	.84	.0290	.0002	0.57	1.1
27212	May 23	V. slight.	Cons.	0.70	6.50	2.25	.0066	.0520	.0468	.0052	.81	.0050	.0001	1.03	1.3
26585	Mar. 27	V slight	V. slight.	0.51	3.60	1.90	.0010	.0264	.0208	.0056	.38	.0040	.0000	0.69	0.3
27213	May 23	Slight.	Cons.	1.65	5.75	3.50	.0086	.0622	.0570	.0052	.45	.0000	.0000	2.02	0.8
26586	Mar. 27	None.	V. slight.	0.53	2.65	1.40	.0002	.0102	.0102	.0000	.32	.0010	.0001	0.60	0.0
27214	May 23	V. slight.	Slight.	1.55	4.35	2.60	.0044	.0300	.0284	.0016	.45	.0000	.0000	1.70	0.3
26587	Mar. 27	Slight.	Cons.	0.39	3.50	1.50	.0014	.0226	.0200	.0026	.44	.0120	.0001	0.51	0.2
27215	May 23	Decided.	Slight.	1.30	5.50	2.50	.0046	.0384	.0316	.0068	.59	.0240	.0002	1.22	0.5
26588	Mar. 27	None.	V. slight.	0.60	3.05	1.65	.0012	.0132	.0132	.0000	.34	.0010	.0000	0.80	0.0
27216	May 23	V. slight	Cons., green.	1.40	4.20	2.40	.0016	.0196	.0168	.0028	.48	.0040	.0000	1.88	0.3
26589	Mar. 27	V. slight.	V. slight	0.27	4.60	1.75	.0014	.0150	.0142	.0008	.46	.0510	.0003	0.39	0.8
27217	May 23	Slight.	Slight.	1.05	5.45	2.80	.0100	.0472	.0460	.0012	.46	.0050	.0002	1.30	0.8

Odor, generally faintly vegetable, sometimes none. On heating, the odor of some of the samples became distinctly vegetable. —— The samples were collected just above the measuring weirs, on the tributaries of North Watuppa Lake, as follows: Nos. 26580 and 27208, from Blossom Brook; Nos. 26581 and 27209, from Cress Brook; Nos. 26582 and 27210, from Highland Brook, at Meridian Street; Nos. 26583 and 27211, from north branch of King Phillip Brook; Nos. 26584 and 27212, from north branch of Nat Brook; Nos. 26585 and 27213, from south branch of Nat Brook; Nos. 26586 and 27214, from Queen's Gutter Brook; Nos. 26587 and 27215, from Ralph Brook, below junction of south and east branches; Nos. 26588 and 27216, from Run Brook, at upstream side of highway crossing; Nos. 26589 and 27217, from Terry Brook, at Meridian Street.

FALMOUTH.

WATER SUPPLY OF FALMOUTH. — FALMOUTH WATER COMPANY.

Population in 1895, 2,655. The works are owned by the Falmouth Water Company, and were completed early in 1899. The source of supply is a system of 15 tubular wells, located on the southerly shore of Long Pond, in a narrow strip of land separating Long Pond from Grew's Pond. The wells are 2½ inches in diameter, about 45 feet deep, and are located from 10 to 30 feet from the shore of Long Pond. Water is pumped to an iron tank, from which it is supplied to the town.

The advice of the State Board of Health to the Falmouth Water Company, relative to the use of the water of Long Pond in Falmouth and of water taken from a system of tubular wells near Long Pond as sources of water supply for that town, may be found on pages 12 and 13 of this volume. Analyses of samples of water collected from the system of tubular wells during a pumping test, and from the pond, are given in the following tables: —

Chemical Examination of Water from a Hydrant supplied from the Works of the Falmouth Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26453	Mar. 6	V. slight.	Slight.	.01	2.70	.0000	.0014	.91	.0020	.0000	.02	0.3	.0010
26454	Mar. 7	None.	V. slight.	.00	2.50	.0000	.0012	.89	.0020	.0001	.02	0.3	.0010
26455	Mar. 8	None.	None.	.00	3.00	.0000	.0010	.88	.0050	.0000	.02	0.3	.0010
26456	Mar. 9	None.	None.	.00	2.80	.0000	.0006	.89	.0010	.0000	.02	0.3	.0010
26457	Mar. 10	None.	V. slight.	.01	2.80	.0000	.0008	.89	.0010	.0000	.02	0.3	.0010
26458	Mar. 11	None.	None.	.00	3.00	.0000	.0006	.89	.0010	.0000	.04	0.3	.0020
27189	May 22	V. slight.	V. slight.	.01	2.60	.0000	.0014	.90	.0030	.0000	.03	0.5	.0010

Odor, none. —— The first six samples were collected from a hydrant at the pumping station, during a pumping test which began at 7 A.M., March 6, and during which water was drawn from the wells at the rate of 250,000 gallons per day; the last sample was collected from the hydrant, at a time when no water had been drawn from the wells for four days.

FALMOUTH.

Chemical Examination of Water from Long Pond in Falmouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27188	May 22	None.	V. slight.	.01	2.70	0.90	.0008	.0128	.0120	.0008	.90	.0020	.0000	.11	0.2

Odor, none, becoming very faintly vegetable on heating.——The sample was collected from the pond, near the pumping station of the Falmouth Water Company.

Water Supply of Fitchburg.

Chemical Examination of Water from Scott Reservoir, Fitchburg.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25987	Jan. 17	Slight.	V. slight.	.11	2.25	1.10	.0006	.0130	.0108	.0022	.18	.0000	.0001	.31	0.2
26717	Apr. 11	V. slight.	V. slight.	.11	1.60	0.70	.0034	.0124	.0100	.0024	.06	.0040	.0000	.22	0.0
27854	July 21	V. slight.	Slight.	.08	2.00	0.80	.0000	.0204	.0146	.0058	.11	.0020	.0000	.31	0.0
29054	Oct. 17	Decided.	Cons.	.10	2.20	1.00	.0012	.0276	.0174	.0102	.16	.0050	.0004	.25	0.0
Av...	....	....	....	.10	2.01	0.90	.0013	.0183	.0132	.0051	.11	.0027	.0001	.27	0.0

Odor of the first sample, none; of the second and last, vegetable; of the third, distinctly unpleasant.

Chemical Examination of Water from Meetinghouse Pond, Westminster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25986	Jan 17	V. slight.	Slight.	.14	2.75	1.50	.0010	.0162	.0144	.0018	.15	.0010	.0000	.37	0.6
26716	Apr. 11	V. slight.	V. slight.	.12	2.60	0.95	.0012	.0158	.0130	.0028	.14	.0050	.0001	.33	0.2
27853	July 21	V. slight.	Slight.	.08	3.15	1.05	.0010	.0168	.0142	.0026	.15	.0010	.0000	.31	0.5
29053	Oct 17	V. slight.	V. slight	.10	2.75	1.05	.0020	.0196	.0178	.0018	.17	.0050	.0000	.24	0.5
Av...	....	....	....	.11	2.81	1.14	.0013	.0171	.0148	.0023	.15	.0030	.0000	.31	0.4

Odor of the first and third samples, faintly vegetable or none; of the second, faintly unpleasant, becoming faintly vegetable and fishy on heating; of the last, none.

FOXBOROUGH.

WATER SUPPLY OF FOXBOROUGH WATER SUPPLY DISTRICT, FOXBOROUGH.

Chemical Examination of Water from the Tubular Wells of the Foxborough Water Supply District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25837	Jan. 3	None.	None.	.00	3.00	.0000	.0000	.40	.0630	.0000	.01	0.8	.0010
27463	June 16	None.	None.	.00	3.50	.0000	.0004	.39	.0480	.0000	.00	0.7	.0020
27685	July 6	None.	None.	.00	3.60	.0000	.0006	.37	.0550	.0000	.02	0.5	.0020
28088	Aug. 2	None.	None.	.00	3.50	.0000	.0004	.38	.0550	.0000	.01	1.0	.0010
28520	Sept. 6	None.	None.	.00	4.10	.0000	.0014	.39	.0320	.0001	.01	1.0	.0030
28888	Oct. 4	None.	None.	.06	4.10	.0000	.0008	.37	.0380	.0001	.02	1.0	.0010
Av.	....	....	....	.01	3.63	.0000	.0006	.38	.0485	.0000	.01	0.8	.0017

Odor, none. — The samples were collected from a faucet at the pumping station.

WATER SUPPLY OF FRAMINGHAM. — FRAMINGHAM WATER COMPANY.

Chemical Examination of Water from the Filter-gallery of the Framingham Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25939	Jan. 12	None.	V. slight.	.02	8.50	.0028	.0038	0.90	.0580	.0002	.05	3.6	.0040
26480	Mar. 13	None.	None.	.00	7.50	.0038	.0020	0.82	.0530	.0003	.05	3.3	.0080
27033	May 8	None.	None.	.01	7.50	.0024	.0036	0.82	.0480	.0003	.04	3.3	.0020
27710	July 10	V. slight.	V. slight.	.10	6.90	.0024	.0054	0.84	.0090	.0002	.05	2.9	.0090
28563	Sept. 11	None.	None.	.00	7.60	.0026	.0074	0.89	.0250	.0001	.06	3.0	.0050
29253	Nov. 6	None.	None.	.01	7.40	.0038	.0040	0.85	.0360	.0005	.06	3.3	.0050

Averages by Years.

-	1888	-	-	.10	5.81	.0027	.0081	0.44	.0308	.0004	-	-	-
-	1889	-	-	.00	6.18	.0031	.0050	0.56	.0366	.0002	-	-	-
-	1890	-	-	.00	7.09	.0020	.0039	0.65	.0631	.0001	-	3.0	-
-	1891	-	-	.00	6.25	.0028	.0035	0.63	.0707	.0001	-	2.8	-
-	1893	-	-	.04	6.07	.0026	.0033	0.62	.0460	.0001	.11	2.6	.0099
-	1894	-	-	.03	6.75	.0025	.0043	0.79	.0515	.0001	.08	2.8	.0272
-	1895	-	-	.04	7.32	.0020	.0049	0.92	.0230	.0000	.07	3.0	.0180
-	1896	-	-	.04	7.37	.0022	.0040	0.91	.0317	.0002	.04	3.2	.0145
-	1897	-	-	.04	7.00	.0021	.0076	1.00	.0245	.0001	.06	3.3	.0072
-	1898	-	-	.05	7.46	.0030	.0065	0.90	.0308	.0001	.09	3.2	.0090
-	1899	-	-	.02	7.57	.0030	.0044	0.85	.0382	.0003	.05	3.2	.0047

NOTE to analyses of 1899: Odor, none.

FRAMINGHAM.

WATER SUPPLY OF STATE CAMP GROUND, FRAMINGHAM.

The advice of the State Board of Health to the Medical Director of the First Brigade, M. V. M., with reference to the quality of the water supply of the camp at South Framingham, may be found on pages 13 to 15 of this volume.

Chemical Examination of Water from Learned's Pond, Framingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
28538	Sept. 11	None.	V. slight.	.05	1.70	0.60	.0004	.0158	.0146	.0012	.22	.0000	.0000	.10	0.0
28539	Sept. 11	Decided.	Cons.	.08	1.60	0.50	.0018	.0122	.0110	.0012	.25	.0010	.0000	.09	0.0

Odor of the first sample, faintly vegetable; of the second, distinctly unpleasant.—The first sample was collected from the pond near the pumping station; the second, from a faucet at the camp ground.

WATER SUPPLY OF FRANKLIN.—FRANKLIN WATER COMPANY.

Chemical Examination of Water from the Wells of the Franklin Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27001	May 3	V. slight.	V. slight.	.08	7.00	.0008	.0014	0.71	.2000	.0000	.09	2.6	.0180
27345	June 7	Decided, milky.	Cons.	.80	5.80	.0004	.0158	0.41	.0520	.0000	.37	1.7	.0250
27669	July 6	V. slight.	V. slight.	.05	8.90	.0010	.0006	0.84	.2470	.0000	.03	2.9	.0040
28025	Aug. 2	V. slight.	V. slight.	.03	8.60	.0002	.0016	0.83	.1880	.0000	.04	3.1	.0100
28528	Sept. 7	V. slight.	V. slight.	.07	8.90	.0004	.0014	0.94	.1900	.0000	.02	3.0	.0100
28889	Oct. 4	V. slight.	V. slight.	.01	9.00	.0006	.0014	1.00	.2700	.0000	.02	3.3	.0050
Av...	....	....	....	.09	8.03	.0006	.0037	0.79	.1912	.0000	.09	2.8	.0120

Odor of the second sample, faintly musty; of the others, none.

GARDNER.

WATER SUPPLY OF GARDNER. — GARDNER WATER COMPANY.

Chemical Examination of Water from Crystal Lake, Gardner.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26592	Mar. 28	V. slight.	V. slight.	.07	3.40	1.15	.0056	.0140	.0130	.0010	.34	.0180	.0002	.22	1.0
27611	June 28	V. slight.	V. slight	.09	3.00	1.25	.0010	.0180	.0170	.0010	.32	.0070	.0002	.24	1.1
28794	Sept. 28	V. slight.	V. slight.	.08	3.15	1.00	.0006	.0238	.0220	.0018	.29	.0020	.0000	.26	0.8
29588	Dec. 6	V. slight.	V. slight.	.02	2.90	1.00	.0014	.0192	.0182	.0010	.36	.0010	.0000	.19	0.6

Averages by Years.

-	1893	-	-	.06	2.65	0.82	.0012	.0126	.0105	.0021	.27	.0021	.0000	.19	0.8
-	1894	-	-	.04	2.75	0.98	.0009	.0111	.0094	.0017	.31	.0023	.0000	.15	1.0
-	1895	-	-	.05	2.75	0.97	.0008	.0192	.0170	.0022	.34	.0020	.0000	.17	1.2
-	1896	-	-	.06	3.07	0.94	.0020	.0156	.0120	.0036	.33	.0050	.0000	.18	1.1
-	1897	-	-	.12	3.31	1.04	.0010	.0176	.0145	.0031	.38	.0096	.0000	.19	1.0
-	1898	-	-	.08	3.46	1.31	.0014	.0152	.0133	.0019	.37	.0082	.0000	.23	1.2
-	1899	-	-	.06	3.11	1.10	.0021	.0187	.0175	.0012	.33	.0070	.0001	.23	0.9

NOTE to analyses of 1899: Odor of the first three samples, faintly vegetable; of the last, none. On heating, the odor of the first sample became faintly fishy.

WATER SUPPLY OF GLOUCESTER.

Chemical Examination of Water from Dike's Brook Storage Reservoir, Gloucester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26559	Mar 22	V. slight.	V. slight.	.20	3.60	1.50	.0002	.0134	.0098	.0036	.84	.0010	.0001	.31	0.3
27612	June 28	V. slight.	Slight.	.14	3.65	1.40	.0016	.0188	.0144	.0044	.88	.0000	.0000	.26	0.2
27813	July 18	V. slight.	V. slight.	.12	3.65	1.45	.0004	.0144	.0130	.0014	.86	.0010	.0000	.30	0.6
28389	Aug. 28	V. slight.	V. slight.	.27	3.50	1.70	.0004	.0204	.0180	.0024	.79	.0020	.0000	.37	0.2
28739	Sept. 26	V. slight.	V. slight.	.49	3.75	1.50	.0156	.0240	.0216	.0024	.91	.0040	.0000	.49	0.5
29124	Oct. 24	V. slight	V. slight.	.61	4.60	1.90	.0222	.0272	.0254	.0018	.90	.0060	.0001	.53	0.3
29459	Nov. 22	V. slight.	V. slight.	.71	4.40	1.65	.0116	.0248	.0234	.0014	.84	.0030	.0000	.61	0.2
29803	Dec. 27	Slight.	Slight.	.65	4.35	1.65	.0054	.0240	.0214	.0026	.86	.0070	.0000	.57	0.2
Av...	....	....	....	.40	3.94	1.59	.0072	.0209	.0184	.0025	.86	.0029	.0000	.43	0.3

Odor of the first sample, distinctly unpleasant, becoming distinctly fishy on heating; of the others, vegetable.

GLOUCESTER.

Chemical Examination of Water from Wallace Pond, Gloucester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26560	Mar. 22	V. slight.	V. slight.	.18	4.25	1.65	.0002	.0100	.0076	.0024	1.22	.0010	.0001	.38	0.5
27613	June 28	Decided.	Cons.	.25	3.50	1.65	.0000	.0258	.0194	.0064	1.11	.0000	.0000	.40	0.2
27814	July 18	V. slight.	Slight.	.20	3.90	1.25	.0002	.0208	.0170	.0038	1.08	.0020	.0000	.45	0.3
28387	Aug. 28	Slight.	Cons., green.	.30	4.35	2.10	.0004	.0298	.0222	.0076	1.15	.0010	.0000	.51	0.3
28740	Sept. 26	Decided.	Cons.	.45	4.35	1.65	.0056	.0340	.0254	.0086	1.15	.0020	.0000	.49	0.3
29125	Oct. 24	Slight.	Slight.	.40	4.00	1.40	.0002	.0334	.0256	.0078	1.06	.0040	.0000	.50	0.3
29460	Nov. 22	V. slight.	Slight.	.42	4.45	1.70	.0044	.0306	.0246	.0060	1.11	.0010	.0000	.44	0.2
29804	Dec. 27	Decided.	Cons.	.57	4.40	1.60	.0114	.0276	.0192	.0084	1.13	.0020	.0000	.46	0.2
Av...	....	....	....	.35	4.15	1.62	.0028	.0265	.0201	.0064	1.13	.0016	.0000	.45	0.3

Odor of Nos. 29125 and 29460, faintly unpleasant, becoming distinctly unpleasant and fishy on heating; of the others, faintly vegetable, becoming stronger, and in March and September fishy on heating.

Microscopical Examination of Water from Wallace Pond, Gloucester.

[Number of organisms per cubic centimeter.]

	1899.							
	Mar.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	23	29	19	29	27	25	23	29
Number of sample,	26560	27613	27814	28387	28740	29125	29460	29804
PLANTS.								
Diatomaceæ,	8	488	220	86	12	10	15	30
Synedra,	1	480	186	82	10	4	12	25
Cyanophyceæ,	0	0	10	100	148	4	0	0
Anabæna,	0	0	10	98	144	0	0	0
Algæ,	0	26	0	6	2	0	0	0
ANIMALS.								
Rhizopoda, Actinophrys,	0	0	2	0	0	0	0	0
Infusoria,	36	256	206	98	526	294	47	46
Ciliated infusorian,	0	10	0	0	0	0	0	0
Cryptomonas,	0	10	40	0	2	80	4	4
Dinobryon,	11	12	10	0	8	0	0	4
Peridinium,	19	218	150	78	468	186	38	32
Raphidomonas,	0	2	0	14	16	0	0	0
Uroglena,	0	0	0	0	20	10	0	0
Vermes,	2	0	4	3	2	2	6	0
Miscellaneous, Zoöglœa,	5	20	7	12	8	7	5	5
TOTAL,	51	790	449	305	696	317	73	80

GLOUCESTER.

Chemical Examination of Water from Haskell's Pond, Gloucester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
29665	1899. Dec. 14	Decided.	Slight.	.90	4.95	2.15	.0248	.0316	.0268	.0048	.95	.0010	.0000	.88	0.8

Odor, vegetable. —— The sample was collected from the pond, at its outlet.

Water Supply of Grafton. — Grafton Water Company.

Chemical Examination of Water from the Filter-gallery of the Grafton Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27338	June 6	None.	None.	.00	10.20	.0000	.0018	1.31	.2900	.0000	.03	3.4	.0020
27689	July 7	V. slight.	None.	.02	9.50	.0010	.0028	1.16	.2600	.0002	.00	3.8	.0070
28024	Aug. 1	V. slight.	V. slight.	.03	10.30	.0004	.0018	1.14	.1700	.0000	.04	3.9	.0550
28524	Sept. 7	V. slight.	Slight, clayey.	.03	9.70	.0000	.0040	0.97	.1360	.0000	.06	3.0	.0200
Av...	....	....	....	.02	9.92	.0003	.0026	1.14	.2140	.0000	.03	3.4	.0210

Odor, none. —— The first four samples were collected from faucets in the town; the last, from the pump well at the pumping station.

Granville.

The advice of the State Board of Health to Claude A. Magill and others, with reference to a source of water supply for the town of Granville, may be found on pages 15 and 16 of this volume. Analyses of samples of water collected from suggested sources of supply are given in the following table: —

Chemical Examination of Water from Brooks in Granville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
27524	June 21	V. slight.	Slight.	.21	3.50	0.85	.0014	.0122	.0110	.0012	.18	.0020	.0000	.32	1.0
28122	Aug. 9	None.	V. slight.	.08	3.95	0.90	.0018	.0096	.0082	.0014	.29	.0040	.0000	.21	0.6
27525	June 21	V. slight.	Slight.	.45	3.80	1.60	.0006	.0200	.0180	.0020	.11	.0000	.0000	.70	0.5
28121	Aug. 9	None.	V. slight.	.09	3.25	0.85	.0000	.0084	.0056	.0028	.10	.0040	.0000	.19	0.3

Odor, faintly vegetable, or none.—The first two samples were collected from Tinker Brook, on north side of road from Granville to Granville Centre; the last two, from Seymour Brook, about half a mile above junction with Trumble Brook.

Water Supply of Great Barrington.

The advice of the State Board of Health to the town of Great Barrington, with reference to the present sources of water supply of the town and the quality of the water of a proposed additional source of supply, may be found on pages 16 and 17 of this volume. Analyses of samples of water collected during the investigations from various sources in Great Barrington and vicinity are given in the following table: —

GREAT BARRINGTON.

Chemical Examination of Water from Various Surface Water Sources in Great Barrington and Vicinity.

[Parts per 100,000.]

Number	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
28365	Aug. 24	None.	None.	.00	9.10	1.25	.0006	.0026	.0026	.0000	.09	.0190	.0000	.05	5.7
28371	Aug. 24	V. slight.	Slight.	.09	6.10	1.45	.0066	.0132	.0094	.0038	.08	.0010	.0001	.24	3.3
28372	Aug. 24	V. slight	Slight.	.10	11.30	3.20	.0006	.0502	.0366	.0136	.07	.0020	.0000	.56	3.8
28633	Sept. 15	Slight.	Cons.	.08	11.90	3.30	.0016	.0540	.0432	.0108	.09	.0010	.0000	.56	8.9
28366	Aug. 24	None.	V. slight.	.00	7.75	1.05	.0026	.0030	.0026	.0004	.06	.0090	.0001	.04	4.6
28630	Sept. 15	V. slight.	V. slight.	.02	9.30	1.25	.0014	.0044	.0042	.0002	.08	.0070	.0000	.12	6.1
27914	July 27	V. slight.	V. slight.	.05	7.20	-	.0020	.0054	-	-	.09	.0040	.0000	.05	4.4
28367	Aug. 24	V. slight.	V. slight	.14	5.25	1.90	.0014	.0072	.0058	.0014	.05	.0010	.0000	.22	3.3
28631	Sept. 15	Slight.	Cons.	.15	7.70	1.65	.0002	.0186	.0164	.0022	.07	.0000	.0000	.31	5.0
28368	Aug. 24	V. slight.	Slight.	.14	13.85	2.25	.0018	.0090	.0058	.0032	.07	.0110	.0001	.17	8.1
28369	Aug. 24	V. slight.	Slight.	.10	11.95	3.45	.0018	.0196	.0172	.0024	.07	.0010	.0000	.29	7.1
28370	Aug. 24	None.	V. slight.	.02	6.90	1.50	.0022	.0146	.0138	.0008	.07	.0000	.0000	.20	4.3
28373	Aug. 24	V. slight.	Slight.	.08	8.50	2.30	.0024	.0274	.0232	.0042	.07	.0020	.0000	.29	4.9
28632	Sept. 15	V. slight.	Slight.	.06	8.30	2.35	.0010	.0292	.0268	.0024	.06	.0020	.0000	.37	5.7
28634	Sept. 15	-	-	-	-	-	-	-	-	-	-	-	-	-	9.3
28374	Aug. 24	V. slight.	Slight.	.10	11.85	2.75	.0014	.0088	.0074	.0014	.11	.0110	.0002	.16	7.4

Odor of Nos. 28365, 28630 and 27914, none; of No. 28371, faintly vegetable; of Nos. 28372, 28633, 28632 and 28374, distinctly unpleasant; of Nos. 28366 and 28367, none, becoming distinctly vegetable on heating; of Nos. 28631, 28370 and 28373, distinctly vegetable; of Nos. 28368 and 28369, none, becoming distinctly vegetable on heating. The odor was not determined in No. 28634. —— No. 28365 was collected from the low-service pumping station, drawing water from Green River; No. 28371 from East Mountain Reservoir, one of the sources of supply of the town; Nos. 28372 and 28633, from Lake Mansfield, from which water is drawn for fire protection; Nos. 28366 and 28630, from Seekonk Brook, just above the bridge in Alford Village; No. 27914, from spring near Roaring Brook, on Laird Farm; Nos. 28367 and 28631, from Roaring Brook, near Laird Farm; No. 28368, from Muddy Brook or Konkapot River, just east of Three Mile Hill; No. 28369, from the north-westerly end of Lake Buel; No. 28370, from Prospect Lake in Egremont; Nos. 28373 and 28632, from the easterly side of Long Pond; No. 28634, from Round Pond; No. 28374, from Seymour Brook near the saw mill.

GREENFIELD.

Water Supply of Greenfield.

Chemical Examination of Water from Glen Brook Storage Reservoir in Leyden.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates	Nitrites.		
	1899.														
26577	Mar. 27	V. slight	V. slight.	.01	4.25	0.50	.0018	.0028	.0026	.0002	.10	.0040	.0000	.08	2.6
27621	June 28	V. slight.	V. slight.	.02	6.20	0.85	.0028	.0168	.0146	.0022	.18	.0120	.0000	.11	3.6
28781	Sept. 27	V. slight.	V. slight.	.07	5.60	1.15	.0018	.0108	.0098	.0010	.18	.0010	.0000	.15	3.5
29793	Dec. 27	V. slight.	None.	.07	5.35	0.50	.0000	.0050	.0048	.0002	.12	.0110	.0000	.10	3.3
Av...	....	....	....	.04	5.35	0.82	.0016	.0088	.0079	.0009	.12	.0070	.0000	.10	3.2

Odor, none. A faintly vegetable odor was developed in the second sample on heating.

Water Supply of Groton. — Groton Water Company.

Chemical Examination of Water from the Well of the Groton Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25833	Jan. 3	None.	None.	.00	4.10	.0000	.0000	.16	.0070	.0000	.01	2.0	.0010
26287	Feb. 21	None.	V. slight.	.00	5.50	.0000	.0006	.17	.0080	.0000	.02	2.2	.0020
26665	Apr. 4	None.	None.	.00	4.20	.0002	.0006	.15	.0070	.0000	.02	1.4	.0040
27080	May 8	None.	None.	.00	3.00	.0000	.0010	.15	.0090	.0000	.02	1.6	.0020
27344	June 6	V. slight.	None.	.02	3.70	.0000	.0010	.20	.0100	.0000	.02	1.7	.0040
27664	July 5	V. slight.	None.	.02	4.30	.0004	.0020	.20	.0080	.0000	.01	2.0	.0030
28045	Aug. 3	None.	None.	.03	5.10	.0000	.0016	.22	.0120	.0000	.03	2.1	.0060
28465	Sept. 4	V. slight.	None.	.07	4.90	.0000	.0014	.16	.0040	.0000	.05	2.0	.0150
28916	Oct. 6	V. slight.	None.	.05	5.40	.0000	.0010	.18	.0030	.0000	.02	2.6	.0060
29240	Nov. 4	None.	None.	.04	6.60	.0000	.0012	.17	.0070	.0000	.03	3.0	.0070
29599	Dec. 7	None.	None.	.00	4.30	.0000	.0008	.18	.0030	.0000	.02	2.3	.0030
Av...	....	....	....	.02	4.69	.0001	.0010	.18	.0071	.0000	.02	2.1	.0048

Odor, none.

GROTON.

Chemical Examination of Water from Baddacook Pond, Groton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26236	Feb. 21	Decided.	Slight.	.20	3.50	2.50	.0048	.0348	.0180	.0168	.08	.0010	.0001	1.22	1.0
26664	Apr. 4	Slight.	Slight.	.05	1.00	0.55	.0006	.0114	.0082	.0032	.08	.0000	.0000	0.20	0.0
27343	June 6	Slight.	Slight.	.48	5.25	1.75	.0010	.0248	.0200	.0048	.18	.0010	.0000	0.71	2.0
28044	Aug. 3	V. slight.	V. slight.	.27	5.30	2.00	.0000	.0218	.0204	.0014	.19	.0020	.0000	0.58	2.0
28915	Oct. 6	Decided.	Cons.	.26	5.05	1.60	.0010	.0230	.0220	.0010	.19	.0010	.0000	0.52	2.6
29596	Dec. 7	V. slight.	V. slight	.36	5.15	1.65	.0004	.0214	.0194	.0020	.18	.0010	.0000	0.50	2.3
Av...	....	....	....	.27	4.21	1.67	.0013	.0229	.0180	.0049	.14	.0010	.0000	0.62	1.6

Odor, unpleasant or none. An unpleasant odor was developed in all of the samples on heating.

Harvard.

The advice of the State Board of Health to Hildreth Bros. of Harvard, with reference to the quality of the water of a well used as an auxiliary source of supply for several houses in the village of Harvard, may be found on pages 17 and 18 of this volume.

Chemical Examination of Water from a Well near the Factory of Hildreth Bros., in Harvard.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
[illegible]	Mar. 30	None.	V. slight.	.00	10.50	.0004	.0014	.44	.0000	.0000	.01	6.4	.0000
[illegible]	Mar. 28	V. slight.	V. slight.	.00	4.80	.0000	.0004	.32	.0130	.0000	.03	1.4	.0000

Odor, none.—The first sample was collected from a tubular well, sunk in rock to a depth of 228 feet. The well is situated on the summit of a hill, near the factory of Hildreth Bros., and is used for the supply of several families. The second sample was collected from a well on the side of the hill below the well from which the first sample was collected.

HARVARD.

Chemical Examination of Water from a Well in Harvard.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26594	Mar. 28	V. slight.	Cons.	.05	3.40	.0000	.0024	.56	.0040	.0000	.07	0.5	.0350

Odor, none. —— The sample was collected from a public well, located in the common in the village of Harvard.

Water Supply of Haverhill.

Chemical Examination of Water from Inlet of Crystal Lake.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25829	Jan. 2	V. slight.	None.	.19	3.25	1.10	.0006	.0162	.0146	.0016	.29	.0050	.0001	.34	1.3
26007	Jan. 23	V. slight.	Slight.	.20	3.75	1.40	.0008	.0096	.0076	.0020	.30	.0140	.0001	.30	1.1
26275	Feb. 20	V. slight.	V. slight.	.17	3.75	1.45	.0030	.0130	.0108	.0022	.23	.0170	.0000	.34	1.0
26584	Mar. 20	None.	V. slight.	.18	2.55	1.25	.0040	.0118	.0108	.0010	.20	.0120	.0000	.33	0.5
26890	Apr. 24	V. slight.	V. slight.	.29	2.95	1.10	.0006	.0132	.0116	.0016	.27	.0020	.0000	.30	0.6
27190	May 22	V. slight.	V. slight.	.24	3.45	1.40	.0014	.0146	.0136	.0010	.18	.0030	.0000	.30	1.3
27589	June 26	V. slight.	V. slight.	.20	4.10	1.35	.0024	.0178	.0154	.0024	.19	.0010	.0000	.38	1.0
27872	July 24	V. slight.	V. slight.	.11	2.85	1.45	.0012	.0204	.0194	.0010	.21	.0000	.0000	.37	0.8
28392	Aug. 28	V. slight.	V. slight.	.11	2.95	1.70	.0012	.0208	.0190	.0018	.17	.0010	.0000	.33	0.6
28733	Sept. 25	V. slight.	V. slight.	.08	2.50	1.15	.0002	.0188	.0168	.0020	.22	.0030	.0001	.33	1.1
Av.*.	....	....	....	.17	3.18	1.34	.0016	.0159	.0143	.0016	.22	.0054	.0000	.35	0.9

Odor, generally faintly vegetable, sometimes none. On heating, the odor of some of the samples became distinctly vegetable. —— The samples were collected from the principal feeder, just above its entrance into the lake.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

HAVERHILL.

Chemical Examination of Water from Crystal Lake, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25830	Jan. 2	Slight.	Cons.	.21	3.45	1.65	.0010	.0334	.0236	.0098	.28	.0010	.0001	.46	1.0
26008	Jan. 23	None.	V. slight.	.21	3.25	1.55	.0004	.0140	.0124	.0016	.26	.0010	.0001	.38	1.0
26276	Feb. 20	None.	V. slight.	.14	3.75	1.50	.0028	.0160	.0148	.0012	.33	.0050	.0001	.36	1.3
26535	Mar. 20	V. slight.	V. slight.	.11	3.40	1.40	.0024	.0148	.0144	.0004	.29	.0060	.0001	.34	1.0
26891	Apr. 24	V. slight.	V. slight.	.13	2.70	1.00	.0006	.0120	.0116	.0004	.27	.0030	.0001	.30	0.8
27191	May 22	V. slight.	V. slight.	.18	2.95	1.05	.0000	.0148	.0142	.0006	.26	.0080	.0007	.33	1.1
27590	June 26	V. slight.	V. slight.	.21	3.00	1.50	.0010	.0208	.0194	.0014	.20	.0010	.0000	.40	0.8
27873	July 24	V. slight.	V. slight.	.15	2.85	1.45	.0004	.0216	.0198	.0018	.21	.0000	.0001	.41	0.8
28393	Aug. 28	V. slight.	Cons.	.11	3.15	1.50	.0008	.0210	.0176	.0034	.17	.0010	.0000	.38	1.1
28734	Sept. 25	V. slight.	V. slight.	.08	3.50	1.00	.0006	.0162	.0158	.0004	.45	.0050	.0001	.19	1.7
29154	Oct. 25	V. slight.	V. slight.	.10	2.90	1.25	.0004	.0170	.0158	.0012	.28	.0040	.0000	.29	0.8
29161	Oct. 25	V. slight.	V. slight.	.10	2.70	0.90	.0014	.0172	.0156	.0016	.26	.0020	.0000	.31	0.6
29465	Nov. 22	None.	V. slight.	.09	3.30	1.00	.0010	.0160	.0154	.0006	.45	.0010	.0000	.18	1.3
29466	Nov. 22	V. slight.	V. slight.	.08	3.05	0.95	.0010	.0166	.0154	.0012	.37	.0010	.0000	.26	1.0
29802	Dec. 27	V. slight.	V. slight.	.14	3.75	1.15	.0002	.0134	.0130	.0004	.44	.0010	.0000	.19	1.7

Averages by Years.

-	1893	-	-	.26	2.78	1.12	.0003	.0182	.0150	.0032	.24	.0020	.0000	.37	1.0
-	1894	-	-	.17	3.05	1.03	.0017	.0220	.0193	.0027	.27	.0007	.0000	.34	1.0
-	1895	-	-	.11	3.32	1.22	.0012	.0180	.0159	.0021	.30	.0015	.0000	.36	1.5
-	1896	-	-	.25	3.00	1.22	.0007	.0219	.0152	.0067	.27	.0050	.0000	.38	1.1
-	1897	-	-	.23	2.99	1.26	.0008	.0177	.0141	.0036	.29	.0022	.0000	.36	1.0
-	1898	-	-	.21	3.18	1.37	.0014	.0201	.0176	.0025	.31	.0033	.0000	.37	1.0
-	1899*	-	-	.14	3.20	1.27	.0009	.0173	.0158	.0015	.30	.0025	.0001	.32	1.1

NOTE to analyses of 1899: Odor of the first sample, distinctly fishy and oily; of the second, none, becoming distinctly fishy and oily on heating; of the others, generally faintly vegetable. —— Nos. 26276, 28734, 29154 and 29161 were collected from faucets in the town; the others, from the lake, near its outlet.

Microscopical Examination.

An insignificant number of organisms was found in each of the samples, except in the sample collected on June 8, which contained 76 *Uroglena* per cubic centimeter.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

HAVERHILL.

Chemical Examination of Water from Kenoza Lake, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26012	Jan. 23	Slight.	V. slight.	.12	3.95	1.35	.0004	.0144	.0136	.0008	.37	.0010	.0001	.39	1.4
26451	Mar. 5	V. slight.	Cons.	.08	3.75	1.00	.0016	.0148	.0132	.0016	.42	.0020	.0002	.24	1.7
26893	Apr. 24	V. slight.	V. slight.	.07	3.30	1.05	.0004	.0148	.0120	.0028	.36	.0040	.0000	.24	1.4
27874	July 24	V. slight.	V. slight.	.05	3.65	1.25	.0004	.0176	.0170	.0006	.37	.0020	.0001	.25	1.6
29158	Oct. 25	V. slight.	None.	.08	3.65	1.20	.0006	.0172	.0164	.0008	.40	.0020	.0001	.23	1.6

Averages by Years.

-	1888	-	-	.01	3.47	0.81	.0003	.0148	-	-	.34	.0060	.0000	-	-
-	1893	-	-	.09	3.55	1.12	.0013	.0202	.0163	.0039	.41	.0010	.0000	.26	1.6
-	1894	-	-	.06	3.40	0.73	.0015	.0148	.0132	.0016	.40	.0027	.0000	.22	1.6
-	1895	-	-	.09	3.97	1.17	.0005	.0177	.0165	.0012	.44	.0000	.0000	.25	2.0
-	1896	-	-	.10	3.86	1.19	.0011	.0162	.0142	.0020	.39	.0021	.0000	.24	1.6
-	1897	-	-	.12	3.83	1.27	.0012	.0178	.0163	.0015	.38	.0022	.0000	.27	1.9
-	1898	-	-	.10	3.72	1.22	.0006	.0154	.0144	.0010	.40	.0022	.0000	.27	1.8
-	1899	-	-	.08	3.66	1.17	.0007	.0157	.0144	.0013	.38	.0022	.0001	.27	1.5

NOTE to analyses of 1899: Odor of the second sample, faintly musty and disagreeable; of the others, faintly vegetable.

Chemical Examination of Water from Lake Saltonstall, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26014	Jan. 23	V. slight.	V. slight.	.07	6.25	1.50	.0008	.0126	.0118	.0008	.74	.0120	.0001	.20	2.9
26897	Apr. 24	V. slight.	V. slight	.06	5.45	1.00	.0006	.0128	.0114	.0014	.63	.0110	.0002	.17	2.5
27878	July 24	V. slight	V. slight	.08	6.25	1.40	.0010	.0196	.0190	.0006	.64	.0010	.0001	.28	2.5
29160	Oct. 25	V. slight.	V. slight.	.06	6.25	1.50	.0014	.0190	.0182	.0008	.72	.0010	.0000	.22	2.9
Av...	....	....	....	.07	6.05	1.35	.0009	.0160	.0151	.0009	.68	.0062	.0001	.22	2.7

Odor of the second sample, faintly grassy, becoming distinctly grassy on heating; of the others, none.

HAVERHILL.

Chemical Examination of Water from Lake Pentucket, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26013	Jan. 23	V. slight.	V. slight.	.07	3.50	1.40	.0000	.0144	.0140	.0004	.45	.0010	.0001	.23	1.3
26896	Apr. 24	V. slight.	V. slight.	.05	3.15	1.00	.0000	.0116	.0102	.0014	.38	.0010	.0000	.18	1.3
27875	July 24	V. slight.	V. slight.	.06	3.75	1.10	.0002	.0192	.0184	.0008	.39	.0000	.0001	.26	1.6
29159	Oct. 25	V. slight.	Slight.	.06	3.75	1.10	.0016	.0206	.0200	.0006	.46	.0020	.0000	.23	1.3
Av...	....	....	....	.06	3.54	1.15	.0004	.0164	.0156	.0008	.42	.0010	.0000	.22	1.4

Odor of the second sample, distinctly vegetable and mouldy; of the others, none.

Chemical Examination of Water from Johnson's Pond in Boxford and Groveland.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26011	Jan. 23	V. slight.	V. slight.	.18	4.00	1.50	.0000	.0122	.0116	.0006	.35	.0030	.0001	.32	2.0
26892	Apr. 24	V. slight.	V. slight.	.11	3.40	0.85	.0002	.0122	.0114	.0008	.37	.0030	.0001	.26	1.6
27879	July 24	V. slight.	V. slight.	.10	5.55	1.55	.0000	.0182	.0176	.0006	.32	.0020	.0000	.31	2.6
29157	Oct. 25	None.	V. slight.	.07	3.65	1.15	.0010	.0194	.0182	.0012	.37	.0010	.0000	.28	1.7

Averages by Years.

-	1896	-	-	.19	4.32	1.32	.0011	.0186	.0157	.0029	.40	.0032	.0000	.32	2.0
-	1897	-	-	.19	4.28	1.38	.0011	.0201	.0180	.0021	.40	.0048	.0000	.33	2.1
-	1898	-	-	.18	4.02	1.39	.0010	.0196	.0182	.0014	.36	.0032	.0000	.36	1.9
-	1899	-	-	.11	4.15	1.26	.0003	.0155	.0147	.0008	.35	.0022	.0000	.29	2.0

Note to analyses of 1899: Odor of the first sample, none; of the third, none, becoming faintly unpleasant on heating; of the others, faintly vegetable.——The second sample was collected from the pond; the others, from faucets in the city.

HAVERHILL.

Chemical Examination of Water from East Meadow River at its Entrance into Millvale Reservoir, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26009	Jan. 23	V. slight.	V. slight.	.52	4.45	1.85	.0006	.0122	.0108	.0014	.26	.0070	.0001	.64	1.4
26277	Feb. 20	V. slight.	V. slight.	.40	4.75	1.75	.0032	.0138	.0120	.0018	.44	.0100	.0001	.51	1.7
26536	Mar. 20	V. slight.	V. slight.	.39	3.60	1.50	.0018	.0142	.0134	.0008	.24	.0020	.0000	.54	0.8
26894	Apr. 24	V. slight.	V. slight.	.58	4.05	1.90	.0002	.0142	.0136	.0006	.22	.0030	.0000	.63	1.0
27192	May 22	Slight.	Slight.	.67	5.00	2.25	.0010	.0214	.0184	.0030	.25	.0030	.0000	.73	1.3
27591	June 26	V. slight.	V. slight.	.37	4.50	1.90	.0006	.0180	.0154	.0026	.23	.0010	.0000	.55	1.3
27876	July 24	V. slight.	V. slight.	.33	4.80	1.55	.0002	.0164	.0156	.0008	.26	.0030	.0000	.40	1.7
28394	Aug. 28	V. slight.	V. slight.	.18	4.70	1.00	.0006	.0094	.0088	.0006	.31	.0020	.0001	.27	1.6
28735	Sept. 25	Slight.	Slight.	.40	5.40	1.90	.0002	.0198	.0186	.0012	.34	.0030	.0002	.60	2.0
29155	Oct. 25	V. slight.	V. slight.	.45	6.00	2.00	.0008	.0166	.0152	.0014	.38	.0020	.0000	.54	2.1
29467	Nov. 22	V. slight.	V. slight.	.59	6.20	2.20	.0028	.0286	.0272	.0014	.36	.0010	.0000	.79	2.0
29782	Dec. 26	V. slight.	V. slight.	.68	6.00	2.15	.0020	.0178	.0174	.0004	.38	.0050	.0000	.89	2.2

Averages by Years.

-	1896	-	-	.77	5.52	2.13	.0012	.0201	.0177	.0024	.32	.0049	.0000	.80	1.9
-	1897	-	-	.88	5.51	2.25	.0012	.0213	.0191	.0022	.32	.0060	.0000	.79	2.0
-	1898	-	-	.96	5.15	2.37	.0009	.0231	.0209	.0022	.29	.0040	.0000	.93	1.7
-	1899	-	-	.46	4.95	1.83	.0012	.0169	.0155	.0014	.31	.0035	.0000	.59	1.6

Note to analyses of 1899: Odor, faintly vegetable or none. On heating, the odor of all of the samples became vegetable and sometimes mouldy or unpleasant. —— The samples were collected from the river, at Thompson's Bridge, just above its entrance into Millvale storage reservoir.

HAVERHILL.

Chemical Examination of Water from Millvale Reservoir on East Meadow River, Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25910	Jan. 23	V. slight.	V. slight.	.52	4.55	1.70	.0002	.0124	.0108	.0016	.27	.0050	.0000	.60	1.4
26278	Feb. 20	V. slight.	V. slight.	.31	5.00	1.50	.0034	.0096	.0084	.0012	.32	.0070	.0001	.45	2.0
26537	Mar. 20	V. slight.	V. slight.	.39	3.35	1.35	.0006	.0138	.0130	.0008	.25	.0010	.0000	.54	0.8
26895	Apr. 24	V. slight.	V. slight.	.43	3.45	1.70	.0010	.0152	.0120	.0032	.22	.0010	.0000	.55	0.6
27193	May 22	Slight.	Slight.	.60	4.25	1.95	.0006	.0212	.0198	.0014	.24	.0040	.0000	.69	1.3
27502	June 26	V. slight.	V. slight.	.57	5.20	1.95	.0010	.0212	.0180	.0032	.21	.0010	.0000	.63	1.7
27877	July 24	Slight.	Slight.	.39	4.60	1.80	.0000	.0228	.0202	.0026	.27	.0030	.0000	.59	1.7
28395	Aug. 28	Slight.	Slight.	.26	3.45	1.65	.0006	.0200	.0174	.0026	.19	.0020	.0000	.46	1.1
28736	Sept. 25	Decided.	Cons.	.21	4.00	1.50	.0000	.0190	.0176	.0014	.28	.0020	.0000	.39	2.0
29156	Oct. 25	V. slight.	V. slight.	.26	4.75	1.40	.0006	.0196	.0178	.0018	.32	.0010	.0000	.45	1.7
29468	Nov. 22	V. slight.	V. slight.	.45	5.15	1.60	.0014	.0254	.0240	.0014	.34	.0010	.0000	.59	1.8
29783	Dec. 26	Slight.	V. slight.	.40	5.35	1.85	.0006	.0206	.0190	.0016	.36	.0010	.0000	.60	1.8

Averages by Years.

-	1896	-	-	.74	5.15	2.09	.0010	.0223	.0204	.0019	.32	.0044	.0000	.76	1.8
-	1897	-	-	.84	4.99	2.23	.0009	.0236	.0211	.0025	.31	.0040	.0000	.80	1.8
-	1898	-	-	.74	4.78	2.22	.0008	.0231	.0201	.0030	.30	.0030	.0001	.77	1.6
-	1899	-	-	.40	4.42	1.68	.0005	.0184	.0165	.0019	.27	.0034	.0000	.54	1.5

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of most of the samples became distinctly vegetable and occasionally unpleasant. —— The samples were collected from the reservoir, near its outlet.

Microscopical Examination.

The average number of organisms per cubic centimeter found in these samples was 1,932, consisting chiefly of *Synedra* and *Dinobryon*. A small number of *Crogiana* was found in the sample collected in December.

WATER SUPPLY OF HINGHAM AND HULL. — HINGHAM WATER COMPANY.

Chemical Examination of Water from Accord Pond, Hingham.

[Parts per 100,000.]

Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
1899.														
January,	V. slight.	V. slight.	.28	3.33	1.47	.0003	.0154	.0130	.0024	.65	.0013	.0001	.47	0.3
February,	V. slight.	V. slight.	.33	3.60	1.80	.0011	.0157	.0137	.0020	.65	.0015	.0000	.63	0.2
March,	V. slight.	V. slight.	.24	2.95	1.35	.0014	.0135	.0113	.0022	.55	.0018	.0000	.39	0.2
April,	V. slight.	Slight.	.27	3.11	1.37	.0006	.0140	.0125	.0015	.61	.0020	.0000	.43	0.1
May,	V. slight.	Slight.	.22	3.06	1.39	.0008	.0164	.0143	.0021	.51	.0004	.0000	.45	0.0
June,	V. slight.	V. slight.	.20	3.05	1.29	.0005	.0169	.0141	.0028	.65	.0017	.0000	.44	0.1
July,	V. slight.	V. slight.	.15	2.75	1.10	.0000	.0170	.0140	.0030	.60	.0000	.0001	.39	0.2
August,	V. slight.	V. slight.	.10	2.85	1.25	.0004	.0124	.0116	.0008	.67	.0000	.0000	.36	0.5
September,	V. slight.	V. slight.	.16	3.35	1.50	.0002	.0156	.0146	.0010	.64	.0020	.0000	.34	0.3
October,	V. slight.	V. slight.	.13	3.00	1.40	.0002	.0148	.0128	.0020	.61	.0020	.0001	.28	0.3
November,	V. slight.	V. slight.	.16	3.10	1.40	.0002	.0148	.0142	.0006	.59	.0050	.0000	.34	0.3
December,	V. slight.	V. slight.	.21	2.50	0.90	.0010	.0144	.0132	.0012	.65	.0020	.0000	.30	0.3

Averages by Years.

1888	-	-	.22	2.93	0.97	.0001	.0162	-	-	.56	.0046	.0001	-	-
1893	-	-	.16	3.02	1.00	.0003	.0121	.0103	.0018	.63	.0032	.0000	.29	0.3
1894	-	-	.20	3.04	1.11	.0002	.0114	.0097	.0017	.62	.0024	.0000	.33	0.3
1895	-	-	.22	3.50	1.37	.0006	.0135	.0121	.0014	.67	.0110	.0000	.31	0.3
1896	-	-	.22	3.02	1.22	.0007	.0150	.0132	.0018	.62	.0027	.0000	.37	0.3
1897	-	-	.28	3.01	0.95	.0005	.0145	.0117	.0028	.69	.0037	.0000	.35	0.5
1898	-	-	.31	3.19	1.40	.0009	.0175	.0139	.0036	.63	.0008	.0000	.42	0.5
1899*	-	-	.20	3.05	1.35	.0006	.0151	.0133	.0018	.62	.0016	.0000	.40	0.2

NOTE to analyses of 1899: Odor, generally faintly vegetable and sometimes oily and fishy. A distinctly oily and fishy odor was developed in all of the samples collected from January to May, inclusive.

The analyses for the months from January to June, inclusive, are the averages of several samples collected during the month. During each of the remaining months only one sample was collected.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

HINGHAM AND HULL.

Microscopical Examination of Water from Accord Pond, Hingham.

[Number of organisms per cubic centimeter.]

Date of examination,	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
PLANTS.												
Diatomaceæ,	18	4	13	83	106	30	11	4	7	19	46	38
Asterionella,	9	1	10	66	75	8	8	0	0	1	0	4
Cyanophyceæ,	0	0	0	0	6	8	0	26	18	34	0	2
Merismopœdia,	0	0	0	0	0	0	0	0	16	0	0	0
Microcystis,	0	0	0	0	0	0	0	24	0	34	0	2
Algæ,	1	0	0	0	6	1	0	24	8	0	0	0
Fungi, Molds,	0	0	0	0	0	1	0	0	0	0	0	0
ANIMALS.												
Infusoria,	33	54	24	48	49	28	23	11	10	7	8	18
Ciliated infusorian,	0	39	2	0	0	0	0	0	0	0	0	0
Cryptomonas,	11	1	0	1	1	2	0	2	0	0	0	0
Dinobryon,	0	0	8	12	30	3	0	0	9	4	6	9
Peridinium,	0	1	1	1	0	17	22	6	0	0	0	0
Uroglena,	14	8	5	28	6	0	0	0	0	0	0	0
Vermes,	0	0	2	2	1	2	0	0	0	1	0	1
Crustacea, Cyclops,	0	0	pr.	pr.	pr.	0	0	0	0	pr.	pr.	0
Miscellaneous, Zoöglœa,	3	2	3	4	8	4	3	3	3	8	3	3
TOTAL,	55	60	42	137	176	72	37	68	44	69	55	60

Chemical Examination of Water from a Faucet in Hingham, supplied from Accord Pond.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26032	Jan. 24	V. slight.	V. slight.	.31	3.80	1.40	.0002	.0142	.0120	.0022	.61	.0010	.0000	.44	1.0
26073	Jan. 30	V. slight.	V. slight.	.30	4.00	1.80	.0002	.0136	.0128	.0008	.68	.0010	.0000	.51	0.6
26166	Feb. 6	V. slight.	V. slight.	.26	3.35	1.55	.0000	.0132	.0120	.0012	.62	.0010	.0000	.46	0.8
26269	Feb. 20	V. slight.	V. slight.	.25	4.00	1.50	.0010	.0138	.0120	.0018	.66	.0050	.0000	.43	1.1
26378	Mar. 1	V. slight.	V. slight.	.33	4.95	1.60	.0014	.0128	.0120	.0008	.67	.0040	.0000	.37	2.1
26395	Mar. 6	V. slight.	Slight.	.21	4.75	1.90	.0014	.0120	.0112	.0008	.68	.0020	.0000	.37	1.7
26468	Mar. 13	V. slight.	V. slight.	.27	4.50	1.50	.0008	.0104	.0098	.0006	.57	.0020	.0000	.36	2.0
26583	Mar. 20	None.	V. slight.	.21	4.70	1.65	.0010	.0120	.0116	.0004	.63	.0020	.0000	.36	1.8
26579	Mar. 27	V. slight.	V. slight.	.28	4.15	1.25	.0006	.0109	.0104	.0005	.56	.0000	.0000	.37	1.8
26662	Apr. 4	None.	V. slight.	.32	4.50	1.50	.0006	.0104	.0102	.0002	.62	.0060	.0000	.35	1.7
26703	Apr. 10	V. slight.	V. slight.	.28	3.00	1.50	.0004	.0138	.0130	.0008	.57	.0010	.0000	.48	0.3
26856	Apr. 17	V. slight.	V. slight.	.25	3.25	1.45	.0002	.0124	.0122	.0002	.62	.0020	.0000	.46	0.3
27032	May 8	V. slight.	V. slight.	.11	5.00	1.50	.0000	.0080	.0060	.0020	.68	.0030	.0000	.18	1.6

Odor, faintly vegetable or none. A fishy and oily odor was developed in many of the samples on heating.

HINGHAM AND HULL.

Microscopical Examination of Water from a Faucet in Hingham, supplied from Accord Pond.

[Number of organisms per cubic centimeter.]

	1899.												
	Jan.	Jan.	Feb.	Feb.	Mar.	Mar.	Mar.	Mar.	Mar.	Apr.	Apr.	Apr.	May.
Day of examination,	25	31	7	21	2	7	14	21	28	6	11	18	9
Number of sample,	26032	26073	26166	26269	26378	26395	26468	26533	26579	26662	26703	26856	27032
PLANTS.													
Diatomaceæ,	20	29	18	13	1	2	0	4	5	27	65	86	646
Asterionella,	6	15	11	10	0	1	0	4	5	25	54	79	4
Synedra,	14	14	3	1	1	1	0	0	0	2	3	0	632
Algæ,	4	6	4	0	0	0	0	0	0	0	0	2	10
ANIMALS.													
Infusoria,	1	5	1	7	0	0	0	1	0	0	0	0	0
Vermes,	0	0	0	1	0	0	0	1	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	3	3	3	0	5	0	3	0	5	3	3	0
TOTAL,	25	43	26	24	1	7	0	9	5	32	68	91	656

Chemical Examination of Water from Fulling Mill Pond, Hingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26904	Apr. 24	V. slight.	None.	.20	4.75	1.50	.0000	.0088	.0086	.0002	.68	.0110	.0001	.19	1.3
26997	May 2	V. slight.	V. slight.	.20	4.80	1.50	.0006	.0080	.0072	.0008	.70	.0160	.0000	.27	1.4
27416	June 12	V. slight.	Slight.	.17	5.10	1.40	.0016	.0094	.0074	.0020	.70	.0070	.0001	.22	1.3
27702	July 10	V. slight.	Slight.	.20	4.90	1.00	.0016	.0180	.0152	.0028	.81	.0110	.0000	.32	1.3
28550	Sept. 11	V. slight.	V. slight.	.06	5.30	1.20	.0020	.0048	.0034	.0014	.81	.0120	.0000	.06	1.3
Av...	....	....	....	.17	4.97	1.32	.0012	.0088	.0074	.0014	.74	.0114	.0000	.21	1.3

Odor of the first and last samples, none; of the others, faintly vegetable. —— The first two samples were collected from a faucet in the town; the others, from the gate-house, and represent water from the filter basin.

HINSDALE.

Water Supply of Hinsdale Fire District, Hinsdale.

Chemical Examination of Water from the Storage Reservoir of the Hinsdale Fire District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26303	Feb. 21	V. slight.	None.	.20	1.65	0.90	.0078	.0106	.0100	.0006	.05	.0010	.0001	.30	0.3
26919	Apr. 25	None.	V. slight.	.06	1.50	0.50	.0006	.0066	.0055	.0011	.05	.0020	.0001	.20	0.0
27601	June 27	Slight.	Slight.	.12	1.75	1.10	.0004	.0188	.0126	.0062	.04	.0020	.0000	.34	0.2
28901	Oct. 5	Decided.	Slight.	.30	1.75	1.15	.0000	.0242	.0196	.0046	.04	.0010	.0000	.46	0.2
29698	Dec. 19	Slight.	Slight.	.35	2.30	1.10	.0004	.0198	.0164	.0034	.05	.0010	.0000	.32	0.3
Av...	....	....	....	.21	1.79	0.95	.0018	.0160	.0128	.0032	.05	.0014	.0000	.32	0.2

Odor, faintly vegetable or none; in June, also unpleasant. On heating, the odor of all of the samples was vegetable. —— The first and last samples were collected from faucets in the town, the others, from the reservoir.

Water Supply of Holbrook.

(See *Randolph.*)

Water Supply of Holliston. — Holliston Water Company.

Chemical Examination of Water from the Well of the Holliston Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25056	Jan. 16	V. slight, milky.	V. slight.	.24	3.00	.0002	.0058	.25	.0010	.0000	.26	0.8	.0100
26558	Mar. 21	V. slight.	None.	.18	2.60	.0018	.0076	.17	.0040	.0001	.28	0.5	.0050
27229	May 24	Slight, milky.	Slight.	.36	3.50	.0010	.0092	.28	.0050	.0001	.22	1.3	.0350
27896	July 24	V. slight.	None.	.16	4.80	.0004	.0094	.24	.0040	.0000	.18	1.3	.0200
28858	Sept. 26	V. slight.	V. slight.	.08	5.40	.0000	.0084	.28	.0050	.0000	.11	1.6	.0090
29470	Nov. 22	V. slight.	V. slight.	.22	4.00	.0016	.0108	.33	.0070	.0000	.28	1.3	.0220

Averages by Years.

-	1892	-	-	.05	4.16	.0001	.0043	.27	.0106	.0000	-	2.1	.0430
-	1894	-	-	.10	4.60	.0001	.0035	.32	.0155	.0001	.06	2.4	.0218
-	1895	-	-	.25	4.28	.0006	.0097	.31	.0117	.0000	.29	1.6	.0095
-	1896	-	-	.28	3.68	.0008	.0114	.28	.0052	.0000	.30	1.0	.0067
-	1897	-	-	.25	3.92	.0006	.0098	.33	.0103	.0000	.22	1.5	.0015
-	1898	-	-	.38	3.82	.0011	.0123	.28	.0045	.0000	.34	1.2	.0243
-	1899	-	-	.21	3.88	.0008	.0077	.26	.0043	.0000	.22	1.1	.0168

NOTE to analyses of 1899: Odor, none. A faintly vegetable odor was developed in two of the samples on heating. —— No. 26558 was collected from a faucet at the pumping station; the others, from the well.

Water Supply of Holyoke.

The advice of the State Board of Health to the city of Holyoke, with reference to a high-service system of water supply for that city, may be found on pages 18 to 20 of this volume. Analyses of samples of water collected from the sources under consideration are given in the tables which follow.

The advice of the State Board of Health to the water commissioners of Holyoke, with reference to the proposed location of ice houses near Ashley Pond, one of the sources of water supply of the city, and the cutting of ice from that source for domestic use, may be found on pages 106 and 107 of this volume.

Chemical Examination of Water from Whiting Street Storage Reservoir, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26023	Jan. 24	Slight.	Slight.	.11	4.45	1.10	.0044	.0222	.0164	.0058	.14	.0030	.0001	.28	2.3
26295	Feb. 21	Slight.	Slight.	.10	5.00	1.75	.0188	.0266	.0192	.0074	.11	.0050	.0001	.25	2.5
26549	Mar. 21	V. slight.	V. slight.	.05	3.50	1.00	.0034	.0116	.0084	.0032	.00	.0050	.0001	.16	1.8
26918	Apr. 25	Slight.	Slight.	.06	3.65	0.85	.0010	.0114	.0086	.0028	.09	.0030	.0001	.18	2.0
27204	May 23	Slight.	V. slight.	.10	3.85	0.90	.0006	.0170	.0148	.0022	.08	.0000	.0000	.20	2.0
27595	June 27	Slight.	Slight.	.18	4.25	1.00	.0006	.0240	.0170	.0070	.07	.0020	.0000	.27	2.1
27838	July 25	Slight.	Cons.	.20	4.75	1.45	.0095	.0650	.0260	.0390	.08	.0030	.0000	.38	2.5
28327	Aug. 22	V. slight.	Cons.	.20	5.85	2.10	.0000	.0646	.0300	.0346	.07	.0010	.0000	.42	2.3
28756	Sept. 26	Decided.	Cons.	.40	6.90	2.75	.0312	.0588	.0378	.0210	.10	.0070	.0004	.60	3.3
29128	Oct. 24	Decided.	Cons.	.22	5.75	1.95	.0164	.0640	.0372	.0268	.10	.0080	.0006	.45	3.0
29451	Nov. 21	Slight.	Slight.	.22	4.70	1.65	.0024	.0328	.0276	.0052	.09	.0060	.0002	.29	2.1
Av.	....	....	....	.17	4.79	1.50	.0080	.0362	.0221	.0141	.09	.0039	.0001	.31	2.4

Odor, generally vegetable, sometimes none. On heating, the odor was generally stronger and sometimes fishy or unpleasant.

HOLYOKE.

Microscopical Examination of Water from Whiting Street Storage Reservoir, Holyoke.

[Number of organisms per cubic centimeter.]

	1899.										
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
Day of examination,	25	23	22	26	24	28	26	23	27	25	22
Number of sample,	26023	26295	26549	26918	27204	27595	27888	28327	28756	29128	29451
PLANTS.											
Diatomaceæ,	16	1	32	1,078	96	6,140	80	48	244	146	62
Asterionella,	4	0	17	996	24	6,000	78	20	12	26	20
Fragilaria,	11	0	12	8	0	132	0	0	0	0	39
Synedra,	0	1	2	70	54	0	2	24	208	110	3
Cyanophyceæ,	0	0	0	0	6	32	622	520	1,040	200	2
Anabæna,	0	0	0	0	4	24	580	186	200	4	0
Aphanizomenon,	0	0	0	0	0	0	0	4	648	6	0
Cœlosphærium,	0	0	0	0	2	4	42	330	184	188	0
Algæ,	1	0	0	2	4	228	2	122	109	90	192
Protococcus,	0	0	0	0	0	40	0	40	0	0	188
Raphidium,	0	0	0	2	0	0	0	4	40	70	3
Scenedesmus,	0	0	0	0	0	4	0	44	56	4	0
Staurastrum,	0	0	0	0	4	184	0	16	8	8	0
ANIMALS.											
Rhizopoda,	0	0	0	0	2	0	0	0	0	2	0
Infusoria,	23	4	1,057	613	592	1,604	26	52	165	518	15
Codonella,	1	0	1	2	0	4	0	0	1	10	2
Cryptomonas,	6	0	1	8	2	16	0	4	0	500	1
Dinobryon,	12	3	1,048	592	576	1,564	0	0	0	0	10
Monas,	0	0	0	0	10	0	0	0	0	0	0
Peridinium,	0	0	6	2	0	8	2	28	0	0	1
Trachelomonas,	2	0	1	2	0	8	24	20	164	8	1
Vermes,	0	7	2	24	10	2	0	28	13	2	0
Anuræa,	0	0	1	0	2	0	0	4	12	0	0
Polyarthra,	0	7	1	12	2	2	0	20	0	2	0
Synchæta,	0	0	0	12	0	0	0	0	0	0	0
Crustacea,	pr.	0	0	0	pr.	pr.	pr.	pr.	pr.	pr.	pr.
Bosmina,	0	0	0	0	0	0	0	0	pr.	pr.	0
Cyclops,	pr.	0	0	0	pr.	pr.	0	pr.	pr.	pr.	pr.
Daphnia,	pr.	0	0	0	0	pr.	pr.	pr.	pr	pr.	0
Miscellaneous, Zoöglœa,	5	5	3	12	40	40	8	50	25	15	5
TOTAL,	45	17	1,094	1,729	750	8,046	736	820	1,596	973	277

HOLYOKE.

Chemical Examination of Water from Wright and Ashley Ponds, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26291	Feb. 21	V. slight.	Slight.	.15	4.10	1.60	.0060	.0210	.0162	.0048	.11	.0040	.0001	.36	2.0
26570	Mar. 25	V. slight.	V. slight.	.10	4.75	1.05	.0012	.0126	.0096	.0030	.11	.0020	.0001	.20	2.7
26571	Mar. 25	V. slight.	Cons.	.10	5.00	1.25	.0008	.0120	.0096	.0024	.09	.0090	.0001	.18	2.8
27200	May 23	Slight.	Slight.	.11	4.10	1.00	.0000	.0126	.0120	.0006	.07	.0010	.0001	.22	2.2
28326	Aug. 22	V. slight.	V. slight.	.10	4.15	1.40	.0000	.0184	.0152	.0032	.08	.0010	.0001	.33	2.0
29449	Nov. 21	V. slight.	V. slight.	.10	4.30	1.10	.0060	.0190	.0184	.0006	.09	.0010	.0001	.27	2.2
Av*..	....	....	....	.11	4.30	1.25	.0026	.0167	.0143	.0024	.09	.0025	.0001	.27	2.2

Odor of the first three samples, distinctly unpleasant; of the others, faintly unpleasant. —— No. 26571 was collected from a faucet in City Hall; the others, from the ponds.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Microscopical Examination of Water from Wright and Ashley Ponds, Holyoke.

[Number of organisms per cubic centimeter.]

	1899.					
	February.	March.	March.	May.	August.	November.
Day of examination,	28	27	27	24	23	22
Number of sample,	26291	26570	26571	27200	28326	29449
PLANTS.						
Diatomaceæ,	0	44	44	372	48	147
Asterionella,	0	30	8	234	16	29
Melosira,	0	10	8	96	0	114
Cyanophyceæ,	0	2	0	7	54	0
Anabæna,	0	0	0	0	46	0
Algæ,	0	0	4	0	508	5
Protococcus,	0	0	0	0	500	5
ANIMALS.						
Infusoria,	385	128	302	5	1	7
Dinobryon,	288	26	222	2	0	2
Euglena,	10	2	6	0	0	0
Synura,	80	68	0	0	0	0
Uroglena,	0	26	0	0	0	0
Vermes,	0	0	2	1	1	0
Crustacea, Cyclops,	0	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	0	3	7	5	12	3
TOTAL,	385	177	359	390	622	162

HOLYOKE.

Chemical Examination of Water from Fomar Reservoir on the Manhan River, Southampton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26293	Feb. 21	V. slight.	V. slight.	.11	3.15	1.26	.0004	.0064	.0054	.0010	.10	.0010	.0001	.24	1.1
27201	May 23	V. slight.	Slight.	.20	3.15	1.00	.0000	.0082	.0074	.0008	.08	.0010	.0000	.32	1.3
28325	Aug. 22	V. slight.	Slight.	.09	3.90	1.20	.0004	.0128	.0082	.0046	.09	.0020	.0001	.24	1.3
29450	Nov. 21	V. slight.	V. slight.	.48	4.40	1.60	.0004	.0132	.0114	.0018	.13	.0010	.0001	.49	1.6
Av...	....	....	....	.21	3.65	1.26	.0003	.0101	.0081	.0020	.10	.0012	.0001	.32	1.3

Odor, vegetable.

Chemical Examination of Water from Tatro Brook, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25947	Jan. 14	V. slight.	V. slight.	.29	4.75	2.00	.0006	.0072	.0070	.0002	.09	.0020	.0000	.39	2.2
26071	Jan. 27	V. slight.	V. slight.	.22	4.40	1.75	.0002	.0074	.0072	.0002	.09	.0060	.0000	.42	2.0
26294	Feb. 21	V. slight.	V. slight.	.20	5.10	1.30	.0004	.0092	.0074	.0018	.08	.0080	.0001	.35	2.2
26548	Mar. 21	V. slight.	V. slight.	.21	3.65	1.40	.0006	.0094	.0086	.0008	.09	.0010	.0000	.34	1.6
26917	Apr. 25	V. slight.	Slight.	.40	4.50	1.75	.0002	.0110	.0102	.0008	.07	.0020	.0000	.57	1.7
27203	May 23	Slight.	Slight.	.30	5.75	1.50	.0006	.0118	.0112	.0006	.07	.0000	.0001	.39	2.9
Av.*.	....	....	....	.27	4.71	1.56	.0004	.0097	.0089	.0008	.08	.0030	.0000	.41	2.1

Odor, faintly vegetable or none. —— The samples were collected from the brook, at the site of a proposed reservoir for the supply of the high-service district.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Dibble Brook, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25946	Jan. 14	V. slight.	V. slight.	0.72	5.50	2.25	.0004	.0220	.0216	.0004	.09	.0180	.0000	1.08	2.0
26070	Jan. 27	V. slight.	V. slight.	1.00	5.90	3.00	.0004	.0280	.0266	.0014	.07	.0150	.0000	1.38	1.7
26292	Feb. 21	V. slight.	Slight, earthy.	0.70	5.55	2.45	.0000	.0198	.0188	.0010	.07	.0120	.0000	0.90	2.2
26547	Mar. 21	V. slight.	Slight.	0.68	4.65	1.90	.0006	.0198	.0194	.0004	.06	.0100	.0001	0.78	1.4
26916	Apr. 25	V. slight.	V. slight.	0.73	4.50	1.95	.0006	.0192	.0184	.0008	.07	.0060	.0001	0.90	1.8
27202	May 23	Slight.	Slight.	0.95	5.80	2.75	.0016	.0270	.0244	.0026	.07	.0060	.0001	1.09	2.2
Av.*	....	....	....	0.78	5.24	2.33	.0008	.0221	.0210	.0011	.07	.0096	.0001	0.97	1.9

Odor, generally faintly vegetable, sometimes none.——The samples were collected from the brook, at the point where water can be diverted into the proposed high-service reservoir on Tatro Brook.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

The advice of the State Board of Health to the American Thread Company, relative to the quality of the water drawn from the wells on the premises of the company in Holyoke, may be found on pages 20 and 21 of this volume. An analysis of a sample of water from the wells is given in the following table: —

Chemical Examination of Water from the Wells of the American Thread Company, Holyoke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
27502	June 20	Decided, milky.	V. slight.	.70	9.70	.0208	.0084	.48	.0080	.0002	.10	6.0	.0900

Odor, none.——The sample was collected from two tubular wells near Mill No. 1 of the American Thread Company.

Water Supply of Hopedale.

(See *Milford.*)

HUDSON.

Water Supply of Hudson.

Chemical Examination of Water from Gates Pond, Berlin.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25960	Jan. 17	None.	V. slight.	.01	0.75	0.25	.0024	.0038	.0038	.0000	.05	.0010	.0000	.08	0.0
26490	Mar. 15	V. slight.	Slight.	.08	2.50	1.00	.0054	.0150	.0124	.0026	.23	.0010	.0000	.19	0.5
27131	May 17	V. slight.	Slight.	.07	2.15	1.05	.0010	.0198	.0170	.0028	.21	.0000	.0001	.19	0.3
27800	July 18	V. slight.	V. slight.	.03	2.20	1.05	.0018	.0154	.0150	.0004	.21	.0010	.0000	.23	0.6
28225	Aug. 15	V. slight.	V. slight.	.05	2.50	1.00	.0000	.0158	.0142	.0016	.18	.0020	.0000	.20	0.6
28654	Sept. 18	V. slight.	Slight.	.04	5.60	2.75	.0002	.0186	.0182	.0004	.24	.0000	.0000	.24	1.4
28655	Sept. 18	V. slight.	Slight.	.04	5.05	2.45	.0004	.0170	.0156	.0014	.21	.0000	.0000	.14	0.5
29400	Nov. 15	V. slight.	Slight.	.07	2.45	0.85	.0040	.0170	.0154	.0016	.22	.0010	.0000	.22	0.5

Averages by Years.

-	1888	-	-	.06	2.55	0.69	.0015	.0158	-	-	.19	.0055	.0001	-	-
-	1889	-	-	.03	2.14	0.58	.0020	.0189	.0139	.0050	.19	.0048	.0001	-	-
-	1890	-	-	.02	2.82	1.04	.0023	.0161	.0124	.0037	.21	.0054	.0000	-	1.2
-	1891	-	-	.04	2.52	0.90	.0011	.0150	.0117	.0033	.20	.0074	.0000	-	0.9
-	1893	-	-	.05	2.45	1.01	.0040	.0178	.0146	.0032	.23	.0039	.0000	.20	0.6
-	1894	-	-	.04	2.27	0.83	.0016	.0148	.0124	.0024	.22	.0008	.0000	.15	0.6
-	1895	-	-	.05	2.45	0.92	.0015	.0175	.0144	.0031	.23	.0027	.0000	.20	0.9
-	1896	-	-	.06	2.43	0.84	.0037	.0150	.0123	.0027	.26	.0050	.0000	.17	0.9
-	1897	-	-	.05	2.20	0.92	.0047	.0159	.0139	.0020	.23	.0028	.0000	.15	0.6
-	1898	-	-	.07	2.37	0.99	.0019	.0155	.0133	.0022	.24	.0026	.0000	.18	0.7
-	1899*	-	-	.05	2.55	1.11	.0021	.0149	.0135	.0014	.19	.0009	.0000	.19	0.5

NOTE to analyses of 1899: Odor, faintly vegetable or none.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

HUDSON.

Microscopical Examination of Water from Gates Pond, Berlin.

[Number of organisms per cubic centimeter.]

	1899.							
	Jan.	Mar.	May.	July.	Aug.	Sept.	Sept.	Nov.
Day of examination,	18	16	18	18	16	19	19	15
Number of sample,	25960	26490	27181	27800	28225	28654	28655	29400
PLANTS.								
Diatomaceæ,	0	134	86	42	180	39	36	486
Asterionella,	0	109	49	16	154	0	0	128
Melosira,	0	0	7	0	0	19	0	170
Tabellaria,	0	20	25	24	12	19	30	182
Cyanophyceæ,	0	0	0	0	52	3	1	2
Anabæna,	0	0	0	0	20	0	0	0
Merismopœdia,	0	0	0	0	28	0	0	0
Algæ,	0	0	2	8	38	7	13	107
Protococcus,	0	0	0	6	0	0	0	94
ANIMALS.								
Rhizopoda, Actinophrys,	0	0	0	0	0	0	1	0
Infusoria,	0	34	2	20	86	63	12	38
Dinobryon,	0	26	0	20	82	61	7	34
Vermes,	0	1	1	0	3	0	0	2
Crustacea, Daphnia,	0	0	0	0	pr.	0	0	0
Miscellaneous, Zoöglœa,	0	5	7	3	8	3	0	8
TOTAL,	0	174	98	73	367	115	63	643

Chemical Examination of Water from Fosgate Brook, in Berlin.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25959	Jan. 17	Decided.	Cons., earthy.	.32	2.65	1.10	.0010	.0134	.0086	.0048	.14	.0070	.0000	0.41	0.6
26233	Feb. 16	Slight.	Slight.	.10	2.85	0.90	.0022	.0048	.0036	.0012	.20	.0190	.0000	0.12	0.8
26489	Mar. 15	V. slight.	V. slight.	.08	2.60	0.85	.0006	.0052	.0040	.0012	.18	.0080	.0000	0.14	0.3
26756	Apr. 13	V. slight.	V. slight.	.09	3.25	1.15	.0004	.0038	.0030	.0008	.27	.0100	.0001	0.14	0.5
27130	May 17	Decided.	Slight.	.29	2.75	0.80	.0000	.0144	.0122	.0022	.15	.0000	.0000	0.32	0.5
27488	June 20	Slight.	Slight.	.47	4.75	1.25	.0148	.0160	.0140	.0020	.17	.0010	.0001	0.31	1.4
29399	Nov. 15	Slight.	Slight.	.93	6.50	2.85	.0036	.0312	.0300	.0012	.17	.0020	.0004	1.38	2.0
29690	Dec. 19	V. slight.	V. slight.	.23	3.90	1.15	.0012	.0112	.0092	.0020	.20	.0010	.0000	0.39	0.8
Av.	....	....	....	.31	3.66	1.26	.0030	.0125	.0106	.0019	.18	.0060	.0001	0.40	0.9

Odor of the first sample, none; of the second, very faintly musty; of the others, generally faintly vegetable, becoming stronger on heating.—— Water from Fosgate Brook is diverted into Gates Pond.

HULL.

Water Supply of Hull.

(See *Hingham.*)

Water Supply of Huntington Fire District, Huntington.

Population of the town in 1895, 1,450. The works are owned by the fire district, and were completed in the spring of 1899. The source of supply is Cold Brook, in Huntington, on which a small reservoir has been constructed. Water is diverted into Cold Brook from the upper portion of Gold-mine Brook, the water-shed of which is contiguous to that of Cold Brook. The water-sheds tributary to the reservoir have a combined area of about 2 square miles, and contain a very small population. Water is supplied to the town by gravity.

Chemical Examination of Water from Cold Brook Reservoir, in Huntington.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26333	Feb. 24	V. slight.	V. slight.	.05	2.75	0.75	.0000	.0042	.0042	.0000	.10	.0020	.0000	.20	0.8
26952	Apr. 24	V. slight.	V. slight.	.08	2.25	0.75	.0052	.0072	.0046	.0026	.08	.0010	.0000	.17	0.8
28227	Aug. 16	Decided.	V. slight.	.18	4.35	1.35	.0012	.0050	.0050	.0000	.08	.0020	.0000	.30	1.1
28385	Aug. 28	Decided.	V. slight.	.25	4.00	1.55	.0020	.0238	.0168	.0070	.09	.0030	.0000	.37	1.0
29153	Oct. 26	Slight.	V. slight.	.24	4.00	1.20	.0006	.0100	.0090	.0010	.19	.0020	.0000	.32	1.3
29784	Dec. 25	V. slight.	V. slight.	.20	2.96	1.15	.0006	.0084	.0080	.0004	.14	.0030	.0000	.48	1.0
Av.*	....	....	....	.16	3.22	1.06	.0016	.0088	.0073	.0015	.12	.0021	.0000	.29	1.0

Odor of Nos. 26333 and 28385, vegetable; of the others, none.——No. 28227 was collected from a faucet in the town, and the others from the reservoir.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Water Supply of Hyde Park and Milton. — Hyde Park Water Company.

The advice of the State Board of Health to the board of health of Hyde Park, with reference to the quality of the water supplied to the town by the Hyde Park Water Company, may be found on pages 21 and 22 of this volume. Analyses of samples of water collected from the various wells from which the supply is drawn and from faucets in different parts of the town are given in the following tables: —

Chemical Examination of Water from the Wells of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25966	Jan. 17	V. slight.	V. slight.	.04	9.50	.0092	.0026	1.01	.1275	.0008	.08	4.0	.0100
26236	Feb. 16	V. slight.	V. slight.	.03	9.50	.0082	.0026	0.96	.1200	.0004	.10	4.0	.0050
26476	Mar. 14	V. slight.	V. slight.	.02	8.50	.0074	.0024	0.85	.0930	.0002	.08	3.6	.0080
26694	Apr. 10	V. slight.	V. slight.	.04	7.20	.0056	.0026	0.73	.0780	.0002	.10	3.3	.0050
27109	May 16	V. slight.	V. slight.	.01	9.30	.0094	.0032	0.92	.1240	.0008	.09	3.6	.0060
27505	June 20	None.	V. slight.	.03	10.50	.0110	.0028	1.14	.1160	.0002	.08	4.6	.0040
27808	July 18	V. slight.	V. slight.	.02	9.70	.0116	.0042	1.23	.0980	.0008	.09	4.3	.0020
28197	Aug. 14	V. slight.	V. slight.	.04	10.70	.0144	.0048	1.50	.0780	.0001	.10	3.9	.0100
28672	Sept. 19	V. slight.	V. slight.	.04	11.50	.0168	.0054	1.66	.0930	.0001	.12	4.6	.0040
29024	Oct. 16	V. slight.	V. slight.	.07	13.70	.0188	.0066	1.63	.0850	.0002	.13	5.3	.0170
29377	Nov. 14	V. slight.	V. slight.	.12	12.80	.0190	.0068	1.63	.1240	.0001	.13	4.9	.0230
29695	Dec. 19	V. slight.	V. slight.	.06	12.20	.0154	.0050	1.67	.1400	.0005	.10	4.3	.0270
29809	Dec. 28	V. slight.	V. slight.	.10	11.30	.0152	.0048	1.60	.0900	.0008	.09	4.6	.0430

Averages by Years.

-	1888	-	-	.00	6.06	.0001	.0023	0.75	.0641	.0002	-	-	-
-	1893	-	-	.02	8.62	.0031	.0032	1.19	.0879	.0002	.10	3.7	.0112
-	1894	-	-	.03	9.68	.0040	.0039	1.37	.0643	.0001	.09	3.9	.0175
-	1895	-	-	.04	9.44	.0063	.0035	1.31	.0867	.0001	.09	4.0	.0149
-	1896	-	-	.03	9.68	.0084	.0046	1.21	.0882	.0003	.11	4.1	.0141
-	1897	-	-	.04	9.94	.0093	.0037	1.30	.1170	.0002	.08	4.2	.0069
-	1898	-	-	.08	10.28	.0120	.0046	1.17	.1271	.0003	.12	4.4	.0113
-	1899*	-	-	.04	10.39	.0122	.0041	1.24	.1043	.0002	.10	4.2	.0107

NOTE to analyses of 1899: Odor in October, very faintly unpleasant; at other times, none, becoming faintly unpleasant on heating in June and August. —— The samples were collected from a faucet at the pumping station. For analyses of water from the Neponset River opposite the wells of the Hyde Park Water Company, see subsequent chapter on "Examination of Rivers."

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

HYDE PARK AND MILTON.

Chemical Examination of Water from Faucets in Hyde Park, supplied from the Wells of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
28257	Aug. 17	Slight.	Slight.	.02	11.30	.0134	.0070	1.70	.0920	.0000	.12	3.9	.0200
28553	Sept. 11	V. slight.	None.	.12	12.00	.0150	.0076	1.90	.0760	.0004	.13	4.4	.0280
28554	Sept. 11	V. slight.	V. slight.	.07	11.60	.0140	.0080	1.91	.0730	.0002	.13	4.4	.0180
28555	Sept. 11	V. slight.	V. slight.	.04	11.90	.0148	.0066	1.91	.0650	.0003	.13	4.4	.0070
28556	Sept. 11	None.	None.	.06	13.00	.0176	.0076	1.91	.0700	.0003	.11	4.4	.0040
28557	Sept. 11	Decided.	Cons.	.08*	12.70	.0182	.0068	1.92	.0580	.0007	.16	4.4	.2400
28558	Sept. 11	V. slight.	None.	.06	12.90	.0172	.0084	1.87	.0770	.0000	.11	5.3	.0080
29427	Nov. 17	Slight.	Cons.	.06	12.50	.0108	.0092	1.70	.0850	.0009	.16	4.6	.0600
29428	Nov. 17	Slight.	Cons.	.07	12.60	.0102	.0122	1.70	.0850	.0006	.18	4.6	.0920

Odor of the first sample, none; of the others, faintly unpleasant.——The samples were collected from faucets in various parts of the town.

* Filtered.

Chemical Examination of Water from the Wells of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxgen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
28744	Sept. 26	V. slight.	V. slight.	0.05	12.00	.0206	.0080	1.69	.1200	.0003	.14	4.7	.0160
28751	Sept. 26	V. slight.	V. slight.	0.10	11.50	.0222	.0070	2.08	.1030	.0002	.12	4.6	.0300
28750	Sept. 26	Decided.	Heavy.	0.05	10.50	.0048	.0056	2.07	.0110	.0003	.19	4.6	.0040
28749	Sept. 26	Decided.	Cons.	1.20	13.60	.0847	.0185	2.31	.0120	.0004	.39	5.3	.3700
28745	Sept. 26	Decided.	Heavy.	0.01	10.50	.0006	.0036	1.29	.0800	.0004	.11	4.6	.0030
28747	Sept. 26	Decided.	Heavy.	0.00	14.70	.0032	.0028	1.27	.3400	.0005	.09	6.7	.0080
28752	Sept. 26	V. slight.	Cons.	0.07	7.00	.0002	.0030	1.11	.0400	.0000	.07	2.0	.0050
28753	Sept. 26	Decided.	Heavy.	0.03	5.50	.0002	.0026	0.61	.0290	.0000	.03	1.7	.0090
28746	Sept. 26	Decided.	Heavy.	0.01	11.80	.0006	.0036	1.65	.2080	.0004	.07	4.6	.0130
28748	Sept. 26	Decided.	Heavy.	0.06	11.40	.0034	.0128	1.88	.0080	.0011	.30	4.6	.0080

Odor, faintly unpleasant, or none. The odor of all of the samples became faintly unpleasant on heating.——The samples were collected from separate wells or groups of wells, as follows: No. 28744, from a tap at the pumping station while pumping from the wells in groups Nos. 1 and 2 situated near the river, south and west of the pumping station; No. 28751, from a tap in the pumping station while pumping from the wells in groups Nos. 3, 4 and 5, which are situated north-west and south-east of the pumping station; No. 28750, from a well in group No. 3, situated about 80 feet north-west of the pumping station and 120 feet from the river; No. 28749, from a well in group No. 3, situated about 60 feet from the river; No. 28745, from a well in group No. 1, 60 feet west of the pumping station and 140 feet from the river; No. 28747, from a well in group No. 1, 30 feet from the river; No. 28752, from the northerly well in group No. 5, about 100 feet from the pumping station and 250 feet from the river; No. 28753, from the southerly well in group No. 5, about 450 feet south of the pumping station and 240 feet from the river; No. 28746, from a well in group No. 2, about 250 feet south-west of the pumping station and 220 feet from the river; No. 28748, from the southerly well in group No. 2, 600 feet south-west of the pumping station and 30 feet from the river.

Water Supply of Ipswich.

Chemical Examination of Water from Dow's Brook above the Storage Reservoir of the Ipswich Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26001	Jan. 23	V. slight.	V. slight.	.17	3.75	1.45	.0000	.0060	.0038	.0022	.40	.0020	.0000	.20	1.1
26281	Feb. 20	Slight.	Cons., earthy.	.19	3.80	1.20	.0010	.0116	.0072	.0044	.58	.0050	.0001	.30	1.4
26885	Apr. 24	V. slight.	V. slight.	.34	3.70	1.00	.0000	.0080	.0076	.0004	.40	.0010	.0000	.45	0.8
27180	May 22	V. slight.	V. slight.	.37	4.35	1.35	.0002	.0182	.0126	.0006	.42	.0020	.0000	.44	1.3
27593	June 27	V. slight.	Slight.	.08	5.40	1.60	.0002	.0126	.0082	.0044	.50	.0170	.0000	.17	1.7
27849	July 20	None.	None.	.00	5.25	0.60	.0000	.0008	.0008	.0000	.59	.0200	.0000	.01	2.0
28435	Aug. 31	V. slight.	Cons.	.14	6.75	1.65	.0010	.0192	.0094	.0098	.62	.0050	.0001	.19	2.2
28730	Sept. 28	V. slight.	Slight.	.26	5.50	1.50	.0000	.0126	.0120	.0006	.52	.0020	.0000	.39	2.0
29097	Oct. 22	V. slight.	V. slight.	.40	5.65	1.95	.0006	.0176	.0158	.0018	.58	.0030	.0000	.54	2.0
29438	Nov. 20	V. slight.	V. slight.	.34	5.40	2.10	.0008	.0132	.0128	.0004	.42	.0020	.0000	.47	1.7
29779	Dec. 26	V. slight.	None.	.78	5.45	2.35	.0010	.0178	.0176	.0002	.49	.0030	.0000	.91	1.7

Averages by Years.

-	1895	-	-	.47	4.74	1.62	.0006	.0129	.0111	.0018	.61	.0042	.0001	.46	1.6
-	1896	-	-	.38	4.45	1.39	.0009	.0122	.0105	.0017	.57	.0045	.0000	.46	1.7
-	1897	-	-	.44	4.66	1.62	.0022	.0131	.0112	.0019	.55	.0065	.0000	.40	1.7
-	1898	-	-	.63	4.25	1.78	.0007	.0183	.0134	.0049	.47	.0029	.0000	.59	1.3
-	1899	-	-	.28	5.00	1.52	.0004	.0121	.0098	.0023	.49	.0056	.0000	.37	1.6

Note to analyses of 1899: Odor, faintly vegetable or none. On heating, the odor of all of the samples was vegetable, and of the last sample, also unpleasant.—— The samples were collected from the brook, at its entrance to the storage reservoir.

IPSWICH.

Chemical Examination of Water from the Storage Reservoir of the Ipswich Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26002	Jan. 28	Slight.	V. slight.	.82	4.10	1.70	.0004	.0184	.0146	.0038	.40	.0070	.0000	.42	1.0
26282	Feb. 20	Slight.	V. slight.	.18	4.50	1.25	.0030	.0090	.0068	.0022	.48	.0110	.0002	.30	1.7
26886	Apr. 24	Slight.	Slight.	.26	8.50	1.50	.0002	.0146	.0128	.0018	.88	.0030	.0001	.46	0.6
27181	May 22	V. slight.	V. slight.	.21	8.70	1.25	.0008	.0214	.0194	.0020	.43	.0020	.0000	.36	1.1
27594	June 27	V. slight.	Slight.	.12	8.85	1.35	.0014	.0220	.0168	.0052	.42	.0000	.0000	.30	1.1
27850	July 20	V. slight.	V. slight.	.11	4.20	1.10	.0006	.0188	.0170	.0018	.46	.0020	.0000	.31	1.7
28436	Aug. 31	Slight.	V. slight.	.10	4.65	1.75	.0016	.0294	.0262	.0032	.51	.0010	.0000	.38	1.8
28731	Sept. 28	Slight.	V. slight.	.10	4.30	1.50	.0020	.0230	.0212	.0018	.55	.0040	.0001	.32	1.8
29098	Oct. 22	Slight.	Slight.	.10	4.50	1.25	.0006	.0248	.0232	.0016	.56	.0050	.0000	.35	2.0
29439	Nov. 20	Slight.	V. slight.	.22	4.55	1.60	.0010	.0220	.0210	.0010	.52	.0010	.0000	.37	1.7
29780	Dec. 26	Slight.	V. slight.	.18	4.65	1.55	.0008	.0214	.0194	.0020	.58	.0010	.0001	.40	1.7

Averages by Years.

-	1895	-	-	.45	5.25	1.89	.0022	.0194	.0169	.0025	.76	.0072	.0001	.50	1.9
-	1896	-	-	.32	4.60	1.54	.0017	.0178	.0147	.0031	.67	.0058	.0001	.41	1.7
-	1897	-	-	.33	4.64	1.64	.0023	.0196	.0169	.0027	.62	.0058	.0000	.39	1.6
-	1898	-	-	.46	4.74	1.79	.0020	.0191	.0160	.0031	.55	.0048	.0001	.49	1.5
-	1899	-	-	.17	4.23	1.44	.0011	.0204	.0180	.0024	.46	.0034	.0000	.36	1.4

NOTE to analyses of 1899: Odor, generally vegetable, sometimes none. On heating, the odor of the first and last samples was faintly fishy.

IPSWICH.

Microscopical Examination of Water from the Storage Reservoir of the Ipswich Water Works.

[Number of organisms per cubic centimeter.]

	1899.										
	Jan.	Feb.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	24	21	24	23	28	21	31	26	23	20	27
Number of sample,	26002	26282	26886	27181	27594	27850	28436	28731	29098	29439	29780
PLANTS.											
Diatomaceæ,	3	8	52	24	12	0	410	5	18	0	0
Cyclotella,	1	0	0	0	0	0	402	2	2	0	0
Cyanophyceæ, Anabæna,	0	0	0	0	0	0	2	0	0	0	0
Algæ,	0	0	2	0	74	0	0	42	24	0	0
Protococcus,	0	0	0	0	0	0	0	40	15	0	0
Raphidium,	0	0	0	0	74	0	0	0	4	0	0
ANIMALS.											
Rhizopoda, Actinophrys,	0	0	0	0	0	0	0	0	1	0	0
Infusoria,	14	6	1,062	1,513	262	0	4	8	13	26	692
Dinobryon,	6	6	1,000	1,444	134	0	0	0	3	21	690
Monas,	0	0	40	0	0	0	0	0	0	0	0
Peridinium,	5	0	2	64	128	0	2	6	3	2	0
Vermes,	0	0	10	1	1	0	2	1	1	5	0
Miscellaneous, Zoöglœa,	7	5	8	10	12	0	7	8	7	0	5
TOTAL,	24	19	1,134	1,548	361	0	425	64	64	31	697

WATER SUPPLY OF KINGSTON.

Chemical Examination of Water from the Wells of the Kingston Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26060	Jan. 27	None.	None.	.00	4.60	.0000	.0002	.79	.0070	.0000	.02	1.1	.0010
26557	Apr. 15	None.	None.	.00	4.20	.0000	.0016	.80	.0080	.0000	.00	1.1	.0010
27278	May 31	None.	None.	.00	4.20	.0000	.0010	.79	.0110	.0000	.02	1.8	.0020
28226	Aug. 15	None.	None.	.00	5.00	.0000	.0020	.76	.0050	.0000	.02	1.0	.0020
28769	Sept. 27	None.	None.	.01	5.00	.0010	.0022	.76	.0090	.0000	.01	0.9	.0050
Av...	....	....	....	.00	4.60	.0002	.0014	.78	.0080	.0000	.01	1.2	.0022

Odor, none.

LANCASTER.

WATER SUPPLY OF LANCASTER.

(See *Clinton*.)

WATER SUPPLY OF LAWRENCE.

The advice of the State Board of Health to the city of Lawrence, with reference to the quality of the water supplied to that city, may be found on pages 22 and 23 of this volume.

Chemical Examination of Water from the Merrimack River above Lawrence, opposite the Intake of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Suspended.					
	1899.														
25979	Jan. 18	Slight.	Slight.	.32	3.00	1.15	.0022	.0152	.0128	.0024	.19	.0050	.0001	.46	1.0
26212	Feb. 15	Slight.	V. slight.	.26	4.30	1.75	.0098	.0158	.0132	.0026	.22	.0040	.0001	.42	1.3
26494	Mar. 15	Decided.	Cons.	.30	2.65	1.05	.0018	.0174	.0118	.0056	.14	.0060	.0000	.42	0.5
26942	Apr. 26	Decided.	Cons.	.31	3.65	1.20	.0006	.0162	.0122	.0040	.12	.0040	.0000	.50	0.3
27135	May 17	Slight.	Slight.	.32	3.25	1.35	.0020	.0196	.0154	.0042	.13	.0080	.0003	.50	0.6
27542	June 22	Slight.	Cons.	.23	4.10	1.35	.0084	.0296	.0186	.0110	.25	.0050	.0003	.39	1.3
27845	July 20	Slight.	Slight.	.20	4.00	1.15	.0108	.0268	.0202	.0066	.28	.0050	.0003	.40	1.0
28232	Aug. 16	Slight.	Cons.	.22	4.50	1.80	.0106	.0244	.0176	.0068	.31	.0050	.0005	.43	1.4
28693	Sept. 20	Slight.	Cons.	.19	4.50	1.45	.0148	.0312	.0200	.0112	.38	.0060	.0003	.36	1.1
29070	Oct. 18	Slight.	Slight.	.24	4.50	1.75	.0248	.0268	.0236	.0032	.38	.0070	.0006	.35	1.7
29401	Nov. 15	Slight.	Cons.	.38	4.90	1.90	.0136	.0272	.0240	.0032	.31	.0030	.0004	.65	1.3
29721	Dec. 20	Decided.	Cons.	.50	4.55	2.00	.0060	.0284	.0212	.0072	.20	.0090	.0002	.78	1.0

Averages by Years.

-	1888	-	-	.30	3.68	1.08	.0026	.0180	-	-	.18	.0094	.0002	-	-
-	1889	-	-	.30	3.09	0.87	.0030	.0176	.0144	.0032	.17	.0072	.0003	-	-
-	1890	-	-	.33	4.19	1.48	.0046	.0166	.0132	.0034	.17	.0089	.0001	-	1.6
-	1891	-	-	.27	3.79	1.32	.0040	.0152	.0121	.0031	.18	.0110	.0001	-	1.3
-	1892	-	-	.43	4.12	1.47	.0042	.0181	.0152	.0029	.18	.0105	.0001	-	1.4
-	1893	-	-	.42	3.86	1.48	.0057	.0181	.0141	.0040	.20	.0081	.0002	.53	1.1
-	1894	-	-	.37	3.70	1.30	.0062	.0167	.0141	.0026	.23	.0063	.0001	.44	1.2
-	1895	-	-	.51	4.34	1.75	.0064	.0249	.0185	.0064	.28	.0071	.0002	.59	1.4
-	1896	-	-	.42	3.98	1.52	.0068	.0220	.0183	.0037	.24	.0087	.0003	.53	1.2
-	1897	-	-	.56	3.84	1.54	.0049	.0228	.0186	.0042	.20	.0067	.0001	.54	1.1
-	1898	-	-	.45	3.90	1.63	.0050	.0212	.0169	.0043	.22	.0058	.0003	.53	1.1
-	1899	-	-	.29	3.99	1.49	.0068	.0232	.0175	.0057	.24	.0056	.0003	.47	1.0

NOTE to analyses of 1899: Odor, frequently faintly vegetable or musty and sometimes unpleasant. —The samples were collected from the river, opposite the intake of the Lawrence water works, about 1 foot beneath the surface. For a comparison of the analyses of the river water at Lowell and Lawrence for a series of years, see "Merrimack River," in the chapter on "Examination of Rivers."

LAWRENCE.

Chemical Examination of Water from the Merrimack River after passing through the Sand Filter of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25980	Jan. 18	Slight.	Slight.	.32	3.50	1.35	.0072	.0110	.0094	.0016	.19	.0140	.0001	.39	1.4
26218	Feb. 15	V. slight.	None.	.26	4.50	1.50	.0094	.0084	.0078	.0006	.24	.0170	.0001	.32	1.7
26495	Mar. 15	V. slight.	None.	.31	3.50	1.05	.0092	.0078	.0074	.0004	.20	.0230	.0001	.32	1.8
26943	Apr. 26	Decided.	Slight.	.30	4.35	1.35	.0134	.0066	.0064	.0002	.19	.0240	.0001	.27	2.0
27136	May 17	V. slight.	V. slight.	.29	3.85	1.35	.0066	.0088	.0082	.0006	.17	.0200	.0000	.32	1.1
27543	June 22	Slight.	Slight, floc.	.24	5.35	1.20	.0126	.0074	.0068	.0006	.28	.0140	.0002	.20	2.0
27846	July 20	Slight.	V. slight.	.14	5.10	1.35	.0116	.0096	.0090	.0006	.32	.0380	.0008	.20	1.8
28283	Aug. 16	Slight, milky.	Slight.	.20	4.55	1.30	.0034	.0064	.0062	.0002	.32	.0200	.0000	.21	1.4
28694	Sept. 20	V. slight.	V. slight.	.12	4.20	1.35	.0050	.0080	.0076	.0004	.39	.0160	.0001	.17	1.1
29078	Oct. 18	Slight.	Slight.	.11	4.50	1.35	.0040	.0094	.0080	.0014	.43	.0210	.0001	.21	2.1
29402	Nov. 15	Slight.	V. slight.	.48	5.60	1.70	.0122	.0124	.0116	.0008	.34	.0120	.0000	.46	2.0
29722	Dec. 20	V. slight.	V. slight.	.43	4.75	1.70	.0096	.0112	.0112	.0000	.24	.0270	.0000	.48	1.6

Averages by Years.

-	1894	-	-	.39	6.10	1.41	.0103	.0094	.0081	.0013	.30	.0309	.0002	.29	2.8
-	1895	-	-	.50	5.95	1.70	.0146	.0108	.0094	.0014	.31	.0274	.0001	.36	2.7
-	1896	-	-	.40	5.43	1.64	.0121	.0099	.0079	.0020	.25	.0319	.0004	.32	2.4
-	1897	-	-	.56	5.17	1.68	.0123	.0108	.0095	.0013	.25	.0317	.0002	.38	2.0
-	1898	-	-	.43	4.66	1.69	.0107	.0090	.0084	.0006	.26	.0324	.0001	.35	1.9
-	1899	-	-	.27	4.44	1.42	.0087	.0089	.0083	.0006	.28	.0205	.0001	.30	1.6

NOTE to analyses of 1899: Odor in July, faintly unpleasant; in November, faintly earthy; at other times, none. On heating, the odor of most of the samples was faintly vegetable, and in May and June, also unpleasant. — The samples were collected from a faucet in the check valve, just beyond the pump. The average amount of iron found in the samples was .0537 parts per 100,000.

LAWRENCE.

Chemical Examination of Water from the Distributing Reservoir of the Lawrence Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25981	Jan. 18	V. slight.	V. slight.	.30	4.00	1.25	.0078	.0108	.0098	.0010	.20	.0110	.0002	.36	1.6
26214	Feb. 15	V. slight.	V. slight.	.26	4.15	1.70	.0066	.0086	.0084	.0002	.23	.0320	.0001	.32	1.7
26496	Mar. 15	V. slight.	V. slight.	.28	3.85	1.15	.0076	.0092	.0084	.0008	.20	.0170	.0000	.31	1.3
26944	Apr. 26	V. slight.	V. slight.	.25	3.75	1.25	.0046	.0086	.0076	.0010	.15	.0190	.0001	.29	1.1
27187	May 17	V. slight.	V. slight.	.21	3.15	1.25	.0006	.0118	.0104	.0014	.16	.0280	.0001	.30	1.0
27544	June 22	Slight.	V. slight.	.12	4.20	1.50	.0010	.0090	.0070	.0020	.29	.0150	.0002	.22	1.0
27847	July 20	V. slight.	V. slight.	.08	4.65	1.20	.0014	.0108	.0092	.0016	.31	.0300	.0003	.21	1.4
28234	Aug. 16	V. slight.	V. slight.	.10	4.85	1.75	.0004	.0064	.0060	.0004	.31	.0200	.0001	.22	1.3
28695	Sept. 20	V. slight.	V. slight.	.09	4.35	1.50	.0010	.0100	.0094	.0006	.36	.0110	.0001	.20	1.6
29096	Oct. 21	Slight.	Slight.	.11	4.75	1.35	.0010	.0106	.0102	.0004	.40	.0240	.0003	.20	1.7
29403	Nov. 15	Slight.	V. slight.	.20	4.80	1.75	.0024	.0118	.0114	.0004	.31	.0160	.0000	.34	1.7
29723	Dec. 20	Slight.	V. slight.	.24	4.60	1.35	.0076	.0104	.0100	.0004	.30	.0160	.0001	.29	1.7
Av...	....	....	....	.19	4.22	1.42	.0035	.0098	.0090	.0008	.27	.0199	.0001	.27	1.4

Odor, faintly vegetable or none.—The samples were collected from a faucet at the gate-house, and represent water flowing out of the reservoir. The reservoir is supplied with filtered water.

WATER SUPPLY OF LEE.—BERKSHIRE WATER COMPANY.

Chemical Examination of Water from the Upper Reservoir of the Berkshire Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27603	June 27	Slight.	Slight.	.30	2.10	1.25	.0006	.0276	.0236	.0040	.04	.0010	.0000	0.55	0.2
27906	July 26	Slight.	Cons.	.50	3.05	2.15	.0002	.0548	.0498	.0050	.11	.0020	.0000	1.07	0.2
28526	Sept. 7	Decided.	Cons.	.59	3.25	2.25	.0012	.0632	.0360	.0272	.06	.0040	.0000	0.96	0.2
28873	Oct. 3	Decided.	Cons.	.60	3.45	2.15	.0068	.0608	.0502	.0106	.05	.0020	.0000	0.92	0.6
Av...	....	....	....	.50	2.96	1.95	.0022	.0516	.0399	.0117	.06	.0022	.0000	0.87	0.3

Odor of the first two samples, faintly vegetable, becoming stronger, and in the second sample also fishy on heating; of the last two, distinctly disagreeable.

LEE.

Microscopical Examination of Water from the Upper Reservoir of the Berkshire Water Company.

[Number of organisms per cubic centimeter.]

	1899. June.	1899. July.	1899. Sept.	1899. Oct.
Day of examination,	28	27	8	4
Number of sample,	27603	27908	28526	28873
PLANTS.				
Diatomaceæ,	602	108	118	152
Asterionella,	592	102	0	48
Synedra,	6	0	102	76
Cyanophyceæ,	2	0	0	4
Algæ,	4	4	204	80
Arthrodesmus,	2	2	204	64
ANIMALS.				
Infusoria,	184	594	124	985
Cryptomonas,	2	0	0	100
Dinobryon,	44	4	116	864
Mallomonas,	22	0	0	4
Peridinium,	116	590	6	4
Uroglena,	0	0	0	8
Vermes,	3	0	2	0
Crustacea,	pr.	0	pr.	pr.
Bosmina,	0	0	0	pr.
Cyclops,	pr.	0	pr.	0
Entomostracan ova,	0	0	pr.	0
Miscellaneous, Zoöglœa,	8	5	5	20
TOTAL,	803	711	451	1,241

Chemical Examination of Water from the Lower Reservoir of the Berkshire Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27604	June 27	V. slight.	V. slight.	.22	3.00	1.40	.0006	.0186	.0124	.0012	.04	.0050	.0001	0.38	1.4
27909	July 26	V. slight.	Slight.	.70	3.75	1.95	.0006	.0244	.0222	.0022	.03	.0050	.0000	1.16	1.3
28527	Sept. 7	V. slight.	V. slight.	.32	3.20	1.75	.0008	.0192	.0168	.0024	.04	.0070	.0000	0.43	1.3
28874	Oct. 3	V. slight.	V. slight.	.37	3.45	2.00	.0012	.0232	.0214	.0018	.08	.0020	.0000	0.61	1.3
Av...	....	....	....	.40	3.35	1.77	.0008	.0201	.0182	.0019	.05	.0047	.0000	0.64	1.3

Odor, faintly vegetable, sometimes none.

LEICESTER.

WATER SUPPLY OF LEICESTER WATER SUPPLY DISTRICT, LEICESTER.

Chemical Examination of Water from the Wells of the Leicester Water Supply District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27351	June 8	V. slight.	V. slight.	.09	4.60	.0004	.0024	.23	.0500	.0008	.05	1.8	.0150
27641	July 4	None.	V. slight.	.00	5.10	.0000	.0014	.26	.0780	.0000	.02	3.0	.0020
28085	Aug. 8	None.	None.	.02	4.70	.0000	.0008	.19	.0940	.0000	.07	1.7	.0010
28544	Sept. 11	V. slight.	V. slight.	.12	10.20	.0140	.0070	.25	.0020	.0008	.11	4.4	.0220
28924	Oct. 9	None.	None.	.04	5.20	.0000	.0010	.26	.1180	.0000	.02	2.2	.0020
Av...	....	....	....	.05	5.96	.0029	.0025	.24	.0684	.0002	.05	2.6	.0084

Odor, none. —— The first and third samples were collected from faucets in the town; the others, from one of the wells.

WATER SUPPLY OF LENOX. — LENOX WATER COMPANY.

Chemical Examination of Water from the Storage Reservoir of the Lenox Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26344	Feb. 27	V. slight.	V. slight.	.03	6.75	0.75	.0006	.0028	.0026	.0002	.07	.0120	.0000	.08	5.0
26907	Apr. 23	V. slight.	Slight.	.06	4.10	0.50	.0008	.0098	.0086	.0012	.07	.0050	.0000	.12	2.6
27355	June 8	V. slight.	Cons.	.04	8.25	0.95	.0050	.0210	.0182	.0028	.10	.0040	.0000	.14	6.4
28714	Sept. 21	V. slight.	Slight.	.05	9.50	1.25	.0006	.0194	.0168	.0026	.08	.0010	.0000	.17	7.1
29751	Dec. 22	Decided.	V. slight.	.06	9.50	1.00	.0004	.0058	.0050	.0008	.10	.0040	.0000	.15	6.0
Av...	....	....	....	.05	7.62	0.89	.0015	.0118	.0103	.0015	.08	.0052	.0000	.13	5.4

Odor, faintly vegetable. —— The samples were collected from the reservoir on Williams River, near its outlet.

WATER SUPPLY OF LEOMINSTER.

Chemical Examination of Water from Haynes Reservoir, Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26018	Jan. 24	Slight.	Slight.	.19	1.60	0.85	.0002	.0150	.0126	.0024	.14	.0030	.0000	.83	0.2
26545	Mar. 21	V. slight.	V. slight.	.03	1.05	0.40	.0052	.0106	.0074	.0032	.09	.0020	.0001	.11	0.0
27222	May 24	V. slight.	Cons.	.20	1.90	1.05	.0000	.0268	.0182	.0086	.10	.0030	.0000	.38	0.0
27902	July 26	Slight.	Cons.	.20	2.75	1.65	.0006	.0276	.0148	.0128	.12	.0010	.0000	.56	0.0
28779	Sept. 27	Decided.	Cons.	.10	2.15	1.35	.0008	.0460	.0258	.0202	.08	.0020	.0000	.39	0.0
29457	Nov. 22	Slight.	Cons.	.10	2.45	1.40	.0000	.0384	.0280	.0104	.12	.0010	.0000	.39	0.0
Av...	....	....	....	.14	1.98	1.12	.0011	.0274	.0178	.0096	.11	.0020	.0000	.35	0.0

Odor, faintly vegetable or none. On heating, the odor of some of the samples became stronger; in January, faintly fishy; in November, distinctly unpleasant.

Microscopical Examination of Water from Haynes Reservoir, Leominster.

[Number of organisms per cubic centimeter.]

	1899.					
	Jan.	Mar.	May.	July.	Sept.	Nov.
Day of examination,	25	22	25	27	28	23
Number of sample,	26018	26545	27222	27902	28779	29457
PLANTS.						
Diatomaceæ,	9	15	764	378	312	1,696
Asterionella,	2	9	184	48	24	1,428
Melosira,	0	0	34	116	148	16
Tabellaria,	4	3	514	192	140	220
Cyanophyceæ,	0	0	64	236	796	0
Anabæna,	0	0	30	24	100	0
Clathrocystis,	0	0	2	196	196	0
Microcystis,	0	0	0	16	0	0
Oscillaria,	0	0	0	0	500	0
Algæ,	0	0	68	136	24	38
Protococcus,	0	0	0	72	0	28

LEOMINSTER.

Microscopical Examination of Water from Haynes Reservoir, Leominster — Concluded.

[Number of organisms per cubic centimeter.]

	1899.					
	Jan.	March.	May.	July.	Sept.	Nov.
ANIMALS.						
Infusoria,	452	18	718	4	16	2
Ciliated infusorian,	0	0	0	0	12	0
Dinobryon,	433	7	700	0	0	2
Peridinium,	18	4	2	0	0	0
Vorticella,	0	0	12	0	0	0
Vermes,	0	0	19	4	4	16
Anurea,	0	0	16	4	4	16
Crustacea, Daphnia,	0	0	pr.	0	0	0
Miscellaneous, Zoöglœa,	0	7	20	40	0	10
TOTAL,	461	40	1,623	796	1,152	1,768

Chemical Examination of Water from Morse Reservoir, Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26019	Jan. 24	Slight.	Slight.	.20	1.80	0.95	.0022	.0144	.0116	.0028	.10	.0010	.0000	.32	0.0
26546	Mar. 21	V. slight.	V. slight.	.14	1.75	0.75	.0050	.0108	.0088	.0020	.09	.0020	.0000	.27	0.3
27223	May 24	Slight.	Slight.	.14	1.65	0.75	.0000	.0142	.0120	.0022	.09	.0040	.0000	.26	0.0
27903	July 26	Slight.	Cons.	.17	2.25	1.40	.0000	.0266	.0180	.0086	.10	.0010	.0000	.45	0.0
28780	Sept. 27	Decided.	Cons.	.18	1.95	1.40	.0016	.0392	.0214	.0178	.11	.0020	.0000	.43	0.0
29458	Nov. 22	V. slight.	Slight.	.20	2.60	1.40	.0000	.0302	.0244	.0058	.13	.0020	.0000	.44	0.0
Av...	....	....	....	.17	2.00	1.11	.0015	.0226	.0160	.0066	.10	.0020	.0000	.36	0.0

Odor, generally vegetable, sometimes none. An unpleasant odor was developed in the last three samples on heating.

LEOMINSTER.

Microscopical Examination of Water from Morse Reservoir, Leominster.

[Number of organisms per cubic centimeter.]

	1899.					
	Jan.	March.	May.	July.	Sept.	Nov.
Day of examination,	25	22	25	27	28	28
Number of sample,	26019	26546	27223	27903	28780	29458
PLANTS.						
Diatomaceæ,	933	646	688	92	96	18
Asterionella,	910	640	190	4	36	0
Melosira,	0	0	62	2	28	0
Synedra,	3	1	108	4	12	11
Tabellaria,	20	5	324	80	18	7
Cyanophyceæ,	1	0	0	142	136	0
Anabæna,	0	0	0	138	62	0
Clathrocystis,	0	0	0	4	74	0
Algæ,	0	0	8	1,218	3,072	0
Cosmarium,	0	0	0	1,200	0	0
Raphidium,	0	0	6	0	64	0
Scenedesmus,	0	0	0	0	3,000	0
ANIMALS.						
Infusoria,	86	7	158	0	12	29
Ciliated infusorian,	0	0	0	0	10	0
Dinobryon,	85	5	158	0	0	0
Peridinium,	1	2	0	0	0	27
Vermes,	0	0	0	1	3	1
Crustacea, Cyclops,	0	0	0	pr.	pr.	0
Miscellaneous, Zoöglœa,	3	5	15	3	12	5
TOTAL,	1,023	658	867	1,451	3,331	53

Chemical Examination of Water from Fall Brook, above the Fall Brook Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26015	Jan. 24	V. slight.	Slight.	.23	2.50	0.80	.0000	.0068	.0062	.0006	.14	.0020	.0000	.30	0.2
26283	Feb. 21	V. slight.	Slight.	.14	2.25	1.15	.0020	.0148	.0098	.0050	.11	.0010	.0000	.26	0.2
26542	Mar. 21	V. slight.	V. slight.	.20	1.85	0.65	.0010	.0128	.0096	.0032	.11	.0050	.0001	.31	0.2
26939	Apr. 26	V. slight.	V. slight.	.35	2.00	1.00	.0000	.0112	.0108	.0004	.10	.0020	.0000	.50	0.0
27614	June 28	V. slight.	Cons.	.10	1.85	0.85	.0010	.0212	.0164	.0048	.12	.0000	.0000	.25	0.2
27899	July 26	Slight.	Slight.	.26	2.85	1.50	.0002	.0220	.0186	.0034	.12	.0020	.0000	.61	0.2
28336	Aug. 23	Slight.	Slight.	.04	1.95	0.70	.0006	.0158	.0140	.0018	.11	.0010	.0000	.17	0.3
28776	Sept. 27	V. slight.	Slight.	.16	2.65	1.15	.0006	.0162	.0152	.0010	.14	.0020	.0000	.35	0.2
29137	Oct. 25	Slight.	V. slight.	.03	1.95	0.85	.0010	.0198	.0174	.0024	.16	.0010	.0000	.28	0.2
29454	Nov. 22	V. slight.	V. slight.	.29	3.40	1.20	.0002	.0128	.0120	.0008	.20	.0000	.0000	.44	0.2
29806	Dec. 27	None.	V. slight.	.45	3.65	1.50	.0004	.0128	.0120	.0008	.22	.0030	.0000	.68	0.3

LEOMINSTER.

Chemical Examination of Water from Fall Brook, above the Fall Brook Reservoir — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1897	-	-	.61	3.01	1.49	.0006	.0135	.0126	.0009	.16	.0041	.0000	.60	0.5
-	1898	-	-	.46	2.54	1.30	.0005	.0129	.0114	.0015	.13	.0036	.0000	.50	0.6
-	1899	-	-	.20	2.45	1.03	.0006	.0151	.0129	.0022	.14	.0017	.0000	.38	0.2

NOTE to analyses of 1899: Odor, generally vegetable, sometimes none. —— The samples were collected from Fall Brook, as it enters the reservoir.

Chemical Examination of Water from Fall Brook Reservoir, Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26016	Jan. 24	Slight.	Cons.	.20	1.90	1.00	.0002	.0158	.0126	.0032	.12	.0010	.0000	.32	0.2
26284	Feb. 21	V. slight.	Slight.	.19	2.35	1.25	.0022	.0156	.0120	.0036	.14	.0010	.0000	.33	0.5
26543	Mar. 21	V. slight.	V. slight.	.18	1.95	0.70	.0014	.0116	.0100	.0016	.10	.0030	.0001	.31	0.2
26940	Apr. 26	V. slight	Slight.	.10	2.15	1.00	.0010	.0114	.0100	.0014	.13	.0040	.0001	.26	0.0
27220	May 24	V. slight.	Slight.	.12	1.85	0.80	.0006	.0152	.0134	.0018	.12	.0020	.0000	.26	0.0
27615	June 28	Slight.	Cons.	.08	2.10	1.15	.0008	.0180	.0142	.0038	.12	.0000	.0000	.27	0.2
27900	July 26	V. slight.	Slight.	.07	1.95	0.90	.0006	.0202	.0144	.0058	.18	.0030	.0000	.27	0.2
28337	Aug. 23	Slight.	Slight.	.05	1.95	0.65	.0008	.0168	.0140	.0028	.12	.0010	.0000	.21	0.3
28777	Sept. 27	Slight.	Slight.	.09	1.75	1.05	.0002	.0170	.0154	.0016	.14	.0010	.0000	.22	0.2
29138	Oct. 25	V. slight.	Slight.	.05	1.75	0.90	.0002	.0182	.0148	.0034	.16	.0010	.0000	.22	0.2
29455	Nov. 22	V. slight.	Slight.	.08	1.90	0.85	.0002	.0182	.0156	.0026	.13	.0000	.0000	.24	0.0
29807	Dec. 27	Slight.	Cons.	.10	1.75	0.85	.0000	.0152	.0138	.0014	.14	.0010	.0000	.26	0.2

Averages by Years.

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1897	-	-	.36	2.96	1.39	.0026	.0200	.0160	.0040	.20	.0033	.0000	.45	0.6
-	1898	-	-	.26	2.35	1.16	.0011	.0169	.0139	.0030	.16	.0037	.0001	.35	0.5
-	1899	-	-	.11	1.95	0.92	.0007	.0161	.0133	.0028	.13	.0015	.0000	.26	0.2

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none; in July, faintly unpleasant, becoming also fishy on heating. —— The samples were collected from the reservoir, at the gate-house, 1 foot beneath the surface.

LEOMINSTER.

Microscopical Examination of Water from Fall Brook Reservoir, Leominster.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	25	23	22	27	25	29	27	24	28	26	23	29
Number of sample,	26016	26284	26548	26940	27220	27615	27900	28337	28777	29138	29455	29807
PLANTS.												
Diatomaceæ,	77	58	4	64	354	64	163	110	944	210	145	54
Asterionella,	71	57	4	62	300	20	9	86	918	162	85	38
Synedra,	5	1	0	1	34	32	146	2	16	2	0	4
Tabellaria,	0	0	0	0	20	12	0	50	8	46	50	11
Cyanophyceæ, Anabæna,	0	0	0	0	0	0	0	0	4	16	20	2
Algæ,	2	0	0	1	9	2	0	8	2	0	0	0
ANIMALS.												
Infusoria,	29	1	6	17	64	107	98	172	587	20	5	68
Dinobryon,	1	0	1	10	56	0	93	150	576	12	0	64
Peridinium,	16	0	3	5	0	102	0	20	10	8	2	3
Vermes,	1	1	0	1	6	13	0	4	1	0	2	0
Crustacea,	0	0	0	0	pr.	pr.	0	pr.	pr.	pr.	0	0
Cyclops,	0	0	0	0	pr.	0	0	pr.	pr.	pr.	0	0
Daphnia,	0	0	0	0	0	pr.	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	3	5	3	8	8	12	5	15	0	7	8	5
TOTAL,	112	65	13	91	441	198	266	309	1,538	253	180	129

Chemical Examination of Water from Fall Brook Reservoir, Leominster, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26017	Jan. 24	Slight.	Slight.	.19	2.15	1.00	.0038	.0156	.0132	.0024	.13	.0020	.0000	.34	0.3
26285	Feb. 21	V. slight.	Slight.	.21	2.40	1.35	.0030	.0148	.0128	.0020	.14	.0020	.0000	.36	0.5
26544	Mar. 21	Slight.	Slight.	.20	2.40	1.05	.0026	.0192	.0152	.0040	.13	.0050	.0001	.31	0.2
26941	Apr. 26	V. slight.	Slight.	.10	2.00	1.00	.0006	.0116	.0098	.0018	.12	.0030	.0001	.29	0.2
27221	May 24	V. slight.	Slight.	.14	1.75	0.95	.0010	.0156	.0140	.0016	.12	.0050	.0000	.24	0.0
27616	June 28	Slight.	Cons.	.10	1.75	1.05	.0006	.0158	.0128	.0030	.11	.0000	.0000	.26	0.2
27901	July 26	V. slight.	Slight.	.07	2.60	1.20	.0000	.0156	.0146	.0010	.13	.0010	.0000	.28	0.3
28338	Aug. 23	Slight.	Slight.	.06	1.85	0.45	.0012	.0184	.0146	.0038	.12	.0020	.0000	.21	0.0
28778	Sept. 27	Slight.	Slight.	.04	1.75	1.00	.0012	.0196	.0150	.0046	.12	.0010	.0000	.26	0.2
29139	Oct. 25	Slight.	Slight.	.03	1.80	0.85	.0006	.0184	.0146	.0038	.16	.0060	.0000	.28	0.2
29456	Nov. 22	V. slight.	V. slight.	.10	1.90	0.85	.0001	.0184	.0164	.0020	.13	.0000	.0000	.23	0.0
29808	Dec. 27	Slight.	Cons.	.09	1.80	0.90	.0004	.0190	.0154	.0036	.15	.0010	.0000	.26	0.2
Av...	....	....	....	.11	2.01	0.97	.0013	.0168	.0140	.0028	.13	.0023	.0000	.28	0.2

Odor, faintly vegetable or none; in July, faintly unpleasant, becoming also fishy on heating. The odor of most of the samples became vegetable on heating.—— The samples were collected from the reservoir, near the gate-house, about 1 foot from bottom.

LEXINGTON.

WATER SUPPLY OF LEXINGTON.

Chemical Examination of Water from Vine Brook, above the Storage Reservoir of the Lexington Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26039	Jan. 25	Slight.	V. slight.	.39	3.55	1.45	.0020	.0194	.0172	.0022	.30	.0010	.0000	.52	0.6
26263	Feb. 20	Slight.	V. slight.	.22	4.40	1.80	.0066	.0244	.0214	.0030	.33	.0070	.0001	.52	1.0
26624	Mar. 30	Slight.	Slight.	.37	6.10	2.80	.0042	.0270	.0202	.0068	.34	.0210	.0004	.52	1.8
26982	Apr. 26	Slight.	Slight.	.40	4.25	2.25	.0008	.0270	.0226	.0044	.25	.0020	.0001	.68	0.6
27268	May 31	Slight.	Slight.	.51	4.85	2.10	.0092	.0230	.0202	.0028	.34	.0050	.0001	.50	1.1
27605	June 28	Slight.	Cons., earthy.	.20	4.40	1.35	.0148	.0212	.0124	.0088	.30	.0060	.0007	.27	1.4
27904	July 26	Decided.	Cons.	.57	7.50	2.80	.0086	.0362	.0286	.0076	.32	.0320	.0003	.90	3.1
28380	Aug. 28	Decided.	Cons., floc.	.36	5.80	2.15	.0015	.0705	.0375	.0330	.32	.0020	.0000	.60	1.8
28771	Sept. 27	Slight.	Cons.	.36	6.25	1.85	.0016	.0184	.0152	.0032	.47	.0060	.0000	.47	2.5
29133	Oct. 25	Slight.	Cons.	.48	6.00	1.70	.0008	.0264	.0160	.0104	.47	.0030	.0000	.55	2.0
29473	Nov. 22	Decided.	Cons.	.34	6.05	2.35	.0004	.0312	.0260	.0052	.39	.0010	.0000	.54	2.0
29786	Dec. 27	Decided.	Cons.	.30	6.05	2.65	.0015	.0345	.0215	.0130	.38	.0020	.0005	.70	1.7
Av...	....	....	....	.37	5.43	2.10	.0043	.0299	.0216	.0083	.35	.0078	.0002	.56	1.6

Odor in February, faintly mouldy and disagreeable; in August, offensive; at other times, faintly vegetable or none. On heating, the odor of all of the samples was vegetable, and sometimes musty or unpleasant.

Chemical Examination of Water from the Vine Brook Storage Reservoir, of the Lexington Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26040	Jan. 25	Slight.	V. slight.	.21	3.20	1.00	.0014	.0184	.0146	.0038	.25	.0010	.0001	0.38	0.8
26264	Feb. 20	Slight.	Slight.	.28	4.50	1.85	.0066	.0256	.0236	.0020	.32	.0040	.0002	0.58	1.0
26625	Mar. 30	Slight.	Cons.	.27	4.60	2.00	.0058	.0414	.0232	.0182	.32	.0080	.0000	0.52	1.1
26933	Apr. 26	Slight.	Slight.	.24	3.95	1.70	.0006	.0254	.0206	.0048	.28	.0020	.0002	0.48	0.8
27269	May 31	Decided.	Slight.	.20	4.00	1.90	.0004	.0344	.0236	.0108	.32	.0020	.0000	0.54	1.1
27606	June 28	Decided.	Cons.	.24	4.35	2.35	.0008	.0424	.0308	.0116	.32	.0000	.0000	0.78	1.3
27905	July 26	Decided.	Cons.	.24	5.55	2.95	.0000	.0440	.0312	.0128	.35	.0020	.0000	1.14	1.3
28381	Aug. 28	Decided.	Cons.	.33	6.10	3.80	.0005	.0530	.0365	.0165	.34	.0010	.0000	1.38	1.1
28772	Sept. 27	Decided.	Heavy.	.46	6.45	3.60	.0010	.0665	.0445	.0220	.36	.0040	.0000	1.19	1.4
29134	Oct. 25	Decided.	Cons.	.42	7.50	4.75	.0005	.0705	.0515	.0190	.32	.0020	.0000	1.28	1.3
29474	Nov. 22	Decided.	Heavy.	.36	6.70	3.80	.0010	.0585	.0445	.0140	.33	.0020	.0000	1.25	2.0
29787	Dec. 27	Decided.	Cons.	.35	5.95	3.00	.0015	.0440	.0280	.0160	.35	.0010	.0000	0.97	1.7
Av...	....	....	....	.30	5.24	2.72	.0017	.0437	.0311	.0126	.32	.0024	.0000	0.87	1.2

Odor, faintly vegetable or none; in May, disagreeable. A fishy and unpleasant odor was developed in many of the samples on heating.

LEXINGTON.

Microscopical Examination of Water from the Vine Brook Storage Reservoir of the Lexington Water Works.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	26	21	31	26	31	28	27	29	28	26	24	27
Number of sample,	26040	26264	26625	26938	27269	27606	27905	28381	28772	29134	29474	29787
PLANTS.												
Diatomaceæ,	1	1	0	58	1,356	222	92	56	48	22	6	8
Synedra,	1	1	0	42	1,336	218	74	56	48	16	6	6
Cyanophyceæ, Microcystis,	0	0	0	0	0	0	0	2	0	0	0	0
Algæ,	800	60	202	208	220	1,212	804	12,040	14,036	5,008	8,002	19,202
Protococcus,	800	60	200	200	100	1,200	792	12,000	14,000	5,000	8,000	19,200
Raphidium,	0	0	0	0	68	0	0	8	16	0	0	0
ANIMALS.												
Infusoria,	4	32	500	34	172	420	14	308	108	6	12	2
Ciliated infusorian,	0	0	0	0	0	0	0	12	0	0	0	0
Dinobryon,	0	28	460	28	8	0	0	0	0	0	0	0
Epistylis,	0	0	0	0	0	10	0	0	0	0	0	0
Monas,	0	0	20	0	0	0	14	0	0	0	0	2
Peridinium,	2	3	8	2	164	410	0	288	104	2	12	0
Vermes,	0	2	10	4	8	12	0	6	8	0	6	0
Anurea,	0	0	0	2	6	12	0	2	8	0	6	0
Polyarthra,	0	2	10	2	2	0	0	4	0	0	0	0
Crustacea, Cyclops,	0	0	0	0	0	0	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	0	5	7	25	10	7	10	30	14	5	6	6
TOTAL,	805	100	719	329	1,766	1,873	920	12,440	14,214	5,036	8,032	19,218

Chemical Examination of Water from the Wells of the Lexington Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26626	Mar. 30	V. slight.	None.	.38	7.80	.0282	.0162	.44	.0710	.0036	.50	3.8	.0080
27270	May 31	V. slight.	V. slight.	.38	6.30	.0014	.0114	.49	.0600	.0002	.41	2.5	.0060
27607	June 28	Decided.	Cons., earthy.	.21	8.20	.0010	.0116	.41	.0420	.0001	.36	3.3	.0300
27906	July 26	V. slight.	V. slight.	.09	8.10	.0000	.0060	.44	.0340	.0000	.15	3.6	.0050
28382	Aug. 28	V. slight.	V. slight.	.13	8.80	.0004	.0076	.46	.0230	.0000	.21	3.8	.0130
28773	Sept. 27	Decided.	Slight.	.22	7.80	.0024	.0086	.51	.0220	.0026	.22	4.3	.0200
29135	Oct. 25	V. slight.	V. slight.	.17	8.20	.0014	.0052	.47	.0410	.0000	.17	4.0	.0050
29475	Nov. 22	None.	None.	.14	9.40	.0000	.0092	.54	.0720	.0000	.29	4.3	.0090
29788	Dec. 27	V. slight.	None.	.15	11.00	.0014	.0104	.53	.0490	.0000	.38	4.6	.0030
Av...	....	....	....	.21	8.40	.0040	.0096	.48	.0482	.0007	.30	3.8	.0110

Odor of the first sample, faintly disagreeable; of the others, none. A faintly unpleasant odor was developed in the third sample on heating.—The samples were collected from a faucet in the pumping station, and represent water from the wells before it has passed through the mechanical filter.

LEXINGTON.

Chemical Examination of Water from the Wells of the Lexington Water Works, after passing through a Mechanical Filter.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
26627	Mar. 30	V. slight.	V. slight.	.60	7.50	.0006	.0158	.54	.1600	.0000	.64	3.0	.0150
27271	May 31	V. slight.	None.	.31	7.70	.0002	.0110	.48	.0600	.0003	.38	3.0	.0050
27608	June 28	V. slight.	V. slight.	.11	7.70	.0000	.0080	.44	.0580	.0000	.20	3.1	.0090
27907	July 26	None.	None.	.06	7.30	.0000	.0054	.44	.0350	.0000	.14	3.5	.0030
28383	Aug. 28	V. slight.	None.	.05	8.50	.0004	.0064	.46	.0240	.0000	.18	3.5	.0020
28774	Sept. 27	V. slight.	None.	.10	8.60	.0002	.0066	.52	.0380	.0000	.19	4.3	.0030
29136	Oct. 25	V. slight.	V. slight.	.02	7.90	.0010	.0046	.49	.0340	.0000	.12	3.9	.0050
29476	Nov. 22	V. slight.	V. slight.	.30	9.70	.0002	.0120	.54	.1000	.0001	.43	4.3	.0210
29789	Dec. 27	V. slight.	None.	.47	11.60	.0020	.0132	.55	.0620	.0000	.49	4.7	.0050
Av...	....	....	....	.22	8.50	.0005	.0092	.50	.0657	.0000	.31	3.7	.0076

Odor of the first sample, faintly vegetable; of the others, none. — The samples were collected from a tap at the pumping station, and represent water from the wells that has passed through the mechanical filter.

Water Supply of Lincoln.

(See *Concord.*)

Water Supply of Lowell.

The advice of the State Board of Health to the city of Lowell, with reference to the presence of lead in the water drawn through lead service pipes in that city, and the effect upon the health of the people using the water, may be found on pages 23 to 26 of this volume.

The advice of the Board to the city of Lowell, relative to taking water from certain sources in the vicinity of the city, may be found on pages 26 to 28 of this volume.

LOWELL.

Chemical Examination of Water from the Merrimack River above Lowell.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25961	Jan. 17	Decided.	Cons.	.32	3.10	1.50	.0042	.0166	.0126	.0040	.18	.0060	.0001	.45	0.6
26217	Feb. 14	Slight.	V. slight.	.22	3.50	1.35	.0072	.0138	.0118	.0020	.19	.0070	.0001	.37	1.1
26471	Mar. 14	Decided.	Cons.	.33	3.05	1.35	.0038	.0196	.0134	.0062	.12	.0040	.0001	.44	0.5
26720	Apr. 11	Slight.	Slight.	.30	2.30	1.10	.0010	.0158	.0132	.0026	.08	.0060	.0001	.42	0.5
27110	May 16	Slight.	Slight.	.29	2.95	1.10	.0022	.0152	.0128	.0024	.10	.0110	.0001	.42	0.5
27495	June 20	Slight.	Cons.	.18	3.25	1.10	.0010	.0210	.0152	.0058	.16	.0030	.0001	.31	1.1
27843	July 20	V. slight.	Slight.	.15	3.30	0.95	.0020	.0244	.0166	.0078	.22	.0080	.0003	.38	1.1
28215	Aug. 15	V. slight.	V. slight.	.23	4.15	1.75	.0058	.0176	.0146	.0030	.17	.0040	.0002	.36	0.8
28661	Sept. 19	Slight.	Slight.	.15	3.70	1.85	.0046	.0222	.0180	.0042	.28	.0050	.0003	.27	1.4
29029	Oct. 16	V. slight.	V. slight.	.20	4.20	1.40	.0088	.0176	.0164	.0012	.24	.0060	.0004	.44	1.3
29383	Nov. 14	Slight.	Slight.	.28	4.20	1.65	.0080	.0204	.0190	.0014	.24	.0070	.0002	.51	1.3
29726	Dec. 20	Decided.	Slight.	.62	4.55	1.95	.0120	.0204	.0192	.0012	.22	.0050	.0001	.72	1.0

Averages by Years.

-	1888	-	-	.30	3.42	0.97	.0016	.0148	-	-	.16	.0099	.0002	-	-
-	1889	-	-	.28	2.95	0.84	.0018	.0149	.0126	.0023	.14	.0071	.0002	-	-
-	1890	-	-	.30	3.57	1.54	.0014	.0128	.0104	.0024	.13	.0111	.0001	-	1.4
-	1891	-	-	.29	3.43	1.23	.0017	.0129	.0100	.0029	.13	.0137	.0001	-	1.2
-	1892	-	-	.39	3.61	1.36	.0021	.0141	.0113	.0028	.14	.0092	.0001	-	1.3
-	1893	-	-	.33	3.39	1.18	.0026	.0149	.0120	.0029	.17	.0083	.0001	.44	1.1
-	1894	-	-	.35	3.55	1.26	.0034	.0135	.0109	.0026	.18	.0063	.0001	.40	1.1
-	1895	-	-	.41	3.84	1.46	.0039	.0187	.0140	.0047	.21	.0066	.0001	.54	1.2
-	1896	-	-	.40	3.47	1.28	.0034	.0167	.0136	.0031	.17	.0070	.0001	.52	1.0
-	1897	-	-	.50	3.54	1.46	.0030	.0177	.0153	.0024	.15	.0067	.0001	.52	1.0
-	1898	-	-	.42	3.53	1.56	.0026	.0173	.0150	.0023	.17	.0048	.0001	.49	1.0
-	1899	-	-	.27	3.60	1.42	.0050	.0187	.0152	.0035	.18	.0060	.0002	.42	0.9

Note to analyses of 1899: Odor, generally vegetable, sometimes musty or unpleasant. —— The samples were collected from the river, opposite the intake of the Lowell water works. For a comparison of the analyses of the river at Lowell and Lawrence for a series of years, see "Merrimack River," in the chapter on "Examination of Rivers," in a subsequent portion of this report. The river has not been used directly as a source of water supply during the year.

LOWELL.

Chemical Examination of Water from Tubular Wells in the Valley of River Meadow Brook, a Short Distance above Plain Street.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25063	Jan. 17	V. slight.	V. slight.	.05	8.70	.0006	.0028	.51	.0430	.0001	.10	3.6	.0040
26219	Feb. 14	None.	V. slight.	.05	8.70	.0006	.0028	.50	.0370	.0003	.08	3.6	.0100
26473	Mar. 14	Slight.	Slight.	.12	8.60	.0018	.0036	.46	.0030	.0001	.13	3.4	.0230
26718	Apr. 11	V. slight.	V. slight.	.08	8.50	.0018	.0044	.44	.0240	.0000	.11	3.3	.0100
27112	May 16	V. slight.	None.	.10	8.30	.0030	.0046	.43	.0200	.0001	.18	3.3	.0120
27497	June 20	V. slight.	V. slight.	.10	8.80	.0020	.0042	.40	.0080	.0000	.13	3.3	.0080
27534	June 21	V. slight, milky.	V. slight.	.09	8.80	.0024	.0048	.43	.0170	.0000	.14	3.3	.0180
27585	June 26	V. slight.	V. slight.	.08	8.20	.0028	.0056	.45	.0240	.0001	.15	3.1	.0180
28663	Sept. 19	V. slight.	V. slight.	.10	8.90	.0006	.0064	.50	.0340	.0000	.08	3.3	.0100
29031	Oct. 16	V. slight.	None.	.04	8.30	.0006	.0040	.54	.0350	.0000	.11	3.5	.0060
29336	Nov. 14	Slight.	Slight.	.11	8.10	.0042	.0064	.44	.0160	.0001	.15	3.3	.0210
29728	Dec. 20	V. slight.	V. slight.	.04	8.80	.0044	.0048	.48	.0160	.0001	.11	3.5	.0290

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1894	-	-	.02	7.33	.0003	.0014	.55	.0549	.0002	.02	2.8	.0078
-	1895	-	-	.02	9.22	.0001	.0024	.56	.0323	.0002	.05	3.8	.0119
-	1896	-	-	.02	8.37	.0002	.0025	.53	.0507	.0000	.09	3.8	.0068
-	1897	-	-	.02	8.71	.0008	.0035	.55	.0378	.0001	.08	3.7	.0041
-	1898	-	-	.06	9.02	.0002	.0038	.56	.0302	.0000	.10	3.9	.0066
-	1899*	-	-	.08	8.55	.0020	.0045	.47	.0248	.0000	.12	3.4	.0139

NOTE to analyses of 1899: Odor, none.——No. 27534 was collected from a faucet at the pumping station, and the others from the wells which are locally known as the "Cook" wells.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Tubular Wells in the Valley of River Meadow Brook, a Short Distance above the Old Middlesex Canal in Chelmsford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
26230	Feb. 14	V. slight.	V. slight.	.20	8.60	.0090	.0066	.36	.0070	.0001	.28	3.4	.0480
27834	July 19	Slight.	Slight.	.12	9.20	.0026	.0068	.42	.0220	.0001	.19	3.3	.0280
28217	Aug. 15	V. slight.	None.	.16	8.40	.0072	.0042	.36	.0070	.0000	.17	3.1	.0410

LOWELL.

Chemical Examination of Water from Tubular Wells in the Valley of River Meadow Brook, a Short Distance above the Old Middlesex Canal in Chelmsford — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1895	-	-	.12	9.42	.0020	.0017	.31	.0073	.0000	.05	3.9	.0673
-	1896	-	-	.10	11.50	.0064	.0047	.32	.0071	.0001	.13	5.0	.0697
-	1897	-	-	.20	10.35	.0060	.0058	.35	.0058	.0000	.16	4.8	.0488
-	1898	-	-	.28	8.79	.0069	.0073	.36	.0049	.0001	.25	3.6	.0429
-	1899	-	-	.19	8.73	.0063	.0059	.38	.0120	.0001	.21	3.3	.0390

NOTE to analyses of 1899: Odor, none. —— The samples were collected from the wells which are locally known as the "Hydraulic" wells.

Chemical Examination of Water from Tubular Wells in the Valley of the Merrimack River near the Pawtucket Boulevard.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25962	Jan. 17	V. slight.	V. slight.	.12	4.80	.0076	.0028	.26	.0190	.0000	.06	2.0	.0380
26218	Feb. 14	Slight.	Slight.	.17	4.70	.0106	.0024	.26	.0160	.0001	.08	2.0	.0400
26472	Mar. 14	None.	V. slight.	.18	4.80	.0094	.0024	.28	.0180	.0001	.06	1.7	.0550
26721	Apr. 11	V. slight.	Slight.	.20	4.50	.0104	.0026	.27	.0280	.0000	.06	1.7	.0300
27111	May 16	Slight, milky.	Slight.	.11	4.90	.0162	.0026	.28	.0390	.0001	.08	1.8	.0680
27496	June 20	V. slight.	V. slight.	.16	4.40	.0094	.0032	.26	.0180	.0001	.07	1.3	.0200
27530	June 21	V. slight, milky.	V. slight.	.11	4.50	.0088	.0030	.24	.0230	.0001	.10	1.4	.0300
27584	June 26	V. slight.	V. slight.	.12	5.00	.0104	.0036	.28	.0120	.0001	.10	1.4	.0200
27833	July 19	Slight.	V. slight.	.11	4.40	.0104	.0040	.26	.0180	.0002	.10	1.3	.0200
28216	Aug. 15	Slight.	Slight.	.12	4.00	.0094	.0038	.25	.0200	.0002	.14	1.3	.0450
28662	Sept. 19	Slight.	V. slight.	.16	4.60	.0108	.0058	.29	.0170	.0002	.09	1.7	.0200
29080	Oct. 16	Slight, milky.	Slight.	.12	4.50	.0092	.0028	.31	.0220	.0001	.09	1.7	.0400
29384	Nov. 14	V. slight.	V. slight.	.09	4.50	.0100	.0050	.31	.0150	.0001	.08	1.7	.0370
29727	Dec. 20	V. slight.	V. slight.	.07	4.40	.0100	.0030	.31	.0140	.0000	.08	1.8	.0490

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1896	-	-	.01	4.36	.0044	.0019	.30	.0452	.0001	.04	1.8	.0098
-	1897	-	-	.09	4.55	.0096	.0032	.24	.0255	.0001	.05	1.3	.0222
-	1898	-	-	.13	4.43	.0105	.0030	.27	.0247	.0000	.08	1.9	.0310
-	1899*	-	-	.13	4.56	.0103	.0034	.28	.0208	.0001	.08	1.7	.0388

NOTE to analyses of 1899: Odor, none. —— No. 27530 was collected from a faucet at the pumping station and the others from the wells which are locally known as the "Boulevard" wells.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

LOWELL.

Chemical Examination of Water from Pumping Station Number 1 of the Lowell Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25964	Jan. 17	V. slight.	V. slight.	.06	4.90	.0070	.0022	.33	.0710	.0000	.05	2.3	.0100
26474	Mar. 14	V. slight.	V. slight.	.11	6.00	.0074	.0016	.30	.0290	.0001	.04	2.2	.0380
26719	Apr. 11	V. slight.	V. slight.	.10	4.80	.0078	.0030	.31	.0590	.0000	.07	2.0	.0220
27113	May 16	Slight.	Slight.	.22	6.00	.0130	.0028	.30	.0420	.0001	.07	2.0	.0400
27498	June 20	V. slight.	V. slight.	.11	4.70	.0070	.0034	.24	.0330	.0001	.08	2.0	.0100
27531	June 21	Slight, milky.	V. slight.	.10	4.30	.0060	.0034	.26	.0140	.0001	.09	1.4	.0280
27844	July 20	Slight, milky.	Slight.	.14	4.60	.0080	.0054	.28	.0220	.0001	.12	1.3	.0300
28218	Aug. 15	V. slight.	V. slight.	.11	4.40	.0074	.0038	.26	.0140	.0003	.14	1.4	.0380
28664	Sept. 19	Slight.	Cons.	.20	4.40	.0070	.0050	.29	.0230	.0003	.10	1.7	.0180
29032	Oct. 16	Slight, milky.	Slight.	.08	4.50	.0068	.0040	.32	.0200	.0002	.09	1.7	.0460
29386	Nov. 14	Slight.	Slight.	.18	4.40	.0070	.0044	.31	.0200	.0001	.09	1.7	.0180
29729	Dec. 20	V. slight.	V. slight.	.10	4.40	.0066	.0036	.32	.0200	.0001	.07	1.8	.0200
Av.*.	....	....	....	.12	4.81	.0077	.0036	.30	.0312	.0001	.08	1.8	.0272

Odor, none. A faintly unpleasant odor was developed in the first sample on heating.—— The samples were collected from a tap at the pumping station, and represent water from the Boulevard wells.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Faucets supplied from the Lowell Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27532	June 21	V. slight, milky.	V. slight.	.08	5.80	.0034	.0034	.27	.0290	.0001	.08	1.4	.0150
27533	June 21	V. slight, milky.	V. slight.	.10	5.50	.0018	.0040	.27	.0200	.0001	.09	1.4	.0230
27535	June 21	None.	None.	.02	7.90	.0000	.0034	.43	.0120	.0000	.14	3.3	.0020
27536	June 21	V. slight, milky.	V. slight.	.10	4.00	.0034	.0038	.27	.0280	.0000	.10	1.8	.0260
27537	June 21	V. slight, milky.	V. slight.	.08	9.00	.0004	.0040	.44	.0120	.0000	.14	3.1	.0100
27586	June 26	Slight, milky.	V. slight.	.13	4.00	.0014	.0026	.26	.0290	.0001	.09	1.4	.0500
27587	June 26	Slight, milky.	V. slight.	.08	4.00	.0002	.0042	.26	.0170	.0000	.10	1.4	.0160
28480	Sept. 5	V. slight.	Cons.	.08	5.20	.0004	.0092	.26	.0190	.0001	.12	1.7	.0780
28481	Sept. 5	Slight.	V. slight.	.05	4.40	.0010	.0070	.29	.0190	.0001	.08	1.7	.0730
28482	Sept. 5	None.	None.	.06	9.20	.0000	.0036	.49	.0250	.0001	.09	3.1	.0020
28483	Sept. 5	None.	None.	.07	8.50	.0000	.0042	.50	.0230	.0001	.09	3.1	.0090
28484	Sept. 5	None.	None.	.10	4.70	.0016	.0048	.32	.0150	.0001	.09	1.4	.0100

Odor, none.—— The samples were collected from faucets in various parts of the city.

LOWELL.

Chemical Examination of Water from Beaver Brook and its Tributaries.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
29580	Dec. 5	V. slight.	Slight.	.46	4.75	1.85	.0006	.0190	.0182	.0008	.26	.0150	.0000	.71	1.7
29499	Nov. 27	V. slight.	V. slight.	.50	5.60	1.95	.0004	.0230	.0210	.0020	.30	.0110	.0001	.59	2.0
29502	Nov. 27	V. slight.	V. slight.	.38	5.50	1.90	.0006	.0202	.0198	.0004	.27	.0050	.0001	.62	1.8
29501	Nov. 27	V. slight.	None.	.04	2.25	0.85	.0008	.0158	.0154	.0004	.22	.0010	.0000	.18	1.0
29500	Nov. 27	V. slight.	V. slight.	.20	3.90	1.55	.0000	.0192	.0184	.0008	.17	.0020	.0001	.61	1.0

Odor of No. 29501, distinctly earthy; of the others, faintly vegetable, becoming distinctly vegetable on heating. —— The first sample was collected from Beaver Brook, just below the village of Derry, N. H.; the second, from the brook, just below the village of Pelham, N. H.; the third, from a point just above the village of Collinsville, in Dracut; the fourth, from Corbett's Pond, one of the tributaries of Beaver Brook; the last, from a brook flowing from Gumpus Pond, at a point about 2 miles below the outlet of the pond.

Chemical Examination of Water from Forge Pond and Other Tributaries of Stony Brook.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
29541	Nov. 29	V. slight.	V. slight	.53	6.65	2.10	.0006	.0210	.0192	.0018	.38	.0060	.0001	.69	2.3
29543	Nov. 29	V. slight.	Slight.	.20	4.25	1.80	.0012	.0178	.0168	.0010	.24	.0010	.0001	.43	1.7
29544	Nov. 29	V. slight.	V. slight.	.03	2.60	1.15	.0002	.0174	.0162	.0012	.16	.0010	.0000	.23	1.0
29542	Nov. 29	Slight.	Cons.	.18	2.35	0.95	.0000	.0190	.0144	.0046	.17	.0010	.0001	.36	0.5

Odor of the first sample, faintly vegetable, becoming distinctly vegetable on heating; of the others, none, becoming very faintly vegetable on heating. —— The samples were collected from tributaries of Stony Brook, as follows: the first, from Beaver Brook, in Westford, a short distance above Forge Pond; the second, from Forge Pond, at its outlet; the third, from Long-sought-for Pond; the last, from Nabnasset Pond.

The advice of the State Board of Health to the Lowell Bleachery and Dye Works, with reference to the use of water of the Concord River after filtration through mechanical filters for drinking pur-

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poses, may be found on pages 28 and 29 of this volume. The results of analyses of samples of water before and after filtration are given in the following table: —

Chemical Examination of Water before and after passing through the Mechanical Filters at the Lowell Bleachery and Dye Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27291	May 31	V. slight.	Slight.	.56	5.00	.0096	.0266	.33	.0080	.0001	.60	1.3	-
27292	May 31	V. slight.	Slight.	.03	4.90	.0088	.0154	.36	.0060	.0001	.13	1.3	.0060
27293	May 31	None.	None.	.02	5.00	.0074	.0086	.39	.0080	.0001	.15	1.3	.0010
27294	May 31	None.	None.	.02	5.20	.0076	.0088	.39	.0060	.0001	.16	1.4	.0020

Odor of the first two samples, faintly vegetable; of the last two, faintly musty or earthy. —— The first sample represents unfiltered water; the second, water which has received alum and has passed through the settling tank; the last two represent water which has passed through the filters.

Water Supply of Ludlow.

(See *Springfield.*)

Water Supply of Lynn and Saugus.

Chemical Examination of Water from Breed's Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25904	Jan. 10	V. slight.	V. slight.	.46	3.85	1.60	.0018	.0176	.0166	.0010	.54	.0020	.0000	.63	0.8
26170	Feb. 6	V. slight.	V. slight.	.42	3.65	1.60	.0016	.0130	.0118	.0012	.43	.0030	.0001	.55	1.0
26397	Mar. 7	Slight.	Slight.	.30	3.15	1.35	.0098	.0164	.0122	.0042	.42	.0040	.0002	.45	0.5
26722	Apr. 10	V. slight.	V. slight.	.33	3.55	1.70	.0036	.0312	.0292	.0020	.46	.0030	.0001	.47	0.6
27040	May 8	Slight.	Slight.	.29	2.85	1.15	.0010	.0220	.0186	.0034	.38	.0020	.0000	.42	0.5
27433	June 13	Slight.	V. slight.	.24	2.90	1.40	.0052	.0222	.0192	.0030	.39	.0030	.0000	.49	0.8
27733	July 11	Slight.	Slight.	.20	3.10	1.05	.0020	.0226	.0196	.0030	.36	.0020	.0000	.47	0.5
28087	Aug. 8	V. slight.	V. slight.	.22	3.40	1.25	.0004	.0234	.0194	.0040	.43	.0030	.0000	.45	0.5
28565	Sept. 11	Slight.	Slight.	.27	3.75	1.80	.0056	.0328	.0258	.0070	.43	.0030	.0000	.42	0.8
28957	Oct. 10	Slight.	Slight.	.29	2.75	1.25	.0044	.0256	.0220	.0036	.47	.0010	.0000	.49	0.8
29288	Nov. 7	Slight.	V. slight.	.30	3.20	1.20	.0054	.0254	.0222	.0032	.41	.0010	.0000	.37	0.5
29626	Dec. 12	V. slight.	V. slight.	.34	3.50	1.35	.0038	.0352	.0324	.0028	.48	.0040	.0000	.44	0.8

LYNN AND SAUGUS.

Chemical Examination of Water from Breed's Pond, Lynn — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
-	1888	-	-	.48	3.71	1.42	.0029	.0227	-	-	.45	.0058	.0001	-	-
-	1889	-	-	.45	3.09	1.02	.0007	.0208	.0165	.0043	.41	.0085	.0001	-	-
-	1890	-	-	.42	3.62	1.51	.0014	.0196	.0155	.0041	.41	.0052	.0001	-	1.1
-	1891	-	-	.35	3.35	1.37	.0009	.0156	.0131	.0025	.40	.0080	.0001	-	0.8
-	1892	-	-	.43	3.65	1.38	.0004	.0220	.0177	.0043	.49	.0055	.0000	-	1.0
-	1893	-	-	.65	3.61	1.41	.0039	.0214	.0181	.0033	.55	.0054	.0001	.51	1.1
-	1894	-	-	.65	3.77	1.47	.0023	.0225	.0191	.0034	.58	.0082	.0000	.53	0.9
-	1895	-	-	.48	3.75	1.48	.0016	.0199	.0171	.0028	.58	.0086	.0001	.50	0.9
-	1896	-	-	.39	3.57	1.36	.0023	.0181	.0152	.0029	.52	.0019	.0001	.47	0.7
-	1897	-	-	.43	4.18	1.45	.0025	.0204	.0170	.0034	.58	.0036	.0000	.47	1.0
-	1898	-	-	.46	3.48	1.54	.0022	.0198	.0172	.0026	.49	.0012	.0001	.53	0.8
-	1899	-	-	.30	3.30	1.39	.0037	.0239	.0207	.0032	.43	.0026	.0000	.47	0.7

NOTE to analyses of 1899: Odor, in May, faintly fishy and oily, becoming stronger on heating; at other times, vegetable.

Microscopical Examination of Water from Breed's Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	8	8	12	10	15	13	9	13	12	9	13
Number of sample,	25904	26170	26397	26722	27040	27433	27733	28087	28565	28957	29288	29626
PLANTS.												
Diatomaceæ,	7	5	0	22	72	275	216	154	362	266	13	22
Asterionella,	6	4	0	8	48	216	134	108	186	30	6	8
Tabellaria,	0	0	0	1	16	44	22	12	174	210	4	8
Cyanophyceæ, Anabæna,	0	0	0	0	14	3	0	176	38	6	0	0
Algæ,	0	0	0	0	0	5	14	78	26	22	0	0
ANIMALS.												
Infusoria,	4	7	2	9	135	25	34	19	14	2	1	37
Dinobryon,	4	0	0	0	114	21	28	0	4	0	0	36
Raphidomonas,	0	0	0	0	0	2	0	1	10	0	0	0
Uroglena,	0	0	0	1	16	0	0	0	0	0	0	0
Vermes,	0	1	1	0	2	3	0	3	12	6	0	0
Anuræa,	0	1	1	0	0	1	0	0	12	4	0	0
Crustacea,	0	0	pr.	0	0	pr.	0	pr.	pr.	0	0	pr.
Bosmina,	0	0	0	0	0	0	0	pr.	0	0	0	0
Cyclops,	0	0	0	0	0	pr.	0	0	pr.	0	0	pr.
Daphnia,	0	0	pr.	0	0	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	3	15	10	7	7	7	7	5	10	3	3
TOTAL,	11	16	18	41	230	318	271	437	455	312	17	62

LYNN AND SAUGUS.

Chemical Examination of Water from Birch Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25940	Jan. 12	V. slight.	V. slight.	.10	3.90	1.75	.0020	.0164	.0134	.0030	.53	.0010	.0002	.31	1.1
26169	Feb. 6	V. slight.	V. slight.	.11	3.45	1.45	.0022	.0148	.0112	.0036	.46	.0010	.0000	.30	1.4
26396	Mar. 7	V. slight.	V. slight.	.11	2.50	0.90	.0112	.0152	.0120	.0032	.38	.0020	.0002	.25	0.6
26723	Apr. 10	Slight.	V. slight.	.14	3.45	1.60	.0056	.0186	.0166	.0020	.42	.0020	.0002	.29	0.5
27039	May 8	Slight.	V. slight.	.11	2.75	1.15	.0006	.0164	.0150	.0014	.41	.0010	.0001	.23	0.8
27432	June 13	V. slight.	Slight.	.09	2.85	1.15	.0016	.0166	.0142	.0024	.44	.0030	.0000	.30	0.6
27732	July 11	Slight.	Slight.	.12	3.10	0.90	.0016	.0210	.0186	.0024	.40	.0020	.0000	.33	0.6
28086	Aug. 8	V. slight.	V. slight.	.16	3.30	0.65	.0014	.0220	.0180	.0040	.49	.0020	.0000	.34	1.1
28564	Sept. 11	V. slight.	Slight.	.26	4.05	2.05	.0024	.0256	.0214	.0042	.45	.0050	.0000	.34	1.0
28956	Oct. 10	Slight.	V. slight.	.33	3.25	1.50	.0060	.0340	.0294	.0046	.46	.0010	.0001	.50	0.6
29287	Nov. 7	Slight.	Slight.	.37	3.35	1.25	.0050	.0292	.0266	.0026	.46	.0060	.0001	.39	0.6
29625	Dec. 12	Slight.	Slight.	.58	6.65	2.60	.0036	.0408	.0364	.0044	.57	.0090	.0000	.76	2.9

Averages by Years.

-	1888	-	-	.33	3.48	1.40	.0026	.0287	-	-	.45	.0032	.0001	-	-
-	1889	-	-	.23	2.96	1.14	.0014	.0241	.0190	.0051	.41	.0048	.0001	-	-
-	1890	-	-	.36	3.57	1.35	.0013	.0227	.0179	.0048	.42	.0038	.0001	-	1.0
-	1891	-	-	.42	3.26	1.30	.0005	.0241	.0183	.0058	.40	.0065	.0001	-	0.7
-	1892	-	-	.48	3.78	1.56	.0016	.0299	.0227	.0072	.47	.0092	.0001	-	1.0
-	1893	-	-	.75	4.21	1.63	.0052	.0299	.0218	.0081	.51	.0059	.0001	.53	1.0
-	1894	-	-	.75	4.47	1.88	.0053	.0292	.0242	.0050	.57	.0076	.0001	.63	1.1
-	1895	-	-	.60	5.05	2.12	.0031	.0294	.0222	.0072	.70	.0063	.0001	.62	1.4
-	1896	-	-	.45	4.22	1.65	.0018	.0243	.0208	.0035	.58	.0047	.0001	.55	1.1
-	1897	-	-	.50	4.79	1.86	.0029	.0268	.0229	.0039	.65	.0061	.0001	.52	1.6
-	1898	-	-	.28	3.50	1.42	.0017	.0207	.0173	.0034	.55	.0040	.0000	.34	1.0
-	1899	-	-	.21	3.55	1.41	.0036	.0225	.0194	.0031	.46	.0033	.0001	.36	1.0

NOTE to analyses of 1899: Odor, vegetable and occasionally grassy.

LYNN AND SAUGUS.

Microscopical Examination of Water from Birch Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	14	8	8	12	10	15	13	9	13	12	9	12
Number of sample,	25940	26160	26396	26723	27039	27432	27782	28066	28564	28956	29287	29626
PLANTS.												
Diatomaceæ,	0	17	4	3	124	234	60	78	382	111	102	105
Asterionella,	0	4	3	0	0	18	0	72	264	14	5	10
Cyclotella,	0	5	0	3	0	210	56	0	4	4	5	4
Stephanodiscus,	0	0	1	0	110	0	0	0	0	0	0	0
Synedra,	0	0	0	0	4	3	0	2	0	0	3	74
Tabellaria,	0	8	0	0	10	2	4	4	114	86	82	16
Cyanophyceæ,	0	0	0	0	0	3	8	78	164	10	59	0
Anabæna,	0	0	0	0	0	3	4	70	92	10	50	0
Merismopœdia,	0	0	0	0	0	0	0	0	72	0	0	0
Algæ,	0	0	0	0	1	15	0	84	42	18	2	12
ANIMALS.												
Rhizopoda,	0	0	0	0	0	1	0	0	2	0	0	0
Infusoria,	0	20	4	7	20	3	2	14	38	9	6	21
Dinobryon,	0	0	1	0	0	1	2	2	26	0	0	0
Mallomonas,	0	0	1	1	18	0	0	2	4	0	1	0
Peridinium,	0	11	1	5	2	0	0	2	0	2	2	1
Uroglena,	0	0	0	0	0	0	0	0	0	0	0	pr.
Vermes,	0	1	2	0	2	0	4	6	2	2	1	4
Crustacea,	0	0	pr.	0	0	0	0	pr.	pr.	0	0	pr.
Cyclops,	0	0	pr.	0	0	0	0	pr.	pr.	0	0	pr.
Daphnia,	0	0	pr.	0	0	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	3	12	7	10	5	3	7	8	7	3	7
TOTAL,	0	41	22	17	157	261	77	267	638	157	178	149

LYNN AND SAUGUS.

Chemical Examination of Water from Walden Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25908	Jan. 10	V. slight.	Slight.	0.60	3.70	2.20	.0006	.0222	.0188	.0034	.36	.0010	.0000	.75	0.6
26174	Feb. 6	Slight.	Slight.	0.44	3.50	1.70	.0014	.0206	.0164	.0042	.38	.0010	.0001	.58	1.0
26401	Mar. 7	Slight.	V. slight.	0.40	2.90	1.25	.0136	.0174	.0146	.0028	.32	.0020	.0002	.59	0.8
26727	Apr. 10	V. slight.	Slight.	0.43	2.60	0.90	.0012	.0212	.0166	.0046	.30	.0080	.0001	.54	0.6
27044	May 8	V. slight.	V. slight.	0.22	2.75	1.00	.0010	.0218	.0164	.0054	.29	.0010	.0000	.35	0.2
27437	June 13	Slight.	Cons.	0.26	2.75	1.10	.0036	.0292	.0210	.0082	.33	.0010	.0000	.45	0.6
27737	July 11	Slight.	Cons.	0.35	2.70	1.40	.0064	.0296	.0224	.0072	.34	.0020	.0000	.55	0.5
28091	Aug. 8	Slight.	Slight.	0.44	3.15	1.50	.0004	.0352	.0244	.0108	.37	.0020	.0000	.60	0.5
28569	Sept. 11	Decided.	Cons., earthy.	0.49	3.55	2.00	.0048	.0544	.0380	.0164	.38	.0040	.0000	.68	0.5
28961	Oct. 10	Decided.	Slight.	0.53	3.25	2.10	.0040	.0440	.0350	.0090	.33	.0010	.0000	.76	0.3
29292	Nov. 7	Decided.	Cons.	0.95	3.60	1.95	.0082	.0604	.0520	.0084	.34	.0010	.0000	.84	0.3
29630	Dec. 12	Decided.	Cons.	0.86	4.00	1.90	.0054	.0484	.0436	.0048	.33	.0090	.0000	.75	0.3

Averages by Years.

-	1890	-	-	1.06	4.98	2.53	.0292	.0432	.0351	.0081	.34	.0057	.0001	-	1.1
-	1891	-	-	1.21	4.32	2.20	.0058	.0615	.0403	.0212	.34	.0091	.0001	-	0.7
-	1892	-	-	0.90	4.81	2.50	.0094	.0626	.0383	.0243	.41	.0116	.0001	-	0.6
-	1893	-	-	0.92	4.33	2.40	.0066	.0470	.0309	.0161	.44	.0047	.0001	.80	0.7
-	1896	-	-	0.68	3.45	1.57	.0031	.0296	.0255	.0041	.40	.0017	.0000	.76	0.5
-	1897	-	-	0.77	4.03	1.88	.0040	.0355	.0282	.0073	.45	.0044	.0001	.67	0.8
-	1898	-	-	0.63	3.57	1.81	.0010	.0298	.0248	.0050	.39	.0031	.0000	.66	0.6
-	1899	-	-	0.50	3.20	1.58	.0038	.0337	.0266	.0071	.34	.0023	.0000	.62	0.5

NOTE to analyses of 1899: Odor, generally faintly vegetable and sometimes unpleasant. A fishy odor was developed in the January and September samples on heating.

LYNN AND SAUGUS.

Microscopical Examination of Water from Walden Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	8	8	12	10	15	18	9	18	12	9	18
Number of sample,	25908	26174	26401	26727	27044	27437	27737	28091	28569	28961	29292	29680
PLANTS.												
Diatomaceæ,	0	1	0	30	174	2,550	804	1,058	2,212	482	288	49
Asterionella,	0	0	0	24	20	10	0	68	714	58	8	0
Cyclotella,	0	0	0	4	0	0	20	106	22	14	0	0
Melosira,	0	0	0	0	28	60	64	136	240	90	182	11
Synedra,	0	0	0	0	6	2,400	684	696	1,150	306	110	30
Tabellaria,	0	1	0	2	120	80	36	84	82	8	16	6
Cyanophyceæ,	0	0	0	2	2	0	0	4	4	4	10	0
Algæ,	0	0	0	0	0	9	18	223	150	54	86	11
Protococcus,	0	0	0	0	0	0	16	200	130	24	72	8
ANIMALS.												
Rhizopoda,	0	0	0	0	0	10	0	1	0	0	0	
Actinophrys,	0	0	0	0	0	10	0	0	0	0	0	
Infusoria,	62	54	30	284	230	34	8	62	6	34	10	12
Ciliated infusorian,	0	7	0	0	0	0	0	16	0	0	0	0
Cryptomonas,	18	0	0	4	0	0	0	8	0	0	0	1
Dinobryon,	12	8	9	142	222	0	0	0	2	0	0	0
Euglena,	2	1	10	52	2	0	0	2	0	0	0	0
Peridinium,	26	38	2	72	6	15	2	8	0	28	8	11
Phacus,	0	0	0	0	0	0	0	10	0	0	0	0
Trachelomonas,	2	0	0	2	0	18	6	4	0	2	2	0
Vermes,	3	1	4	3	7	4	2	9	4	4	10	0
Crustacea,	0	0	0	0	0	pr.	pr.	pr.	0	pr.	0	0
Bosmina,	0	0	0	0	0	0	0	pr.	0	0	0	0
Cyclops,	0	0	0	0	0	pr.	pr.	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	3	8	7	15	0	20	10	30	15	25	3	5
TOTAL,	68	64	41	334	418	2,627	842	1,385	2,391	608	385	77

LYNN AND SAUGUS.

Chemical Examination of Water from Glen Lewis Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25906	Jan. 10	V. slight.	Slight.	.24	3.50	1.50	.0002	.0262	.0172	.0090	.36	.0010	.0000	.40	0.5
26171	Feb. 6	Slight.	Slight.	.23	3.20	1.60	.0032	.0210	.0156	.0054	.31	.0000	.0000	.36	0.5
26398	Mar. 7	V. slight.	Slight.	.15	2.70	1.00	.0114	.0164	.0114	.0050	.28	.0010	.0002	.29	0.2
26724	Apr. 10	Slight.	Slight.	.30	3.00	1.40	.0028	.0302	.0210	.0092	.29	.0020	.0001	.33	0.3
27043	May 8	Slight.	Slight.	.21	3.05	1.20	.0018	.0300	.0208	.0092	.27	.0030	.0000	.29	0.2
27434	June 13	V. slight.	Cons.	.30	3.15	1.50	.0078	.0316	.0240	.0076	.34	.0040	.0000	.52	0.3
27734	July 11	Decided.	Heavy.	.37	3.85	2.10	.0008	.0252	.0164	.0088	.32	.0010	.0000	.64	0.5
28088	Aug. 8	Decided.	Slight.	.33	4.65	2.40	.0006	.0760	.0360	.0400	.37	.0040	.0000	.57	0.3
28566	Sept. 11	Decided.	Heavy.	.18	3.95	2.20	.0016	.0807	.0320	.0487	.35	.0020	.0000	.47	0.5
28958	Oct. 10	Decided.	Heavy.	.28	4.25	2.25	.0072	.0620	.0392	.0228	.37	.0010	.0000	.59	0.3
29289	Nov. 7	Decided.	Cons.	.21	4.05	2.40	.0040	.0664	.0556	.0108	.36	.0010	.0000	.57	0.5
29629	Dec. 12	Slight.	Slight.	.13	3.25	1.85	.0010	.0344	.0318	.0026	.31	.0030	.0000	.44	0.2

Averages by Years.

-	1890	-	-	.76	4.84	2.21	.0412	.0445	.0327	.0118	.36	.0063	.0001	-	1.0
-	1891	-	-	.68	3.90	1.75	.0328	.0484	.0324	.0160	.34	.0124	.0002	-	0.6
-	1892	-	-	.62	3.95	1.96	.0127	.0475	.0332	.0143	.40	.0193	.0002	-	0.6
-	1893	-	-	.64	3.81	2.14	.0112	.0729	.0329	.0400	.42	.0040	.0002	.60	0.6
-	1894	-	-	.85	3.81	1.80	.0107	.0495	.0297	.0198	.44	.0023	.0001	.69	0.5
-	1895	-	-	.42	3.77	1.65	.0053	.0381	.0246	.0135	.50	.0086	.0001	.54	0.7
-	1896	-	-	.36	3.74	1.91	.0068	.0567	.0306	.0261	.43	.0069	.0001	.47	0.4
-	1897	-	-	.42	3.80	2.20	.0084	.0460	.0384	.0076	.49	.0125	.0003	.58	0.9
-	1898	-	-	.40	3.68	1.73	.0066	.0393	.0264	.0129	.40	.0030	.0000	.46	0.5
-	1899	-	-	.24	3.55	1.78	.0085	.0417	.0268	.0149	.33	.0019	.0000	.46	0.4

NOTE to analyses of 1899: Odor, generally vegetable and sometimes unpleasant or mouldy.

LYNN AND SAUGUS.

Microscopical Examination of Water from Glen Lewis Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	8	8	12	10	15	18	9	18	12	9	18
Number of sample,	25905	26171	26398	26724	27043	27484	27734	28068	28566	28958	29289	29629
PLANTS.												
Diatomaceæ,	8	0	0	36	136	20	368	144	456	308	520	738
Asterionella,	0	0	0	32	104	8	24	32	0	156	124	18
Melosira,	0	0	0	0	8	6	340	100	456	140	168	0
Synedra,	4	0	0	0	6	1	0	0	0	12	220	720
Cyanophyceæ,	2	1	6	12	14	53	368	932	492	152	4	0
Anabæna,	0	0	0	0	4	0	52	476	44	16	0	0
Clathrocystis,	0	0	3	2	6	52	312	436	428	136	4	0
Cœlosphærium,	2	1	2	0	0	0	4	0	20	0	0	0
Microcystis,	0	0	1	10	4	1	0	20	0	0	0	0
Algæ,	0	2	0	74	288	396	272	582	348	1,028	192	28
Arthrodesmus,	0	0	0	0	2	0	80	0	28	4	20	2
Cœlastrum,	0	0	0	0	2	0	0	108	48	0	0	0
Protococcus,	0	0	0	74	280	0	56	80	64	0	0	17
Raphidium,	0	2	0	0	2	1	8	4	0	96	48	7
Scenedesmus,	0	0	0	0	0	0	0	12	20	896	116	2
Staurastrum,	0	0	0	0	2	388	116	340	186	28	0	0
ANIMALS.												
Infusoria,	584	51	21	270	36	3	48	206	44	36	218	29
Cryptomonas,	36	1	0	20	0	0	0	4	0	20	0	0
Dinobryon,	298	17	0	84	32	0	0	0	0	0	168	4
Euglena,	0	0	6	126	0	0	0	0	0	4	20	2
Mallomonas,	0	0	0	2	2	0	0	0	0	0	20	0
Monas,	0	0	0	20	0	1	0	8	0	0	0	0
Peridinium,	248	6	7	8	2	0	8	4	0	0	0	23
Trachelomonas,	2	0	1	10	0	2	36	184	44	8	0	0
Vermes,	4	3	2	6	12	0	8	8	8	4	2	0
Crustacea,	0	0	0	0	pr.	0	0	pr.	pr.	0	0	0
Cyclops,	0	0	0	0	pr.	0	0	pr.	pr.	0	0	0
Daphnia,	0	0	0	0	pr.	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	3	7	20	12	3	20	30	5	24	10	3
TOTAL,	596	60	36	418	500	475	1,076	1,882	1,358	1,552	944	818

LYNN AND SAUGUS.

Chemical Examination of Water from Hawkes Pond, Lynn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25906	Jan. 10	V. slight.	V. slight.	.50	4.75	2.15	.0014	.0224	.0190	.0034	.43	.0050	.0001	.70	1.6
26172	Feb. 6	Decided.	Slight.	.35	3.75	1.65	.0040	.0234	.0150	.0084	.33	.0010	.0001	.53	1.8
26399	Mar. 7	Slight.	Slight.	.19	2.75	1.05	.0030	.0166	.0108	.0058	.28	.0030	.0001	.33	0.8
26725	Apr. 10	V. slight.	V. slight.	.28	3.45	1.70	.0010	.0174	.0150	.0024	.30	.0040	.0001	.38	1.1
27041	May 8	V. slight.	Slight.	.29	3.25	1.25	.0012	.0252	.0208	.0044	.33	.0030	.0000	.42	1.0
27435	June 13	Slight.	Slight.	.20	3.00	1.25	.0026	.0272	.0222	.0050	.37	.0040	.0000	.43	1.0
27735	July 11	Decided.	Cons.	.11	3.10	1.30	.0010	.0196	.0166	.0030	.34	.0020	.0000	.43	0.8
28089	Aug. 8	V. slight.	Cons.	.10	3.50	1.25	.0004	.0232	.0172	.0060	.41	.0030	.0000	.39	1.1
28567	Sept. 11	Slight.	V. slight.	.09	3.25	1.45	.0036	.0280	.0206	.0074	.38	.0070	.0000	.31	0.6
28959	Oct. 10	Slight.	Slight.	.14	3.85	1.75	.0028	.0304	.0278	.0026	.44	.0010	.0000	.50	1.1
29290	Nov. 7	Decided.	Cons.	.42	6.10	2.40	.0022	.0412	.0366	.0046	.50	.0060	.0001	.67	2.8
29627	Dec. 12	V. slight.	V. slight.	.65	8.45	3.50	.0024	.0364	.0344	.0020	.63	.0130	.0000	.88	3.8

Averages by Years.

-	1897	-	-	.54	4.64	1.85	.0024	.0242	.0204	.0038	.53	.0098	.0001	.59	1.6
-	1898	-	-	.51	4.02	1.80	.0016	.0227	.0189	.0038	.43	.0044	.0001	.57	1.2
-	1899	-	-	.28	4.10	1.72	.0025	.0259	.0218	.0046	.39	.0043	.0000	.50	1.3

Note to analyses of 1899: Odor, generally faintly vegetable, sometimes unpleasant, becoming stronger in some of the samples, and occasionally also fishy, on heating. —— This reservoir receives, at times, water from the Saugus River, which is diverted near Montrose.

Microscopical Examination of Water from Hawkes Pond, Lynn.

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	8	8	12	10	15	13	9	13	12	9	13
Number of sample,	25906	26172	26399	26725	27041	27435	27785	28089	28567	28959	29290	29627
PLANTS.												
Diatomaceæ,	0	1	0	14	96	54	40	322	56	220	152	83
Cyclotella,	0	0	0	0	0	0	7	144	2	6	14	0
Synedra,	0	1	0	5	82	48	30	142	54	170	86	60
Tabellaria,	0	0	0	7	6	5	2	10	0	16	32	22
Cyanophyceæ,	0	0	0	0	0	4	0	16	2	2	0	0
Sphærozyga,	0	0	0	0	0	0	0	14	0	0	0	0
Algæ,	0	4	4	0	27	0	0	56	24	18	12	0

LYNN AND SAUGUS.

Microscopical Examination of Water from Hawkes Pond, Lynn — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda,	0	0	0	0	0	1	0	4	2	1	0	0
Infusoria,	7	843	323	65	50	284	20	6	2	202	83	15
Ciliated infusorian,	0	800	0	0	0	0	0	0	0	0	0	0
Dinobryon,	0	2	77	60	42	79	19	0	0	44	60	0
Euglena,	1	3	11	1	2	0	0	0	0	0	14	0
Peridinium,	6	37	234	4	2	200	1	6	0	150	4	8
Vermes,	0	0	8	3	2	1	0	5	0	0	4	1
Crustacea,	0	0	0	0	0	pr.	pr.	pr.	0	0	0	0
Bosmina,	0	0	0	0	0	0	0	pr.	0	0	0	0
Cyclops,	0	0	0	0	0	pr.	pr.	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	0	8	10	8	12	7	15	35	5	15	5	5
TOTAL,	7	856	343	91	187	351	75	444	91	458	256	104

Chemical Examination of Water from the Saugus River at Montrose.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25909	Jan. 10	V. slight.	V. slight.	.38	4.50	1.70	.0036	.0104	.0094	.0010	0.48	.0210	.0000	.46	2.0
26175	Feb. 6	Slight.	Slight.	.45	8.80	3.30	.0066	.0210	.0170	.0040	0.62	.0200	.0003	.58	3.3
26402	Mar. 7	Decided.	Cons., earthy.	.42	4.50	1.85	.0024	.0184	.0164	.0020	0.37	.0060	.0002	.56	1.6
26728	Apr. 10	V. slight.	V. slight.	.51	4.60	1.85	.0010	.0236	.0212	.0024	0.44	.0180	.0002	.69	1.7
27045	May 8	V. slight.	V. slight.	.63	5.95	2.50	.0020	.0276	.0254	.0022	0.56	.0020	.0000	.78	2.8
27438	June 13	V. slight.	V. slight.	.47	8.20	3.25	.0076	.0302	.0264	.0038	0.59	.0030	.0002	.65	3.4
27738	July 11	V. slight.	Slight.	.50	7.80	2.45	.0044	.0262	.0222	.0040	0.50	.0020	.0001	.72	3.9
28092	Aug. 8	V. slight.	V. slight.	.45	7.45	2.80	.0018	.0246	.0238	.0008	0.51	.0010	.0000	.58	4.0
28570	Sept. 11	V. slight.	Slight.	.40	8.25	3.00	.0060	.0280	.0228	.0052	0.58	.0120	.0000	.45	3.9
28962	Oct. 10	Slight.	Slight.	.44	11.00	3.50	.0076	.0388	.0352	.0036	1.35	.0120	.0009	.75	3.9
29293	Nov. 7	V. slight.	V. slight.	.78	8.60	3.10	.0060	.0316	.0280	.0036	0.61	.0070	.0002	.88	3.6
29631	Dec. 12	Slight.	Slight.	.70	7.95	2.80	.0046	.0366	.0332	.0034	0.72	.0100	.0000	.92	3.8
Av...	....	....	....	.51	7.30	2.67	.0045	.0264	.0234	.0030	0.61	.0091	.0002	.67	3.2

Odor, generally faintly vegetable, becoming stronger, and sometimes earthy or unpleasant, on heating.

LYNN AND SAUGUS.

Chemical Examination of Water from the Saugus River at Howlett's Dam, Saugus.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25907	Jan. 10	V. slight.	V. slight.	0.60	6.50	2.75	.0016	.0214	.0200	.0014	0.67	.0240	.0008	0.73	2.7
26173	Feb. 6	Slight.	Slight.	0.37	7.40	2.70	.0112	.0176	.0140	.0036	0.67	.0440	.0004	0.54	3.5
26400	Mar. 7	Decided.	V. slight.	0.40	4.40	1.80	.0040	.0176	.0166	.0010	0.41	.0110	.0003	0.56	1.3
26726	Apr. 10	V. slight.	Slight.	0.51	4.65	2.05	.0020	.0230	.0208	.0022	0.49	.0120	.0001	0.62	1.6
27042	May 8	Slight.	Cons.	0.72	6.75	3.00	.0068	.0346	.0248	.0098	0.56	.0110	.0006	0.82	2.5
27436	June 13	Slight.	Cons.	0.64	7.35	2.40	.0034	.0408	.0348	.0060	0.90	.0090	.0000	0.67	3.5
27736	July 11	Slight.	Cons.	0.82	8.05	2.20	.0068	.0396	.0304	.0092	1.01	.0080	.0004	0.60	3.9
28090	Aug. 8	Slight.	Cons.	0.75	10.60	2.15	.0976	.0292	.0268	.0024	1.60	.0120	.0034	0.48	3.8
28568	Sept. 11	Decided.	Heavy, earthy.	0.67	13.45	3.85	.2600	.0860	.0325	.0535	2.63	.0070	.0036	0.45	4.0
28960	Oct. 10	Decided.	Cons.	0.57	8.30	3.00	.0068	.0236	.0214	.0022	0.61	.0090	.0004	0.79	4.3
29291	Nov. 7	Decided.	Cons.	0.79	12.20	3.45	.0192	.0396	.0332	.0064	1.63	.0150	.0038	0.98	3.9
29628	Dec. 12	Slight.	V. slight.	0.50	11.40	3.40	.0274	.0356	.0322	.0034	1.93	.0480	.0005	0.57	4.0

Averages by Years.

-	1894	-	-	1.16	8.68	3.36	.0056	.0310	.0272	.0038	1.08	.0112	.0014	0.95	3.5
-	1895	-	-	1.29	8.33	3.62	.0064	.0381	.0349	.0032	0.94	.0125	.0003	1.31	3.1
-	1896	-	-	0.94	7.50	2.92	.0058	.0348	.0304	.0039	0.86	.0163	.0004	0.93	2.7
-	1897	-	-	1.09	7.74	3.08	.0050	.0337	.0317	.0020	0.84	.0110	.0002	1.00	3.1
-	1898	-	-	0.90	7.41	3.11	.0043	.0321	.0295	.0026	0.84	.0164	.0002	0.88	2.8
-	1899	-	-	0.57	8.42	2.69	.0376	.0340	.0256	.0084	1.10	.0171	.0011	0.65	3.2

NOTE to analyses of 1899: Odor, generally faintly vegetable, occasionally musty or unpleasant, becoming stronger on heating.

LYNN AND SAUGUS.

Chemical Examination of Water from a Faucet in Lynn supplied from the Lynn Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25910	Jan. 10	Slight.	V. slight.	.40	3.25	1.60	.0044	.0172	.0156	.0016	.43	.0040	.0000	.50	0.8
26176	Feb. 6	V. slight	V. slight.	.40	5.00	1.80	.0046	.0148	.0132	.0016	.45	.0140	.0001	.54	1.3
26408	Mar. 7	V. slight.	V. slight.	.27	3.65	1.50	.0060	.0142	.0132	.0010	.42	.0050	.0001	.40	0.6
26729	Apr. 10	V. slight.	V. slight.	.22	3.05	1.00	.0022	.0104	.0096	.0008	.42	.0080	.0002	.30	0.6
27046	May 8	V. slight.	V. slight.	.23	2.75	1.05	.0002	.0122	.0110	.0012	.33	.0050	.0001	.31	0.3
27439	June 13	Slight.	V. slight.	.22	2.60	1.25	.0006	.0156	.0136	.0020	.38	.0110	.0000	.40	0.6
27739	July 11	Slight.	Slight.	.31	2.80	1.20	.0032	.0204	.0180	.0024	.37	.0030	.0000	.48	0.5
28098	Aug. 8	V. slight.	V. slight.	.30	3.20	1.25	.0022	.0192	.0172	.0020	.38	.0070	.0000	.45	0.8
28571	Sept. 11	Decided.	Cons.	.27	3.15	1.45	.0020	.0288	.0178	.0110	.45	.0100	.0000	.29	0.5
28963	Oct. 10	V. slight.	V. slight.	.13	3.75	1.50	.0010	.0184	.0172	.0012	.42	.0010	.0001	.39	1.6
29294	Nov. 7	V. slight.	V. slight.	.29	3.20	1.35	.0016	.0190	.0174	.0016	.45	.0060	.0000	.35	0.6
29671	Dec. 15	V. slight.	V. slight.	.52	6.25	2.45	.0022	.0268	.0250	.0018	.57	.0090	.0001	.67	2.3

Averages by Years.

-	1894	-	-	.76	4.60	1.95	.0023	.0216	.0194	.0022	.57	.0065	.0001	.62	1.3
-	1895	-	-	.78	5.12	2.14	.0017	.0225	.0195	.0030	.65	.0102	.0001	.84	1.7
-	1896	-	-	.54	4.41	1.79	.0015	.0217	.0179	.0038	.51	.0063	.0001	.58	1.3
-	1897	-	-	.53	4.88	1.75	.0012	.0206	.0179	.0027	.59	.0079	.0001	.51	1.3
-	1898	-	-	.45	3.75	1.55	.0007	.0173	.0159	.0014	.46	.0047	.0000	.46	1.1
-	1899	-	-	.30	3.55	1.45	.0025	.0181	.0157	.0024	.42	.0069	.0001	.42	0.9

NOTE to analyses of 1899: Odor, generally faintly vegetable, frequently none. An unpleasant odor was developed in the last sample on heating.

LYNN AND SAUGUS.

Microscopical Examination of Water from a Faucet in Lynn supplied from the Lynn Water Works.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	8	8	12	10	15	13	9	13	12	9	16
Number of sample,	25910	26176	26403	26729	27046	27439	27739	28093	28571	28963	29294	29671
PLANTS.												
Diatomaceæ,	5	14	5	4	73	184	120	48	102	84	73	66
Asterionella,	1	4	0	1	11	51	8	10	58	4	3	3
Synedra,	0	1	1	0	13	49	94	4	0	38	0	32
Tabellaria,	4	9	4	2	39	57	14	13	44	32	68	16
Cyanophyceæ,	0	0	0	0	0	0	0	0	0	30	0	0
Anabæna,	0	0	0	0	0	0	0	0	0	14	0	0
Merismopœdia,	0	0	0	0	0	0	0	0	0	12	0	0
Algæ,	0	0	0	0	3	2	0	10	0	24	3	0
Fungi, Crenothrix,	0	0	0	0	10	2	0	8	18	0	0	0
ANIMALS.												
Rhizopoda, Difflugia,	0	0	0	0	0	0	0	0	2	0	0	0
Infusoria,	6	11	2	0	40	0	4	1	12	8	0	3
Dinobryon,	0	0	0	0	33	0	2	0	2	0	0	1
Peridinium,	6	11	1	0	3	0	0	0	0	8	0	0
Trachelomonas,	0	0	1	0	1	0	2	0	10	0	0	1
Vermes,	0	1	0	0	1	0	0	0	0	0	0	0
Crustacea, Cyclops,	0	0	0	0	pr.	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	3	5	5	3	5	3	5	3	20	5	0	3
TOTAL,	14	31	12	7	132	191	129	70	154	151	76	72

WATER SUPPLY OF MALDEN.

(See *Metropolitan Water District*.)

Water Supply of Manchester.

Chemical Examination of Water from the Large Well of the Manchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
27331	June 6	None.	None.	.00	10.30	.0000	.0012	1.81	.1560	.0000	.03	3.0	.0020
27776	July 14	None.	None.	.00	10.40	.0000	.0010	1.57	.1840	.0000	.01	3.1	.0010
28063	Aug. 7	None.	None.	.00	9.70	.0000	.0008	1.68	.2160	.0000	.05	3.1	.0010
28619	Sept. 14	None.	None.	.00	10.50	.0000	.0010	1.59	.1560	.0000	.04	3.0	.0030
28887	Oct. 4	None.	None.	.00	11.00	.0000	.0006	1.80	.1560	.0000	.01	3.4	.0030

Averages by Years.

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1892	-	-	.00	9.38	.0001	.0003	1.75	.1214	.0001	-	3.4	-
-	1893	-	-	.00	9.64	.0000	.0002	1.69	.0975	.0000	.04	3.5	.0096
-	1894	-	-	.00	9.82	.0000	.0006	1.82	.0700	.0000	.01	3.4	.0010
-	1895	-	-	.01	9.87	.0001	.0005	1.80	.0737	.0000	.02	3.3	.0040
-	1896	-	-	.00	10.67	.0003	.0004	1.94	.0950	.0000	.01	3.4	.0027
-	1897	-	-	.01	11.00	.0004	.0014	1.98	.1045	.0000	.00	3.9	.0017
-	1898	-	-	.01	10.87	.0002	.0007	1.91	.1298	.0000	.01	3.6	.0023
-	1899	-	-	.00	10.38	.0000	.0009	1.69	.1736	.0000	.03	3.1	.0020

Note to analyses of 1899: Odor, none.

Water Supply of Mansfield Water Supply District, Mansfield.

Chemical Examination of Water from the Well of the Mansfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
27347	June 7	None.	None.	.00	2.40	.0002	.0010	.25	.0010	.0000	.01	0.3	.0010
27684	July 6	None.	None.	.00	3.00	.0006	.0008	.23	.0020	.0000	.01	0.5	.0010
27960	Aug. 1	None.	None.	.00	2.20	.0004	.0012	.26	.0020	.0000	.02	0.3	.0010
28517	Sept. 6	None.	None.	.00	3.10	.0000	.0006	.27	.0070	.0000	.02	0.8	.0000
28860	Oct. 3	None.	None.	.02	3.10	.0000	.0004	.27	.0030	.0000	.01	0.8	.0020
Av...	....	....	....	.00	2.76	.0002	.0008	.26	.0030	.0000	.01	0.5	.0010

Odor, none.——The samples were collected from a faucet at the pumping station.

MARBLEHEAD.

WATER SUPPLY OF MARBLEHEAD.

Chemical Examination of Water from Collecting Well No 1 of the Marblehead Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25855	Jan. 3	Decided.	Slight.	.05	13.60	.0112	.0018	1.48	.0060	.0004	.06	6.0	.0950
26379	Mar. 1	Decided.	Cons.	.04	13.50	.0150	.0030	1.61	.0250	.0002	.03	6.4	.1200
26666	Apr. 4	Decided.	Cons.	.04	12.50	.0098	.0022	1.31	.0890	.0000	.04	5.4	.1150
27012	May 3	Decided.	Cons.	.00	13.00	.0164	.0028	1.36	.0190	.0001	.06	5.4	.1650
27629	June 28	Slight, milky.	V. slight.	.07	12.90	.0018	.0016	1.49	.0650	.0000	.05	5.1	.0850
28053	Aug. 4	Slight.	Cons.	.07	13.50	.0166	.0010	1.73	.0180	.0001	.08	5.3	.1100
28437	Aug. 31	Decided.	Cons.	.06	14.70	.0156	.0018	1.80	.0230	.0000	.06	5.4	.2250
29266	Nov. 2	Slight.	Heavy.	.02	17.20	.0164	.0030	1.36	.0210	.0005	.07	6.3	.1700
29742	Dec. 21	Decided.	Heavy.	.10	16.80	.0280	.0032	1.71	.0020	.0000	.10	5.6	.9200
Av...	....	....	....	.05	14.19	.0145	.0023	1.54	.0242	.0001	.06	5.7	.2172

Odor, none.——These samples represent a mixture of water of Collecting Well No. 1 with water from Collecting Well No. 2, which flows into it.

Chemical Examination of Water from Collecting Well No. 2 of the Marblehead Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25856	Jan. 3	Decided.	Heavy.	.04	15.90	.0268	.0026	1.55	.0000	.0000	.08	6.7	.3250
26380	Mar. 1	Decided.	Heavy.	.02	15.40	.0278	.0032	1.77	.0010	.0000	.06	7.3	.2800
26667	Apr. 4	Decided.	Heavy.	.00	15.20	.0286	.0024	1.54	.0030	.0000	.09	6.1	.3700
27013	May 3	Decided.	Heavy.	.00	13.50	.0274	.0026	1.42	.0010	.0000	.10	5.7	.3700
27630	June 28	Decided.	Heavy.	.08	13.50	.0286	.0030	1.61	.0000	.0000	.07	5.6	.3400
28054	Aug. 4	Decided.	Cons.	.07	14.00	.0252	.0022	1.79	.0010	.0000	.08	6.3	.1800
28438	Aug. 31	Decided.	Cons.	.05	17.20	.0284	.0028	1.69	.0030	.0000	.11	5.8	.3700
28894	Oct. 2	Decided, milky.	Heavy.	.06	15.30	.0264	.0040	1.76	.0010	.0000	.08	5.7	.2100
29267	Nov. 2	Slight.	Heavy.	.05	14.30	.0288	.0032	1.74	.0020	.0001	.07	5.7	.2300
Av...	....	....	....	.04	14.92	.0276	.0029	1.65	.0013	.0000	.08	6.0	.2972

Odor, none.

MARBLEHEAD.

Chemical Examination of Water from a Faucet supplied from the Marblehead Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29743	Dec. 21	Decided.	Cons.	.01	16.60	.0202	.0028	2.86	.0140	.0001	.06	6.0	.3000

Odor, none.——The sample was collected from a faucet on the main pipe line.

Water Supply of Marlborough.

Chemical Examination of Water from Lake Williams, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25893	Jan. 9	Slight.	Slight.	.08	4.70	1.50	.0006	.0206	.0172	.0034	.57	.0070	.0002	.28	2.0
26712	Apr. 11	Decided.	Cons.	.10	4.25	1.75	.0004	.0240	.0194	.0046	.44	.0100	.0002	.24	1.4
27700	July 10	Slight.	Slight.	.11	4.10	1.15	.0006	.0254	.0216	.0038	.41	.0030	.0000	.30	1.6
28932	Oct. 9	None.	V. slight.	.06	4.00	1.00	.0032	.0238	.0212	.0026	.55	.0000	.0001	.22	2.0
Av...	....	....	....	.09	4.26	1.35	.0012	.0234	.0198	.0036	.49	.0050	.0001	.25	1.7

Odor of the second sample, distinctly disagreeable; of the others, vegetable.——The second sample was collected from a faucet at the pumping station; the others, from the lake.

Chemical Examination of Water from the North Branch of Millham Brook, near its Entrance to the Millham Brook Storage Reservoir, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25892	Jan. 9	V. slight.	Slight.	0.57	4.20	1.60	.0010	.0164	.0130	.0034	.32	.0240	.0001	0.55	1.0
26132	Feb. 6	Slight.	Slight.	0.50	4.50	1.65	.0078	.0114	.0096	.0018	.35	.0220	.0001	0.43	1.0
26390	Mar. 6	Decided.	Heavy, earthy.	0.30	2.90	1.40	.0132	.0496	.0280	.0216	.17	.0150	.0002	0.40	0.8
26708	Apr. 11	V. slight.	Slight.	0.52	3.05	1.50	.0004	.0216	.0200	.0016	.25	.0040	.0001	0.56	0.5
27023	May 8	V. slight.	Slight.	1.52	4.65	2.35	.0044	.0392	.0311	.0081	.27	.0030	.0001	1.26	0.6
27404	June 12	V. slight.	Slight.	1.15	4.60	2.00	.0030	.0294	.0256	.0038	.23	.0070	.0002	0.88	1.1
27696	July 10	Decided.	Cons.	1.30	6.05	2.10	.0040	.0396	.0344	.0052	.19	.0070	.0003	1.09	1.3
29265	Nov. 6	V. slight.	V. slight.	1.00	7.40	2.65	.0008	.0316	.0308	.0008	.48	.0070	.0000	1.22	2.5
29618	Dec. 11	V. slight.	V. slight.	0.67	6.00	2.15	.0000	.0198	.0184	.0014	.36	.0010	.0000	0.70	1.7

MARLBOROUGH.

Chemical Examination of Water from the North Branch of Millham Brook, near its Entrance to the Millham Brook Storage Reservoir, Marlborough — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1896	-	-	1.22	5.45	2.11	.0023	.0262	.0226	.0036	.35	.0095	.0001	1.09	1.4
-	1897	-	-	1.46	5.65	2.51	.0022	.0291	.0265	.0026	.38	.0076	.0001	1.06	1.4
-	1898	-	-	1.35	5.44	2.53	.0018	.0265	.0236	.0029	.34	.0107	.0001	1.05	1.3
-	1899	-	-	0.84	4.82	1.93	.0038	.0287	.0234	.0053	.29	.0100	.0001	0.78	1.1

NOTE to analyses of 1899: Odor, generally vegetable, sometimes none.

Chemical Examination of Water from Millham Brook, near its Entrance to the Millham Brook Storage Reservoir, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25889	Jan. 9	V. slight.	V. slight.	.20	4.55	1.65	.0014	.0120	.0106	.0014	.41	.0240	.0000	.30	1.7
26129	Feb. 6	V. slight.	V. slight.	.17	4.65	1.40	.0036	.0104	.0096	.0008	.40	.0310	.0002	.24	1.7
26391	Mar. 6	Decided.	Cons., earthy.	.24	3.50	1.25	.0076	.0212	.0126	.0086	.22	.0210	.0002	.32	0.6
26709	Apr. 11	V. slight.	Slight.	.23	3.10	1.25	.0028	.0150	.0144	.0006	.25	.0090	.0001	.29	1.0
27024	May 8	V. slight.	V. slight.	.72	5.00	2.00	.0006	.0208	.0204	.0004	.32	.0140	.0002	.66	1.8
27405	June 12	V. slight.	V. slight.	.21	4.50	1.75	.0028	.0170	.0146	.0024	.29	.0100	.0003	.30	1.8
27697	July 10	V. slight.	V. slight.	.31	5.30	1.30	.0014	.0182	.0168	.0014	.31	.0090	.0002	.41	2.0
28070	Aug. 7	V. slight.	Slight.	.09	5.05	1.55	.0014	.0096	.0092	.0004	.51	.0010	.0000	.23	2.1
28535	Sept. 10	Slight.	Slight.	.10	4.45	1.25	.0016	.0140	.0128	.0012	.54	.0050	.0000	.20	1.7
28929	Oct. 9	V. slight.	V. slight.	.36	6.10	1.85	.0002	.0180	.0162	.0018	.53	.0010	.0000	.51	2.3
29262	Nov. 6	V. slight.	V. slight.	.48	7.20	2.35	.0008	.0300	.0256	.0044	.48	.0230	.0000	.53	3.0
29610	Dec. 11	V. slight.	V. slight.	.33	6.25	2.25	.0010	.0166	.0160	.0006	.42	.0060	.0001	.51	2.2

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1896	-	-	.62	5.47	1.90	.0022	.0199	.0174	.0025	.37	.0209	.0001	.65	1.9
-	1897	-	-	.74	5.27	2.02	.0018	.0214	.0198	.0016	.38	.0162	.0001	.65	2.0
-	1898	-	-	.54	5.12	2.11	.0016	.0172	.0156	.0016	.39	.0165	.0001	.58	1.8
-	1899	-	-	.29	4.97	1.65	.0021	.0169	.0149	.0020	.39	.0128	.0001	.40	1.8

NOTE to analyses of 1899: Odor, generally vegetable, occasionally unpleasant or musty.

MARLBOROUGH.

Chemical Examination of Water from Millham Brook Storage Reservoir, Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Suspended.					
	1899.														
25890	Jan. 9	V. slight.	V. slight.	.41	3.75	1.35	.0012	.0146	.0128	.0018	.29	.0210	.0000	.45	1.0
26130	Feb. 6	V. slight.	V. slight.	.20	4.25	1.75	.0022	.0144	.0120	.0024	.36	.0240	.0002	.30	1.6
26392	Mar. 6	Slight.	V. slight.	.24	3.05	1.25	.0072	.0144	.0114	.0030	.19	.0110	.0002	.39	0.5
26710	Apr. 11	Slight.	Slight.	.27	2.85	1.35	.0044	.0154	.0134	.0020	.28	.0080	.0001	.32	1.0
27025	May 8	Slight.	Slight.	.32	3.30	1.10	.0016	.0284	.0190	.0094	.26	.0050	.0001	.42	0.6
27406	June 12	Slight.	Cons.	.22	3.35	1.60	.0002	.0228	.0174	.0054	.27	.0020	.0000	.41	1.3
27698	July 10	Slight.	Cons.	.30	3.55	1.10	.0000	.0280	.0208	.0072	.26	.0030	.0000	.48	1.3
28071	Aug. 7	Decided.	V. slight	.24	3.75	1.45	.0006	.0386	.0206	.0180	.31	.0020	.0000	.40	1.1
28536	Sept. 10	Slight.	Cons.	.46	4.05	1.90	.0080	.0700	.0388	.0312	.27	.0010	.0000	.50	0.9
28930	Oct. 9	Decided.	Cons.	.71	4.25	2.25	.0328	.0500	.0376	.0124	.30	.0010	.0000	.49	1.3
29263	Nov. 6	Decided.	Cons.	.59	3.50	1.65	.0192	.0480	.0328	.0152	.28	.0130	.0004	.50	1.3
29611	Dec. 11	Slight.	Cons.	.54	4.40	2.20	.0002	.0432	.0312	.0120	.28	.0060	.0001	.54	1.1

Averages by Years.

-	1896	-	-	.80	4.44	1.68	.0058	.0306	.0248	.0058	.30	.0088	.0003	.69	1.3
-	1897	-	-	.83	4.24	1.77	.0031	.0293	.0243	.0050	.30	.0088	.0001	.64	1.5
-	1898	-	-	.67	4.30	1.95	.0050	.0239	.0191	.0048	.32	.0095	.0001	.59	1.3
-	1899	-	-	.37	3.67	1.58	.0065	.0323	.0223	.0100	.27	.0081	.0001	.43	1.1

Note to analyses of 1899: Odor, generally vegetable, sometimes grassy or mouldy. —— The samples were collected from the reservoir, 2 feet beneath the surface.

Microscopical Examination of Water from Millham Brook Storage Reservoir, Marlborough.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	10	7	7	12	9	13	11	8	11	10	7	12
Number of sample,	25890	26130	26392	26710	27025	27406	27698	28071	28536	28930	29263	29611
PLANTS.												
Diatomaceæ,	7	2	5	32	406	848	178	2,418	164	168	3,764	4,060
Asterionella,	4	0	0	3	62	108	12	552	0	120	3,560	3,936
Cyclotella,	0	1	0	2	0	2	30	712	160	20	52	12
Fragilaria,	0	0	0	0	0	0	0	0	0	0	132	80
Melosira,	0	0	0	4	0	0	0	720	0	0	0	0
Synedra,	2	1	1	6	220	140	14	128	0	20	4	0
Tabellaria,	1	0	0	2	124	598	122	304	4	8	8	32
Cyanophyceæ,	0	0	0	0	2	146	356	1,096	1,344	134	180	4
Anabæna,	0	0	0	0	2	118	356	1,000	1,288	52	4	0
Cœlosphærium,	0	0	0	0	0	2	0	88	56	80	176	4
Microcystis,	0	0	0	0	0	26	0	0	0	2	0	0
Algæ,	0	0	0	0	0	124	34	136	72	106	100	58
Protococcus,	0	0	0	0	0	36	34	0	60	100	82	50
Raphidium,	0	0	0	0	0	78	0	96	0	0	36	4

MARLBOROUGH.

Microscopical Examination of Water from Millham Brook Storage Reservoir, Marlborough — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Infusoria,	12	39	0	53	28	152	42	8	0	28	536	772
Dinobryon,	11	13	0	51	0	124	0	0	0	8	480	758
Epistylis,	0	0	0	0	24	0	0	0	0	0	0	0
Peridinium,	0	0	0	0	2	0	28	0	0	0	0	0
Trachelomonas,	0	16	0	0	0	8	6	0	0	12	36	4
Uroglena,	0	0	0	0	0	0	0	0	0	0	16	2
Vorticella,	0	0	0	0	0	12	4	0	0	0	0	0
Vermes,	0	0	0	0	4	2	6	16	0	4	0	2
Crustacea,	0	0	0	0	pr.	pr.	0	0	pr.	pr.	pr.	0
Bosmina,	0	0	0	0	0	0	0	0	0	pr.	0	0
Cyclops,	0	0	0	0	pr.	pr.	0	0	pr.	pr.	pr.	0
Daphnia,	0	0	0	0	0	0	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	8	8	10	15	12	12	10	0	10	15	10	6
TOTAL,	22	44	15	100	452	1,284	626	3,672	1,590	456	4,590	4,902

Chemical Examination of Water from Millham Brook Storage Reservoir, Marlborough, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25891	Jan. 9	V. slight.	V. slight.	0.61	4.15	1.65	.0098	.0174	.0154	.0020	.32	.0120	.0001	.49	1.4
26131	Feb. 6	V. slight.	V. slight.	0.35	4.25	1.75	.0046	.0152	.0130	.0022	.33	.0180	.0002	.42	1.1
26393	Mar. 6	Slight.	Slight.	0.39	4.00	1.30	.0188	.0172	.0136	.0036	.28	.0220	.0004	.37	1.0
26711	Apr. 11	Slight.	Slight.	0.32	3.10	1.20	.0098	.0148	.0138	.0010	.25	.0100	.0002	.35	0.8
27026	May 8	Decided.	Slight.	0.32	3.30	1.10	.0006	.0244	.0184	.0060	.26	.0120	.0001	.35	1.0
27407	June 12	Slight.	Cons.	0.47	3.70	1.60	.0148	.0542	.0242	.0300	.29	.0020	.0000	.46	1.0
27699	July 10	Decided.	Cons.	0.47	3.80	1.25	.0000	.0400	.0242	.0158	.29	.0040	.0000	.47	1.3
28072	Aug. 7	Decided.	Cons.	1.70	5.30	1.35	.0750	.0530	.0220	.0310	.32	.0020	.0000	.63	2.2
28537	Sept. 10	Decided.	Heavy.	3.20	7.25	2.50	.1904	.0676	.0404	.0272	.29	.0060	.0000	.88	2.0
28931	Oct. 9	Decided.	Cons.	0.78	4.50	2.00	.0312	.0544	.0376	.0168	.29	.0010	.0001	.49	1.3
29264	Nov. 6	Decided.	Cons.	0.58	3.40	1.65	.0164	.0440	.0332	.0108	.27	.0080	.0000	.50	1.1
29612	Dec. 11	Slight.	Cons.	0.59	4.20	2.05	.0010	.0416	.0292	.0124	.29	.0060	.0000	.49	1.0

Averages by Years.

-	1896	-	-	1.04	5.07	1.94	.0185	.0331	.0271	.0060	.31	.0110	.0002	.82	1.5
-	1897	-	-	1.47	5.33	2.24	.0233	.0343	.0288	.0055	.32	.0075	.0003	.79	1.7
-	1898	-	-	1.29	5.21	2.35	.0472	.0285	.0224	.0061	.31	.0071	.0002	.68	1.5
-	1899	-	-	0.80	4.25	1.62	.0310	.0370	.0238	.0132	.29	.0086	.0001	.49	1.3

NOTE to analyses of 1899: Odor, generally vegetable, occasionally none, frequently mouldy and unpleasant or disagreeable, becoming stronger on heating.—The samples were collected from the reservoir, 2 feet above the bottom.

WATER SUPPLY OF BRANT ROCK, MARSHFIELD. — BRANT ROCK WATER COMPANY.

Chemical Examination of Water from the Well of the Brant Rock Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
28298	1899. Aug. 21	None.	None.	.00	11.40	.0000	.0006	3.20	.0960	.0000	.02	2.2	.0010

Odor, none. —— The sample was collected from a faucet at the pumping station.

WATER SUPPLY OF MAYNARD.

Chemical Examination of Water from White Pond, Maynard.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved	Suspended.		Nitrates.	Nitrites.		
26541	1899. Mar. 21	Decided.	Cons.	.03	1.65	1.00	.0042	.0240	.0188	.0052	.15	.0010	.0000	.18	0.0
27105	May 15	Slight.	V. slight.	.06	3.00	0.90	.0004	.0172	.0150	.0022	.29	.0070	.0000	.24	0.6
27490	June 20	Slight.	Slight.	.06	2.25	0.75	.0004	.0212	.0196	.0016	.30	.0020	.0000	.22	0.3
28738	Sept. 26	V. slight.	Cons.	.00	2.00	1.00	.0006	.0176	.0156	.0020	.38	.0020	.0000	.18	0.6
29691	Dec. 19	V. slight.	Slight.	.01	2.35	0.75	.0006	.0154	.0138	.0016	.37	.0010	.0000	.13	0.5
Av...	....	....	....	.03	2.25	0.88	.0012	.0191	.0166	.0025	.30	.0026	.0000	.19	0.4

Odor of the first and third samples, faintly vegetable; of the second, distinctly vegetable and faintly unpleasant, becoming distinctly fishy and oily on heating; of the fourth, very faintly unpleasant; of the last, none, becoming faintly vegetable on heating. —— No. 27105 was collected from a faucet in the town; the others, from the pond.

MAYNARD.

Microscopical Examination of Water from White Pond, Maynard.

[Number of organisms per cubic centimeter.]

	1899. March.	1899. May.	1899. June.	1899. Sept.	1899. Dec.
Day of examination,	22	16	21	27	19
Number of sample,	26541	27105	27490	28738	29691
PLANTS.					
Diatomaceæ,	20	258	48	88	34
Synedra,	8	190	6	38	0
Cyanophyceæ, Anabæna,	0	0	3	38	0
Algæ,	0	14	2	0	0
ANIMALS.					
Infusoria,	14	354	19	54	21
Dinobryon,	14	344	19	48	12
Monas,	0	10	0	2	0
Uroglena,	0	0	0	0	2
Vermes,	0	3	1	0	0
Miscellaneous, Zoöglœa,	15	5	7	7	3
TOTAL,	49	634	78	187	58

MEDFIELD.

Chemical Examination of Water from a Spring in Medfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
28290	1899. Aug. 21	None.	None.	.00	2.70	.0006	.0022	.23	.0010	.0000	.09	0.8	.0010

Odor, none.——The sample was collected from a spring near Vine Brook, about one-third of a mile above North Street. This spring is used as a source of water supply by a large straw factory and by a portion of the village of Medfield.

Water Supply of Medfield Insane Asylum.

Chemical Examination of Water from Farm Pond in Sherborn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26313	Feb. 22	None.	V. slight.	.02	1.80	0.95	.0012	.0098	.0094	.0004	.25	.0020	.0000	.18	0.3
26954	Apr. 26	None.	None.	.06	1.75	0.75	.0000	.0120	.0110	.0010	.23	.0010	.0000	.18	0.0
27628	June 28	V. slight.	V. slight.	.09	1.75	0.85	.0018	.0122	.0118	.0004	.22	.0000	.0000	.17	0.0
28396	Aug. 28	V. slight.	V. slight.	.06	2.45	1.30	.0014	.0108	.0104	.0004	.24	.0010	.0001	.15	0.0
29141	Oct. 25	None.	None.	.04	1.70	0.75	.0006	.0118	.0106	.0012	.25	.0010	.0000	.16	0.2
29801	Dec. 27	V. slight.	V. slight.	.05	1.75	0.85	.0014	.0124	.0120	.0004	.24	.0010	.0000	.12	0.3
Av...	....	....	....	.05	1.87	0.91	.0011	.0115	.0109	.0006	.24	.0010	.0000	.16	0.1

Odor of the first and fourth samples, faintly vegetable; of the last two, none; of the second and third, none, becoming distinctly fishy or unpleasant on heating. —— No. 29141 was collected from the pond; the others, from faucets in the asylum supplied from the pond.

Water Supply of Medford.

(See *Metropolitan Water District.*)

Medway.

The advice of the State Board of Health to the board of health of Medway, with reference to the quality of the water of a well used as a source of water supply for the Poor Farm in that town, may be found on page 29 of this volume.

Chemical Examination of Water from a Well at the Medway Poor Farm.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29673	Dec. 14	Slight.	V. slight.	.07	9.30	.0000	.0062	.34	.0010	.0000	.12	4.3	.0020

Odor, none.

Water Supply of Melrose.

(See *Metropolitan Water District.*)

METHUEN.

Water Supply of Methuen.

Chemical Examination of Water from the Tubular Wells of the Methuen Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27177	May 20	V. slight.	V. slight.	.02	6.40	.0000	.0026	.32	.0180	.0000	.06	2.0	.0030
27617	June 28	V. slight.	V. slight.	.08	6.20	.0000	.0046	.29	.0180	.0000	.14	2.6	.0050
27861	July 21	V. slight.	Slight.	.08	7.90	.0016	.0042	.35	.0200	.0001	.12	2.9	.0150
28353	Aug. 24	None.	V. slight.	.03	6.90	.0004	.0090	.35	.0280	.0000	.10	2.5	.0120
28727	Sept. 25	V. slight.	V. slight.	.10	6.40	.0000	.0038	.36	.0410	.0000	.09	3.0	.0130
29127	Oct. 23	Slight, milky.	V. slight.	.10	8.00	.0000	.0052	.34	.0180	.0000	.15	2.7	.0070
Av.	....	....	....	.07	6.97	.0003	.0049	.33	.0238	.0000	.11	2.6	.0092

Odor, none.—The first sample was collected from a faucet in the town; the others, from the wells.

Water Supply of Middleborough Fire District, Middleborough.

Chemical Examination of Water from the Well of the Middleborough Fire District.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25840	Jan. 4	V. slight.	V. slight.	.09	8.00	.0006	.0016	.80	.1240	.0000	.06	2.7	.0180
26100	Feb. 1	None.	V. slight.	.05	7.00	.0006	.0028	.81	.1300	.0000	.05	2.9	.0150
26371	Mar. 1	V. slight.	V. slight.	.05	7.00	.0012	.0030	.79	.0890	.0000	.06	2.3	.0170
26674	Apr. 5	None.	V. slight.	.06	6.50	.0012	.0020	.72	.1120	.0000	.06	2.5	.0280
26998	May 3	V. slight.	Slight.	.10	6.80	.0010	.0024	.68	.1160	.0000	.08	2.3	.0280
27323	June 6	V. slight.	V. slight.	.15	5.50	.0014	.0036	.68	.0780	.0000	.17	2.0	.0200
27674	July 6	Slight, milky.	V. slight.	.21	5.90	.0000	.0052	.56	.0280	.0000	.19	2.0	.0180
28031	Aug. 2	Decided.	Cons.	.33	6.00	.0000	.0056	.63	.0280	.0001	.23	2.6	.0820
28475	Sept. 5	Slight, milky.	V. slight.	.20	6.20	.0000	.0060	.62	.0840	.0000	.17	2.0	.0580
28881	Oct. 4	Decided, milky.	Slight.	.20	6.20	.0024	.0040	.63	.0230	.0000	.16	2.2	.0430
29212	Nov. 1	Decided, milky.	Slight.	.30	6.40	.0014	.0062	.62	.0150	.0000	.14	2.6	.0670
29573	Dec. 5	V. slight.	Slight.	.11	6.40	.0030	.0026	.66	.0540	.0000	.09	2.1	.0510

MIDDLEBOROUGH.

Chemical Examination of Water from the Well of the Middleborough Fire District — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
-	1888	-	-	.00	8.67	.0001	.0025	.96	.1494	.0001	-	-	-
-	1895	-	-	.06	6.74	.0001	.0028	.74	.0687	.0000	.08	2.6	.0187
-	1896	-	-	.18	6.54	.0003	.0038	.72	.0565	.0000	.09	2.4	.0288
-	1897	-	-	.09	6.28	.0006	.0039	.71	.0580	.0000	.11	2.5	.0227
-	1898	-	-	.16	6.78	.0008	.0044	.75	.0687	.0001	.14	2.7	.0408
-	1899	-	-	.15	6.54	.0010	.0037	.69	.0684	.0000	.12	2.3	.0329

Note to analyses of 1899: Odor, none.

Water Supply of Middleton.

(See *Danvers.*)

Water Supply of Milford and Hopedale. — Milford Water Company.

The advice of the State Board of Health to the board of health of Milford, with reference to the presence of lead in the water supply of that town, may be found on pages 29 to 31 of this volume.

The advice of the Board to the Milford Water Company, relative to the prevention of lead poisoning caused by the use of the Milford water drawn through lead service pipes, and relative to obtaining an additional supply of water for Milford and Hopedale, may be found on pages 31 and 32 of this volume.

Chemical Examination of Water from the Wells of the Milford Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27418	June 12	None.	None.	.10	2.90	.0014	.0060	.21	.0080	.0000	.22	0.8	.0030
27721	July 11	V. slight.	V. slight.	.04	3.30	.0006	.0056	.23	.0090	.0001	.12	0.8	.0030
28096	Aug. 8	None.	V. slight.	.09	2.80	.0000	.0056	.23	.0090	.0000	.20	1.0	.0010
28612	Sept. 11	None.	V. slight.	.01	3.10	.0000	.0034	.26	.0110	.0000	.07	1.1	.0070
29330	Nov. 9	Slight.	Slight.	.12	4.50	.0030	.0052	.26	.0020	.0000	.11	1.7	.0710
Av...	....	....	....	.07	3.32	.0010	.0052	.24	.0078	.0000	.14	1.1	.0170

Odor, none. A faintly vegetable odor was developed in the third sample on heating.

MILFORD AND HOPEDALE.

Chemical Examination of Water from the Wells of the Milford Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29435	Nov. 17	Slight.	Cons., floc.	.10	4.40	.0042	.0070	.26	.0120	.0000	.10	1.6	.0890
29634	Dec. 12	V. slight.	Cons., floc.	.13	4.90	.0030	.0028	.26	.0120	.0000	.07	1.6	.0850
29433	Nov. 17	None.	V. slight.	.09	3.40	.0006	.0064	.30	.0140	.0000	.11	1.0	.0020
29635	Dec. 12	None.	None.	.05	3.80	.0000	.0032	.28	.0190	.0000	.08	1.1	.0010
29430	Nov. 17	None.	None.	.02	3.60	.0006	.0070	.33	.0110	.0000	.19	0.8	.0020
29636	Dec. 12	None.	None.	.03	4.20	.0000	.0062	.32	.0150	.0000	.16	0.8	.0030

Odor, none.—— The first two samples were collected from well No. 1; the third and fourth, from well No. 2; the last two, from well No. 3. Well No. 1 receives water from well No. 2; wells Nos. 2 and 3 receive the effluent from the sand filters.

Chemical Examination of Water from the Charles River, after passing through the Sand Filters of the Milford Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29434	Nov. 17	None.	None.	.20	4.40	.0006	.0114	.33	.0110	.0000	.40	1.1	.0040
29638	Dec. 12	V. slight.	V. slight.	.14	4.40	.0010	.0126	.27	.0060	.0000	.33	1.0	.0130
29432	Nov. 17	None.	Cons., sand.	.18	4.60	.0006	.0124	.36	.0080	.0000	.48	1.1	.0050
29639	Dec. 12	V. slight.	V. slight.	.18	4.20	.0006	.0150	.28	.0050	.0000	.36	0.6	.0140

Odor, none.——The first two samples were collected from filter No. 2; the last two, from filter No. 3.

Chemical Examination of Water from Charles River opposite the Wells of the Milford Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
28610	Sept. 13	Slight.	Cons.	.20	3.35	1.50	.0016	.0276	.0252	.0024	.23	.0010	.0002	.39	0.3
29148	Oct. 24	Slight.	Slight.	.32	3.35	1.50	.0010	.0282	.0240	.0042	.25	.0010	.0008	.46	0.3
29429	Nov. 17	V. slight.	V. slight.	.33	5.25	2.10	.0024	.0186	.0176	.0010	.32	.0060	.0000	.59	1.3
29637	Dec. 12	V. slight.	Slight.	.26	3.30	1.55	.0006	.0226	.0204	.0022	.25	.0050	.0000	.39	0.6

Odor of the first sample, faintly earthy; of the others, faintly vegetable.

MILFORD AND HOPEDALE.

Chemical Examination of Water from a Pond near the Pumping Station of the Milford Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28611	Sept. 13	Slight.	Slight.	.29	2.80	1.80	.0024	.0522	.0476	.0046	.20	.0000	.0000	.74	0.2
29647	Dec. 12	Decided.	Cons.	.55	3.75	2.10	.0180	.0586	.0496	.0090	.33	.0010	.0000	.84	0.2

Odor of the first sample, distinctly unpleasant, becoming also fishy on heating; of the last, faintly vegetable, becoming distinctly fishy on heating.——The samples were collected from a small pond, about 400 feet west of the pumping station.

Chemical Examination of Water from Echo Lake, in Hopkinton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
29147	Oct. 24	Decided.	Cons.	.12	2.80	1.40	.0016	.0444	.0280	.0164	.24	.0010	.0001	.42	0.2
29646	Dec. 12	Decided.	Cons.	.24	2.90	1.30	.0002	.0346	.0218	.0128	.25	.0020	.0000	.38	0.2

Odor of the first sample, distinctly unpleasant; of the last, none, becoming distinctly vegetable on heating.——The samples were collected from the lake, near its outlet. Echo Lake is situated near the headwaters of the Charles River.

Chemical Examination of Water from a Pond on the Charles River, above Milford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
29829	Nov. 9	V. slight.	V. slight.	.40	4.80	1.90	.0020	.0228	.0196	.0032	.43	.0010	.0000	.49	1.1

Odor, none, becoming faintly vegetable on heating.——The samples were collected from a pond formed by a dam on the Charles River, about half a mile above the pumping station of the Milford Water Company.

MILLBURY.

WATER SUPPLY OF MILLBURY. — MILLBURY WATER COMPANY.

Chemical Examination of Water from the Well of the Millbury Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
27423	June 13	V. slight.	V. slight.	.00	3.50	.0000	.0008	.21	.0220	.0000	.02	2.0	.0020
27714	July 10	V. slight.	V. slight	.04	5.20	.0000	.0042	.19	.0090	.0001	.08	2.2	.0020
28142	Aug. 10	None.	V. slight.	.01	4.80	.0000	.0012	.22	.0150	.0000	.03	2.1	.0010
28552	Sept. 11	V. slight.	V. slight.	.02	5.30	.0000	.0018	.22	.0130	.0000	.01	2.0	.0030
28993	Oct. 11	None.	None.	.02	3.80	.0000	.0006	.17	.0150	.0000	.01	1.3	.0050
Av...	....	....	....	.02	4.52	.0000	.0017	.20	.0148	.0000	.03	1.9	.0026

Odor, none.

WATER SUPPLY OF MILLIS.

Chemical Examination of Water from the Aqua Rex Spring, Millis.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
27419	June 13	None.	None.	.00	6.60	.0000	.0006	.56	.1380	.0000	.01	2.3	.0020
27715	July 11	None.	Slight.	.00	7.40	.0006	.0012	.54	.1740	.0000	.03	2.5	.0040
28069	Aug. 7	None.	None.	.00	7.10	.0000	.0008	.56	.2200	.0000	.01	2.9	.0000
28540	Sept. 11	None.	None.	.00	8.00	.0000	.0010	.59	.1840	.0000	.02	2.3	.0040
28923	Oct. 9	None.	None.	.00	7.00	.0000	.0010	.59	.1760	.0000	.01	3.0	.0040
Av...	....	....	....	.00	7.22	.0001	.0009	.57	.1784	.0000	.02	2.6	.0028

Odor, none.—— The first two samples were collected from the spring; the others, from a faucet at the pumping station.

WATER SUPPLY OF MILTON.

Chemical Examination of Water from a Faucet in Milton, supplied from the Works of the Hyde Park Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
28530	Sept. 8	V. slight.	V. slight.	.06	11.50	.0140	.0080	1.85	.0650	.0001	.09	4.3	.0150
29496	Nov. 25	V. slight.	None.	.02	11.90	.0010	.0058	1.70	.0610	.0018	.09	4.6	.0050

Odor, none.

WATER SUPPLY OF MONSON.

Chemical Examination of Water from a Faucet in Monson, supplied from the Monson Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27226	May 24	V. slight.	Cons.	.00	2.50	.0000	.0022	.12	.0060	.0000	.02	0.6	.0140
27622	June 28	None.	V. slight.	.00	3.00	.0004	.0014	.13	.0040	.0000	.02	0.8	.0050
27947	Aug. 1	None.	V. slight.	.00	3.40	.0002	.0006	.12	.0020	.0000	.02	1.0	.0010
28357	Aug. 24	V. slight.	Slight.	.00	4.10	.0000	.0016	.13	.0020	.0000	.03	1.0	.0300
28802	Sept. 27	None.	V. slight.	.00	3.70	.0004	.0010	.10	.0110	.0000	.02	0.8	.0010
29221	Nov. 1	None.	V. slight.	.00	3.70	.0000	.0020	.11	.0060	.0000	.03	1.1	.0110
Av...	....	....	....	.00	3.40	.0002	.0015	.12	.0055	.0000	.02	0.9	.0103

Odor, none.

WATER SUPPLY OF TURNER'S FALLS FIRE DISTRICT, MONTAGUE.

Chemical Examination of Water from Lake Pleasant, Montague.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26106	Feb. 1	V. slight.	V. slight.	.05	2.75	1.00	.0058	.0110	.0098	.0012	.15	.0020	.0001	.12	0.5
27008	May 3	V. slight.	V. slight.	.05	2.20	0.60	.0004	.0066	.0064	.0002	.10	.0090	.0000	.09	0.2
28035	Aug. 2	V. slight.	V. slight.	.01	3.00	0.80	.0000	.0070	.0066	.0004	.11	.0000	.0000	.13	0.5
29211	Nov. 1	None.	None.	.07	2.20	0.50	.0006	.0082	.0078	.0004	.10	.0030	.0000	.08	0.3

Averages by Years.

-	1888	-	-	.00	2.33	0.49	.0027	.0071	-	-	.09	.0085	.0000	-	-
-	1893	-	-	.04	2.28	0.68	.0023	.0115	.0083	.0032	.12	.0045	.0000	.11	0.6
-	1894	-	-	.04	2.13	0.68	.0022	.0097	.0076	.0021	.12	.0025	.0000	.11	0.4
-	1895	-	-	.05	2.82	0.72	.0023	.0095	.0073	.0022	.13	.0056	.0000	.11	0.6
-	1896	-	-	.04	2.22	0.72	.0012	.0097	.0071	.0026	.14	.0023	.0000	.11	0.4
-	1897	-	-	.05	2.19	0.67	.0023	.0087	.0079	.0008	.14	.0008	.0000	.13	0.5
-	1898	-	-	.07	2.35	0.75	.0022	.0071	.0054	.0017	.13	.0020	.0000	.14	0.4
-	1899	-	-	.04	2.54	0.72	.0017	.0082	.0076	.0006	.11	.0035	.0000	.10	0.4

NOTE to analyses of 1899: Odor, generally faintly vegetable. On heating, the odor of the first sample became distinctly fishy and oily. —— The last sample was collected from a faucet in the town; the others, from the lake.

WATER SUPPLY OF NAHANT.

(See *Swampscott.*)

NANTUCKET.

Water Supply of Nantucket.—Wannacomet Water Company.

Chemical Examination of Water from Wannacomet Pond, Nantucket.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26561	Mar. 22	Slight.	Cons.	.01	6.10	1.55	.0008	.0166	.0122	.0044	2.55	.0030	.0001	.11	1.3
27666	July 5	V. slight.	V. slight.	.05	7.10	1.35	.0016	.0164	.0150	.0014	2.54	.0020	.0000	.17	1.3
28670	Sept. 19	V. slight.	Slight.	.10	7.20	1.65	.0014	.0158	.0134	.0024	2.49	.0010	.0000	.17	2.6
29572	Dec. 4	V. slight.	V. slight.	.11	6.45	1.55	.0000	.0120	.0108	.0012	2.39	.0010	.0000	.11	1.6
Av...	....	....	....	.07	6.71	1.52	.0009	.0152	.0128	.0024	2.49	.0017	.0000	.14	1.5

Odor, faintly vegetable or none. On heating, the odor of the first sample became faintly fishy.

Microscopical Examination of Water from Wannacomet Pond, Nantucket.

[Number of organisms per cubic centimeter.]

	1899. Mar.	1899. July.	1899. Sept.	1899. Dec.
Day of examination,	24	6	21	6
Number of sample,	26561	27666	28670	29572
PLANTS.				
Diatomaceæ,	5,312	6	14	280
Asterionella,	740	0	10	0
Cyclotella,	152	1	0	0
Synedra,	4,420	4	4	280
Cyanophyceæ, Cœlosphærium,	0	0	4	0
Algæ,	0	0	0	0
ANIMALS.				
Rhizopoda, Difflugia,	0	5	0	0
Infusoria,	784	561	244	17
Ciliated infusorian,	12	0	0	0
Dinobryon,	760	0	244	17
Dinobryon cases,	0	561	0	0
Peridinium,	12	0	0	0
Vermes,	2	4	0	0
Crustacea, Daphnia,	0	0	pr.	0
Miscellaneous, Zoöglœa,	5	0	0	2
Total,	6,121	582	280	280

WATER SUPPLY OF NATICK.

Chemical Examination of Water from Dug Pond, Natick.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25812	Jan. 2	V. slight.	Slight.	.20	5.75	1.60	.0024	.0142	.0140	.0002	.68	.0230	.0003	.22	2.3
26069	Jan. 30	Slight.	V. slight.	.21	5.25	1.50	.0022	.0154	.0138	.0016	.68	.0240	.0003	.26	2.1
26356	Feb. 28	Slight.	Slight.	.12	5.15	1.75	.0062	.0164	.0146	.0018	.59	.0290	.0003	.25	2.0
26660	Apr. 4	Slight.	V. slight.	.14	5.05	1.75	.0024	.0144	.0132	.0012	.54	.0470	.0002	.25	1.6
26984	May 1	V. slight.	V. slight.	.14	5.10	1.60	.0014	.0168	.0144	.0024	.53	.0310	.0002	.22	1.8
27274	May 31	None.	Slight.	.08	4.90	1.75	.0008	.0174	.0158	.0016	.64	.0210	.0001	.24	2.1
27654	July 5	V. slight.	Slight.	.09	5.00	1.35	.0004	.0228	.0194	.0034	.64	.0030	.0001	.29	1.8
27934	July 31	Slight.	Slight.	.09	5.10	1.30	.0008	.0232	.0206	.0026	.54	.0020	.0000	.29	1.6
28424	Aug. 31	V. slight.	Slight.	.07	5.55	1.85	.0002	.0216	.0208	.0008	.57	.0020	.0000	.27	2.0
28847	Oct. 2	Slight.	V. slight.	.10	4.55	1.55	.0018	.0336	.0216	.0120	.62	.0030	.0000	.29	2.0
29201	Oct. 31	V. slight.	V. slight.	.15	5.00	1.25	.0014	.0188	.0176	.0012	.63	.0040	.0000	.23	2.2
29622	Nov. 28	V. slight.	V. slight.	.06	4.65	1.25	.0182	.0192	.0172	.0020	.60	.0010	.0001	.19	2.2

Averages by Years

-	1888	-	-	.13	5.24	1.09	.0070	.0228	-	-	.66	.0197	.0003	-	-
-	1889	-	-	.16	5.55	1.20	.0046	.0242	.0197	.0045	.71	.0292	.0004	-	-
-	1890	-	-	.14	5.85	1.36	.0027	.0199	.0166	.0033	.72	.0227	.0002	-	2.7
-	1891	-	-	.09	5.71	1.45	.0085	.0207	.0167	.0040	.69	.0326	.0003	-	2.4
-	1892	-	-	.06	5.38	1.24	.0068	.0173	.0135	.0038	.72	.0323	.0001	-	2.4
-	1893	-	-	.08	5.28	1.39	.0062	.0192	.0158	.0034	.71	.0193	.0003	.23	2.1
-	1894	-	-	.10	5.64	1.65	.0060	.0155	.0132	.0023	.80	.0218	.0001	.21	2.3
-	1895	-	-	.13	6.27	1.86	.0044	.0191	.0164	.0027	.87	.0312	.0001	.24	2.6
-	1896	-	-	.15	6.19	1.77	.0045	.0176	.0147	.0029	.86	.0290	.0002	.25	2.3
-	1897	-	-	.12	5.41	1.47	.0063	.0192	.0166	.0026	.84	.0130	.0002	.25	2.4
-	1898	-	-	.16	5.21	1.57	.0039	.0168	.0152	.0016	.70	.0127	.0002	.25	2.1
-	1899	-	-	.12	5.09	1.54	.0032	.0195	.0169	.0026	.60	.0158	.0001	.25	2.0

NOTE to analyses of 1899: Odor of No. 27654, distinctly unpleasant; of the others, faintly vegetable or none, sometimes becoming fishy or oily on heating. —— The samples were collected from a faucet at the pumping station.

NATICK.

Microscopical Examination of Water from Dug Pond, Natick.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Jan.	Mar.	Apr.	May.	May.	July.	Aug.	Sept.	Oct.	Nov.	Nov.
Day of examination,	3	31	1	6	2	31	6	1	1	3	1	29
Number of sample,	25812	26069	26356	26660	26984	27274	27654	27934	28424	28847	29201	29522
PLANTS.												
Diatomaceæ,	11	326	140	84	466	62	20	25	22	28	86	182
Asterionella,	0	290	114	67	302	7	2	0	0	16	10	41
Cyclotella,	2	14	6	7	36	28	12	2	2	0	6	53
Melosira,	0	14	16	0	18	0	0	7	0	0	52	76
Tabellaria,	6	2	1	2	96	24	0	1	1	2	8	10
Cyanophyceæ,	0	0	0	0	0	0	174	34	8	0	0	0
Microcystis,	0	0	0	0	0	0	170	26	7	0	0	0
Algæ,	1	14	12	6	68	6	39	22	2	26	50	8
ANIMALS.												
Rhizopoda, Difflugia,	0	0	0	0	0	0	0	1	0	0	0	0
Infusoria,	4	122	9	9	18	23	16	10	3	25	32	35
Dinobryon,	3	120	3	0	16	21	0	0	1	18	32	35
Vermes,	0	0	1	1	0	0	2	1	0	0	0	0
Crustacea, Cyclops,	pr.	0	pr.	0	0	pr.	0	0	0	0	0	pr.
Miscellaneous, Zoöglœa,	3	3	5	3	0	0	5	7	8	12	0	3
TOTAL,	19	465	167	103	552	91	256	100	43	91	168	228

WATER SUPPLY OF NEEDHAM.

The advice of the State Board of Health to the town of Needham, with reference to an additional water supply for that town, may be found on pages 32 to 34 of this volume. Analyses of samples of water collected from various test wells in the vicinity of a proposed new well, to be located a short distance east of the present well, are given in the following table: —

NEEDHAM.

Chemical Examination of Water from the large Well of the Needham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26238	Feb. 16	None.	None.	.00	6.80	.0000	.0006	.84	.2550	.0000	.02	2.5	.0010
26684	Apr. 7	None.	None.	.00	6.30	.0000	.0018	.74	.2350	.0000	.02	2.0	.0020
26965	Apr. 27	None.	None.	.00	7.00	.0000	.0010	.73	.2100	.0000	.02	1.8	.0000
27219	May 23	None.	None.	.00	5.80	.0000	.0014	.66	.1480	.0000	.01	1.7	.0020
27468	June 19	None.	None.	.00	6.50	.0006	.0012	.67	.2080	.0000	.02	1.7	.0020
28128	Aug. 10	None.	None.	.02	7.00	.0000	.0004	.76	.2750	.0000	.02	2.0	.0020
28195	Aug. 14	None.	None.	.00	7.50	.0000	.0002	.76	.2350	.0000	.02	2.0	.0010
29066	Oct. 18	None.	None.	.04	5.70	.0000	.0006	.66	.1240	.0000	.03	2.3	.0050
29693	Dec. 19	None.	None.	.00	6.40	.0000	.0008	.74	.1900	.0000	.02	1.7	.0020

Averages by Years.

-	1893	-	-	.00	5.28	.0000	.0007	.63	.1230	.0000	.05	1.9	.0000
-	1894	-	-	.01	5.18	.0013	.0005	.66	.1867	.0000	.01	1.7	.0020
-	1896	-	-	.00	6.65	.0000	.0009	.90	.1575	.0000	.02	2.0	.0010
-	1897	-	-	.00	5.90	.0000	.0020	.82	.1600	.0000	.06	1.8	.0000
-	1898	-	-	.01	7.08	.0003	.0012	.88	.2200	.0000	.02	2.3	.0015
-	1899*	-	-	.01	6.44	.0001	.0009	.72	.2004	.0000	.02	2.0	.0021

NOTE to analyses of 1899: Odor, none.——No. 26684 was collected from the well; the others, from a faucet in the pumping station.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Tubular Test Wells in Needham.

[Parts per 100,000.]

Number.	Dates of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26958	Apr. 27	Decided.	Cons.	.05	7.90	.0000	.0014	.73	.2100	.0002	.02	2.0	.0020
27145	May 18	Decided.	Cons.	.05	7.40	.0000	.0008	.76	.2600	.0003	.01	2.1	.0040
26959	Apr. 27	None.	V. slight.	.01	8.50	.0000	.0012	.88	.3250	.0002	.02	2.5	.0070
27146	May 18	None.	None.	.00	7.80	.0000	.0006	.94	.3225	.0003	.01	2.3	.0050
26960	Apr. 27	None.	None.	.00	6.70	.0000	.0012	.87	.3000	.0000	.02	2.1	.0020
27147	May 18	Decided.	Cons.	.10	10.50	.0000	.0014	.71	.2425	.0000	.01	2.0	.0150
26961	Apr. 27	Slight.	Slight.	.05	9.50	.0012	.0018	.98	.5400	.0003	.02	2.7	.0010
27148	May 18	Slight.	Cons.	.01	7.90	.0000	.0010	.95	.3750	.0003	.02	2.6	.0020
26962	Apr. 27	None.	None.	.00	9.90	.0000	.0012	.95	.5600	.0000	.02	2.7	.0010
27149	May 18	Decided.	Cons.	.02	8.10	.0000	.0010	.96	.3800	.0000	.01	2.6	.0020
26963	Apr. 27	None.	None.	.00	8.80	.0000	.0012	.84	.3650	.0000	.02	2.5	.0010
27150	May 18	Decided.	Cons.	.02	8.00	.0000	.0010	.86	.3550	.0000	.01	2.3	.0030
26964	Apr. 27	None.	None.	.00	6.50	.0000	.0012	.66	.1600	.0000	.01	1.8	.0010
27151	May 18	Slight.	Slight.	.02	7.50	.0000	.0018	.95	.3700	.0002	.01	2.1	.0020
28127	Aug. 10	None.	None.	.00	7.70	.0000	.0010	.85	.3800	.0000	.01	2.1	.0020

Odor, none.——The samples were collected from test wells located easterly and south easterly from the present large well. Nos. 26958 and 27145 were collected from well No. 19; Nos. 26959 and 27146, from well No. 20; Nos. 26960 and 27147, from well No. 21; Nos. 26961 and 27148, from well No. 22; Nos. 26962 and 27149, from well No. 23; Nos. 26963 and 27150, from well No. 26; Nos. 26964 and 27151, from well No. 28; and No. 28127, from a system of 8 tubular wells located near the large well. Water from these wells is pumped into the large well.

NEW BEDFORD.

WATER SUPPLY OF NEW BEDFORD.

Chemical Examination of Water from the Storage Reservoir of the New Bedford Water Works in Acushnet.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28341	Aug. 23	V. slight.	V. slight.	0.70	4.65	2.15	.0002	.0296	.0272	.0024	.48	.0010	.0000	0.78	1.0
29444	Nov. 20	V. slight.	V. slight.	1.00	5.20	2.70	.0030	.0308	.0298	.0010	.58	.0010	.0000	1.07	0.8

Odor, vegetable.

Chemical Examination of Water from the Conduit of the New Bedford Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26270	Feb. 19	V. slight.	V. slight.	.70	4.25	1.85	.0028	.0154	.0144	.0010	.54	.0060	.0001	.78	0.8
26756	Apr. 12	V. slight.	Slight.	.52	3.50	2.00	.0024	.0164	.0152	.0012	.46	.0020	.0000	.67	0.0
27566	June 24	V. slight	V. slight.	.98	4.35	2.00	.0032	.0298	.0280	.0018	.53	.0040	.0000	.86	0.3
Av...	....	....	....	.73	4.03	1.95	.0028	.0205	.0192	.0013	.51	.0040	.0000	.75	0.4

Odor, faintly vegetable. —— The samples were collected from the conduit, at its entrance to the receiving reservoir, and represent water from the storage reservoir.

Chemical Examination of Water from a Faucet at City Hall, New Bedford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28342	Aug. 23	V. slight.	V. slight.	.14	3.60	1.70	.0002	.0202	.0172	.0030	.40	.0020	.0000	.35	0.5
28732	Sept. 25	V. slight.	V. slight.	.08	3.25	1.60	.0008	.0200	.0190	.0010	.46	.0000	.0001	.30	0.8
29117	Oct. 24	V. slight.	V. slight.	.13	3.05	1.35	.0010	.0172	.0166	.0006	.49	.0020	.0000	.35	0.5
29445	Nov. 20	V. slight.	V. slight.	.21	2.95	1.20	.0006	.0172	.0162	.0010	.49	.0010	.0000	.28	0.6
29818	Dec. 29	V. slight	V. slight.	.34	3.20	1.30	.0004	.0160	.0150	.0010	.50	.0010	.0000	.37	0.6
Av...	....	....	....	.18	3.21	1.43	.0006	.0181	.0168	.0013	.47	.0012	.0000	.33	0.6

Odor, none. On heating, the odor of most of the samples was vegetable, and of the first and fourth, faintly unpleasant.

NEW BEDFORD.

Chemical Examination of Water from Little Quittacas Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26273	Feb. 19	V. slight.	Slight.	.25	3.45	1.40	.0036	.0172	.0152	.0020	.51	.0020	.0000	.40	0.8
26759	Apr. 12	V. slight.	Slight.	.22	3.35	1.80	.0006	.0158	.0132	.0026	.44	.0010	.0000	.35	0.8
27564	June 24	V. slight.	V. slight.	.20	3.15	1.25	.0022	.0182	.0178	.0004	.44	.0000	.0000	.35	0.8
28344	Aug. 23	V. slight.	Slight.	.20	3.45	1.70	.0002	.0228	.0184	.0044	.46	.0010	.0000	.48	0.6
28886	Oct. 4	V. slight.	V. slight.	.12	3.00	1.00	.0004	.0184	.0180	.0004	.48	.0000	.0000	.35	0.6
29132	Oct. 24	Slight.	V. slight.	.20	3.70	1.35	.0012	.0186	.0180	.0006	.46	.0020	.0000	.34	0.6
29685	Dec. 18	V. slight.	Slight.	.21	3.25	1.35	.0000	.0174	.0166	.0008	.52	.0010	.0000	.35	0.5
29776	Dec. 26	V. slight.	V. slight.	.20	3.20	1.35	.0002	.0166	.0160	.0006	.48	.0010	.0000	.37	0.6

Averages by Years.

-	1893	-	-	.11	3.02	1.23	.0015	.0156	.0128	.0028	.48	.0025	.0000	.29	0.6
-	1894	-	-	.18	2.91	0.95	.0002	.0165	.0137	.0028	.48	.0008	.0000	.31	0.7
-	1895	-	-	.18	3.17	1.25	.0008	.0162	.0137	.0025	.51	.0037	.0000	.31	0.7
-	1896	-	-	.21	3.17	1.27	.0003	.0194	.0157	.0037	.53	.0033	.0000	.36	0.7
-	1897	-	-	.18	3.04	1.07	.0007	.0188	.0146	.0042	.56	.0020	.0000	.30	0.7
-	1898	-	-	.21	3.31	1.32	.0002	.0175	.0150	.0025	.55	.0007	.0000	.35	1.1
-	1899*	-	-	.20	3.33	1.44	.0012	.0183	.0165	.0018	.47	.0010	.0000	.37	0.5

NOTE to analyses of 1899: Odor, faintly vegetable or none. On heating, the odor of the first sample became faintly fishy.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Microscopical Examination of Water from Little Quittacas Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1899.							
	Feb.	Apr.	June.	Aug.	Oct.	Oct.	Dec.	Dec.
Day of examination, ...	21	14	26	24	5	26	19	27
Number of sample, ...	26273	26759	27564	28344	28886	29132	29685	29776
PLANTS.								
Diatomaceæ, ...	110	1,504	6	11	11	3	17	33
Asterionella, . ? . .	0	982	0	1	0	0	0	16
Synedra, ...	108	548	5	7	6	3	17	15
Cyanophyceæ, ...	0	0	15	17	0	0	0	0
Anabæna, ...	0	0	14	17	0	0	0	0
Algæ, ...	0	4	4	2,004	0	0	3	0
Protococcus, ...	0	0	0	2,000	0	0	0	0

NEW BEDFORD.

Microscopical Examination of Water from Little Quittacas Pond, Lakeville — Concluded.

[Number of organisms per cubic centimeter.]

	1899.							
	Feb.	April.	June.	Aug.	Oct.	Oct.	Dec.	Dec.
ANIMALS.								
Infusoria,	146	192	1	3	4	0	0	1
Dinobryon,	144	188	0	0	4	0	0	0
Vermes, Notholca,	0	1	0	0	0	0	0	0
Crustacea, Cyclops,	0	0	0	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	5	12	5	15	5	5	3	3
TOTAL,	261	1,718	31	2,050	20	8	28	37

Chemical Examination of Water from Great Quittacas Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26272	Feb. 19	V. slight.	V. slight.	.70	3.85	1.90	.0010	.0188	.0168	.0020	.52	.0010	.0000	.86	0.6
26758	Apr. 12	V. slight.	Slight.	.51	3.35	1.85	.0008	.0168	.0158	.0010	.44	.0020	.0000	.66	0.2
27563	June 24	V. slight.	V. slight.	.41	3.60	1.35	.0010	.0182	.0170	.0012	.48	.0010	.0000	.51	0.3
28343	Aug. 23	V. slight.	V. slight.	.28	3.40	1.30	.0000	.0164	.0148	.0016	.48	.0010	.0000	.50	0.3
29643	Dec. 12	V. slight.	Cons.	.26	3.45	1.30	.0004	.0208	.0174	.0034	.52	.0010	.0000	.49	0.5

Averages by Years.

-	1894	-	-	.49	3.30	1.35	.0002	.0154	.0139	.0015	.50	.0017	.0000	.50	0.6
-	1895	-	-	.40	3.30	1.22	.0001	.0154	.0133	.0021	.53	.0020	.0000	.52	0.6
-	1896	-	-	.52	3.82	1.67	.0005	.0198	.0173	.0025	.55	.0030	.0000	.75	0.7
-	1897	-	-	.54	3.56	1.47	.0005	.0160	.0148	.0012	.58	.0002	.0000	.58	0.7
-	1898	-	-	.65	3.81	2.00	.0005	.0197	.0180	.0017	.57	.0005	.0000	.77	0.9
-	1899	-	-	.43	3.53	1.64	.0006	.0182	.0164	.0018	.49	.0012	.0000	.60	0.4

NOTE to analyses of 1899: Odor, generally faintly vegetable or none. On heating, the odor of some of the samples became stronger.

NEW BEDFORD.

Microscopical Examination of Water from Great Quittacas Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1899.				
	Feb.	Apr.	June.	Aug.	Dec.
Day of examination,	21	14	26	24	18
Number of sample,	26272	26758	27566	28343	29643
PLANTS.					
Diatomaceæ,	8	538	19	0	9
Asterionella,	4	506	2	0	0
Cyanophyceæ,	0	0	3	2	0
Algæ,	0	0	8	10	0
ANIMALS.					
Rhizopoda, Actinophrys,	0	1	0	0	0
Infusoria,	38	42	0	10	0
Dinobryon,	38	32	0	5	0
Uroglena,	0	2	0	0	0
Vermes,	1	6	0	2	0
Crustacea, Cyclops,	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	0	7	3	5	3
TOTAL,	47	594	33	29	12

Chemical Examination of Water from Long Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26271	Feb. 19	V. slight.	V. slight.	0.96	4.25	2.50	.0012	.0182	.0178	.0004	.47	.0010	.0000	1.18	0.8
26757	Apr. 12	V. slight.	V. slight.	0.69	3.35	2.00	.0004	.0166	.0162	.0004	.37	.0010	.0000	0.78	0.0
27565	June 24	V. slight.	V. slight.	0.64	3.00	1.50	.0014	.0192	.0182	.0010	.46	.0010	.0000	0.72	0.2
29644	Dec. 12	V. slight	Slight.	0.71	3.70	1.65	.0006	.0194	.0188	.0006	.47	.0020	.0000	0.79	0.3

NEW BEDFORD.

Chemical Examination of Water from Long Pond, Lakeville — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Sus-pended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
-	1894	-	-	1.00	3.80	1.94	.0002	.0183	.0162	.0021	.47	.0018	.0000	0.90	0.5
-	1895	-	-	0.89	4.07	2.25	.0002	.0190	.0167	.0023	.53	.0010	.0000	0.95	0.5
-	1896	-	-	0.95	4.17	2.17	.0005	.0219	.0193	.0026	.58	.0007	.0000	1.16	0.5
-	1897	-	-	0.96	4.00	2.00	.0004	.0203	.0191	.0012	.56	.0010	.0000	0.87	0.6
-	1898	-	-	1.06	4.21	2.46	.0004	.0217	.0204	.0013	.49	.0012	.0000	1.13	0.6
-	1899	-	-	0.75	3.57	1.91	.0009	.0183	.0177	.0006	.44	.0012	.0000	0.87	0.2

Note to analyses of 1899: Odor, faintly vegetable or none; on heating, the odor of all of the samples was vegetable, and of the second sample, also mouldy.

Water Supply of Newburyport.

Chemical Examination of Water from the Newburyport Water Works.

[Parts per 100,000.]

Number.	Date of Collection	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albu-minoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25954	Jan. 16	Slight.	V. slight.	.13	6.10	.0020	.0076	.47	.0140	.0000	.17	2.0	.0100
26463	Mar. 13	Slight.	V. slight.	.09	5.50	.0006	.0036	.63	.0270	.0000	.08	2.1	.0110
27104	May 15	Slight, milky.	Slight.	.06	4.80	.0000	.0082	.49	.0300	.0000	.07	2.0	.0100
27790	July 17	V. slight.	V. slight.	.08	6.20	.0000	.0008	.48	.0220	.0000	.08	2.3	.0070
28646	Sept. 18	Slight.	Cons.	.12	5.90	.0000	.0024	.52	.0180	.0001	.07	2.5	.0380
29374	Nov. 13	Decided.	Slight.	.07	7.00	.0006	.0060	.50	.0310	.0000	.05	2.3	.0390
Av...	....	....	....	.09	5.92	.0005	.0039	.51	.0237	.0000	.09	2.2	.0192

Odor, none. A faintly vegetable odor was developed in the first two samples on heating.—The first sample was collected from the storage basin; the others, from faucets in the town.

WATER SUPPLY OF NEWTON.

Chemical Examination of Water from a Faucet at the Newton Water Works Pumping Station.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25951	Jan. 16	None.	None.	.01	5.50	.0008	.0022	.48	.0480	.0000	.06	2.3	.0030
26228	Feb. 13	None.	None.	.00	6.80	.0000	.0012	.43	.0400	.0000	.02	2.1	.0010
26459	Mar. 13	None.	None.	.03	5.20	.0010	.0026	.43	.0320	.0000	.06	2.2	.0000
26681	Apr. 6	None.	V. slight.	.00	5.00	.0000	.0012	.39	.0340	.0000	.02	1.6	.0010
27108	May 15	None.	None.	.00	6.80	.0000	.0018	.41	.0270	.0000	.02	3.0	.0010
27470	June 19	None.	None.	.00	5.50	.0006	.0024	.50	.0530	.0000	.06	2.2	.0010
27789	July 17	None.	None.	.01	5.70	.0006	.0014	.43	.0190	.0000	.03	2.2	.0020
28218	Aug. 14	None.	None.	.02	6.00	.0000	.0030	.44	.0210	.0000	.11	2.1	.0020
28645	Sept. 18	None.	None.	.02	6.20	.0000	.0026	.45	.0240	.0000	.05	2.5	.0020
29033	Oct. 16	None.	None.	.00	5.90	.0008	.0028	.45	.0180	.0000	.10	2.6	.0010
29368	Nov. 18	None.	V. slight.	.02	6.50	.0014	.0052	.49	.0210	.0000	.09	2.6	.0100
29684	Dec. 18	V. slight.	None.	.08	5.00	.0010	.0078	.56	.0130	.0000	.21	2.0	.0100

Averages by Years.

-	1888	-	-	.01	4.64	.0009	.0111	.35	.0072	.0001	-	-	-
-	1889	-	-	.01	4.01	.0002	.0061	.30	.0119	.0001	-	-	-
-	1892	-	-	.02	5.18	.0006	.0028	.35	.0190	.0001	-	2.4	.0179
-	1893	-	-	.03	5.08	.0004	.0019	.38	.0194	.0000	.09	2.3	.0119
-	1894	-	-	.03	5.99	.0001	.0021	.40	.0157	.0000	.05	2.7	.0110
-	1895	-	-	.03	5.85	.0001	.0023	.42	.0230	.0000	.06	2.4	.0146
-	1896	-	-	.02	5.70	.0007	.0024	.41	.0260	.0000	.06	2.6	.0108
-	1897	-	-	.04	5.80	.0005	.0027	.46	.0350	.0000	.07	2.8	.0122
-	1898	-	-	.04	6.18	.0002	.0024	.47	.0364	.0000	.07	2.8	.0032
-	1899	-	-	.02	5.84	.0005	.0028	.45	.0292	.0000	.07	2.3	.0028

NOTE to analyses of 1899: Odor, none. A vegetable odor was developed in the last sample on heating.

WATER SUPPLY OF NORTH ADAMS.

The advice of the State Board of Health to the board of health of North Adams, relative to the quality of water drawn from wells in the central part of the city as an auxiliary source of water supply, may be found on pages 35 and 36 of this volume. The results of analyses of samples of water collected from the wells are given in the following table.

The advice of the State Board of Health to the board of health of North Adams, relative to the use of ice from Hudson Brook, in Clarksburg, may be found on pages 107 and 108 of this volume.

NORTH ADAMS.

Chemical Examination of Water from Notch Brook Storage Reservoir, North Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26405	Mar. 7	Slight.	Cons.	.06	7.00	0.95	.0026	.0034	.0024	.0010	.04	.0060	.0002	.08	6.0
26950	Apr. 26	V. slight.	Slight.	.06	4.80	0.60	.0008	.0054	.0032	.0022	.05	.0030	.0001	.15	3.4
28377	Aug. 26	V. slight.	Slight.	.04	9.25	1.25	.0020	.0092	.0084	.0008	.05	.0010	.0000	.18	5.3
29170	Oct. 26	Slight.	Cons.	.05	10.10	1.35	.0040	.0104	.0062	.0042	.10	.0020	.0000	.15	8.5
Av...	....	....	....	.05	7.79	1.04	.0023	.0071	.0051	.0020	.06	.0030	.0001	.14	5.8

Odor of the first three samples, none; of the last, very faintly unpleasant, becoming distinctly unpleasant and fishy on heating.

Chemical Examination of Water from Broad Brook in Pownal, Vt.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26404	Mar. 7	V. slight.	Cons.	.07	4.00	1.05	.0002	.0098	.0026	.0072	.04	.0130	.0001	.16	2.3
26949	Apr. 26	V. slight.	V. slight.	.34	2.50	1.20	.0004	.0114	.0100	.0014	.05	.0120	.0000	.68	0.8
28376	Aug. 25	None.	V. slight.	.18	4.65	1.50	.0006	.0062	.0058	.0004	.05	.0180	.0000	.28	2.2
29169	Oct. 26	V. slight.	V. slight.	.20	3.95	1.50	.0008	.0066	.0064	.0002	.09	.0210	.0000	.29	2.2
Av...	....	....	....	.18	3.77	1.31	.0005	.0085	.0062	.0023	.06	.0160	.0000	.35	1.9

Odor, none. On heating, the odor of the third sample became faintly vegetable; of the fourth, faintly unpleasant.

Chemical Examination of Water from Tubular Wells used as an Auxiliary Supply for North Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
29011	Oct. 12	None.	None.	.01	17.90	.0000	.0018	.33	.0660	.0000	.38	10.6	.0010

Odor, none.——The sample was collected from a faucet in the pumping station.

NORTH ADAMS.

The advice of the State Board of Health to N. L. Millard & Co., with reference to the use of water from two wells beneath their factory for drinking purposes, may be found on page 35 of this volume. The results of analyses of samples of water collected from the wells are given in the following table: —

Chemical Examination of Water from the Well at the Factory of N. L. Millard & Co., in North Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
26563	Mar. 22	None.	V. slight.	.01	49.40	.0000	.0026	1.63	1.0000	.0000	.05	33.5	.0020
26564	Mar. 23	None.	V. slight.	.01	53.70	.0000	.0020	1.51	1.0000	.0000	.06	35.5	.0020

Odor, none.

Water Supply of Northampton.

Chemical Examination of Water from Roberts' Meadow Brook, just above the Middle Reservoir of the Northampton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26020	Jan. 24	None.	V. slight.	.11	3.40	0.90	.0002	.0032	.0032	.0000	.10	.0040	.0000	.15	1.1
26238	Feb. 21	V. slight.	V. slight.	.10	3.65	1.15	.0024	.0052	.0048	.0004	.08	.0020	.0001	.16	1.3
26550	Mar. 21	V. slight.	V. slight.	.10	3.15	1.00	.0032	.0072	.0064	.0008	.06	.0050	.0000	.21	1.0
26945	Apr. 25	V. slight.	V. slight.	.21	2.40	1.10	.0008	.0092	.0076	.0016	.07	.0010	.0001	.31	0.8
27305	May 22	V. slight.	V. slight.	.16	3.50	1.00	.0010	.0082	.0060	.0022	.07	.0030	.0001	.24	1.3
27911	July 26	Slight.	Cons.	.33	4.25	1.60	.0020	.0240	.0152	.0088	.07	.0040	.0000	.51	1.6
28361	Aug. 24	Slight.	Slight.	.23	4.50	1.05	.0032	.0132	.0096	.0036	.09	.0010	.0000	.24	2.0
28799	Sept. 27	Slight.	Slight.	.50	5.40	1.75	.0016	.0220	.0156	.0064	.13	.0020	.0000	.78	1.8
29142	Oct. 24	V. slight.	V. slight.	.30	5.00	1.65	.0010	.0116	.0110	.0006	.16	.0010	.0001	.40	1.8
29446	Nov. 20	V. slight.	V. slight.	.19	4.15	1.10	.0004	.0086	.0080	.0006	.11	.0010	.0001	.27	1.8
29790	Dec. 26	V. slight.	V. slight.	.38	3.85	1.50	.0002	.0110	.0102	.0008	.12	.0030	.0000	.45	1.6
Av.	....	....	....	.24	3.93	1.25	.0015	.0112	.0089	.0023	.10	.0025	.0000	.34	1.5

Odor, faintly vegetable or none. On heating, the odor of nearly all of the samples was vegetable.

NORTHAMPTON.

Chemical Examination of Water from the Middle Storage Reservoir on Roberts' Meadow Brook, collected near the Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26021	Jan. 24	V. slight.	V. slight.	.12	3.50	0.85	.0000	.0056	.0046	.0010	.11	.0040	.0000	.18	1.1
26289	Feb. 21	V. slight.	V. slight.	.09	3.55	1.10	.0016	.0052	.0042	.0010	.08	.0020	.0001	.15	1.3
26551	Mar. 21	V. slight.	V. slight.	.11	2.80	1.10	.0012	.0106	.0076	.0030	.07	.0050	.0001	.22	1.0
26946	Apr. 25	V. slight.	V. slight.	.19	3.00	1.00	.0002	.0066	.0064	.0002	.07	.0040	.0001	.29	0.8
27206	May 22	V. slight.	Slight.	.15	3.10	1.15	.0000	.0124	.0090	.0034	.06	.0010	.0001	.24	1.1
27680	July 6	V. slight.	V. slight.	.22	4.15	1.20	.0004	.0192	.0158	.0034	.06	.0020	.0000	.39	1.6
27912	July 26	Slight.	Slight.	.23	4.00	1.35	.0012	.0208	.0166	.0042	.06	.0020	.0000	.43	1.6
28362	Aug. 24	Slight.	Slight.	.21	4.45	1.65	.0000	.0210	.0142	.0068	.07	.0010	.0000	.39	1.4
28800	Sept. 27	Slight.	Slight.	.34	4.65	1.90	.0032	.0192	.0156	.0036	.11	.0000	.0000	.55	1.8
29143	Oct. 24	Slight.	Slight.	.41	4.75	1.75	.0038	.0164	.0152	.0012	.15	.0020	.0001	.50	2.0
29447	Nov. 20	V. slight.	V. slight.	.32	4.40	1.40	.0002	.0182	.0120	.0012	.15	.0000	.0001	.44	1.4
29791	Dec. 26	V. slight.	V. slight.	.27	3.90	1.35	.0002	.0110	.0096	.0014	.13	.0050	.0001	.37	1.6

Averages by Years.

-	1895	-	-	.57	4.56	1.72	.0008	.0181	.0156	.0025	.13	.0024	.0000	.61	1.8
-	1896	-	-	.25	3.39	1.27	.0004	.0121	.0092	.0029	.10	.0047	.0000	.34	1.7
-	1897	-	-	.29	3.90	1.31	.0013	.0116	.0103	.0013	.11	.0023	.0000	.35	1.6
-	1898	-	-	.30	3.84	1.45	.0013	.0126	.0101	.0025	.10	.0037	.0000	.43	1.4
-	1899	-	-	.22	3.85	1.32	.0010	.0134	.0109	.0025	.09	.0023	.0001	.35	1.4

NOTE to analyses of 1899: Odor of No. 27206, faintly vegetable or unpleasant, becoming faintly fishy on heating; of the others, vegetable or none.

Microscopical Examination of Water from the Middle Storage Reservoir on Roberts' Meadow Brook, collected near the Surface.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May	July.	July.	Aug.	Sept.	Oct.	Nov	Dec.
Day of examination,	25	28	22	27	24	7	28	28	29	26	22	28
Number of sample,	26021	26289	26551	26946	27206	27680	27912	28362	28800	29143	29447	29791
PLANTS.												
Diatomaceæ,	20	7	11	99	286	248	329	494	336	396	265	48
Asterionella,	8	0	4	37	4	0	0	30	8	70	176	36
Melosira,	0	0	0	11	114	42	136	100	80	178	20	0
Synedra,	12	5	5	24	154	184	192	262	234	130	69	11
Cyanophyceæ, Oscillaria,	0	0	0	0	0	0	0	0	0	0	0	1
Algæ,	0	0	0	1	2	74	23	8	10	0	0	1
Arthrodesmus,	0	0	0	0	2	74	22	8	6	0	0	0

NORTHAMPTON.

Microscopical Examination of Water from the Middle Storage Reservoir on Roberts' Meadow Brook, collected near the Surface — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	July.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda, Difflugia,	0	0	0	0	0	0	0	2	0	0	0	0
Infusoria,	0	0	0	1	294	98	6	18	12	5	7	7
Dinobryon,	0	0	0	0	266	0	2	0	0	0	7	6
Peridinium,	0	0	0	0	26	98	1	12	6	4	0	0
Vermes,	0	0	0	0	3	2	0	1	2	2	0	0
Crustacea, Cyclops,	0	0	0	0	0	0	pr.	0	pr.	pr.	0	0
Miscellaneous, Zoöglœa,	3	8	7	7	20	5	5	15	8	10	5	3
TOTAL,	23	15	18	108	605	425	363	478	368	418	277	61

Chemical Examination of Water from the Middle Storage Reservoir on Roberts' Meadow Brook, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26022	Jan. 24	Slight.	V. slight.	0.19	3.90	0.90	.0092	.0084	.0062	.0022	.11	.0070	.0002	.24	1.4
26290	Feb. 21	V. slight.	Slight.	0.15	4.00	1.25	.0050	.0060	.0052	.0008	.09	.0080	.0002	.19	1.4
26552	Mar. 21	V. slight	V. slight.	0.12	2.60	1.00	.0010	.0088	.0062	.0026	.06	.0030	.0001	.22	0.8
26947	Apr. 25	V. slight.	Slight.	0.20	2.50	0.75	.0006	.0084	.0064	.0020	.07	.0020	.0001	.31	1.0
27207	May 22	V. slight.	Slight.	0.14	3.40	1.05	.0014	.0102	.0084	.0018	.07	.0000	.0001	.25	1.1
27681	July 6	Slight.	Slight.	0.35	4.65	1.15	.0084	.0118	.0110	.0008	.05	.0000	.0000	.28	1.6
27913	July 26	Decided.	Cons.	1.25	5.35	0.90	.0318	.0228	.0140	.0088	.07	.0020	.0000	.40	2.1
28363	Aug. 24	Decided.	Cons.	2.40	6.45	1.55	.0660	.0260	.0172	.0088	.08	.0050	.0000	.57	1.8
28801	Sept. 27	Slight.	Heavy.	3.25	7.50	2.00	.1076	.0352	.0232	.0120	.09	.0000	.0001	.88	2.6
29144	Oct. 24	Slight.	Slight.	0.34	5.25	2.25	.0034	.0188	.0164	.0024	.16	.0010	.0001	.49	2.0
29448	Nov. 20	V. slight.	V. slight.	0.37	4.25	1.35	.0006	.0126	.0116	.0010	.12	.0010	.0001	.45	1.7
29792	Dec. 26	V. slight.	Slight.	0.25	4.30	1.35	.0030	.0116	.0102	.0014	.13	.0030	.0001	.32	1.7

Averages by Years.

-	1895	-	-	1.86	6.27	2.14	.0159	.0247	.0182	.0065	.14	.0038	.0000	.89	2.0
-	1896	-	-	0.90	4.85	1.54	.0124	.0171	.0118	.0053	.10	.0045	.0000	.54	1.9
-	1897	-	-	0.39	3.95	1.34	.0047	.0133	.0110	.0023	.10	.0050	.0000	.40	1.6
-	1898	-	-	0.54	4.05	1.51	.0108	.0132	.0103	.0029	.10	.0036	.0001	.40	1.5
-	1899	-	-	0.75	4.51	1.29	.0198	.0150	.0113	.0037	.09	.0027	.0001	.38	1.6

NOTE to analyses of 1899: Odor, generally faintly vegetable or none, sometimes unpleasant or disagreeable. On heating, the odor of all of the samples was vegetable or disagreeable and unpleasant.

NORTHAMPTON.

Chemical Examination of Water from a Spring at the Northampton Insane Hospital.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
28871	Oct. 8	None.	V. slight.	.00	21.00	.0008	.0022	1.87	1.2800	.0000	.04	7.3	.0030
28925	Oct. 9	None.	V. slight.	.00	23.00	.0000	.0018	1.40	1.2600	.0000	.02	7.7	.0020
29672	Dec. 16	None.	V. slight.	.04	22.70	.0004	.0014	1.96	1.1400	.0000	.05	6.9	.0140

Odor, none. —— The samples were collected from a spring from which water is drawn for the supply of the hospital.

The advice of the State Board of Health to the Mt. Tom Sulphite Pulp Company, with reference to the quality of the water drawn from tubular wells on the premises of the company, may be found on page 36 of this volume. The results of analyses of samples of water collected from the wells are given in the following table: —

Chemical Examination of Water from Tubular Wells on the Premises of the Mt. Tom Sulphite Pulp Company, Northampton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
28833	Sept. 29	None.	V. slight.	.00	11.50	.0006	.0014	.95	.1060	.0004	.08	5.9	.0030
28964	Oct. 11	None.	V. slight.	.08	8.70	.0006	.0008	.14	.0220	.0000	.16	2.0	.0080

Odor, none. —— The first sample was collected from a tap on the pump drawing water from the three wells nearest the factory; the last, from the well most remote from the factory.

WATER SUPPLY OF NORTH ANDOVER.

Chemical Examination of Water from Great Pond, North Andover.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26003	Jan. 23	V. slight.	Slight.	.20	3.50	1.70	.0002	.0186	.0168	.0018	.32	.0000	.0000	.45	1.3
26266	Feb. 20	V. slight.	Slight.	.18	3.65	1.65	.0022	.0160	.0152	.0008	.32	.0030	.0001	.40	1.1
26530	Mar. 20	None.	V. slight.	.18	3.15	1.40	.0020	.0182	.0166	.0016	.31	.0020	.0000	.36	1.1
26898	Apr. 24	V. slight.	Slight.	.20	3.35	1.15	.0004	.0152	.0140	.0012	.29	.0050	.0001	.34	0.8
27179	May 22	V. slight.	V. slight.	.20	3.65	1.25	.0012	.0198	.0168	.0030	.35	.0050	.0000	.38	1.1
27588	June 27	V. slight.	V. slight.	.14	3.40	1.30	.0002	.0224	.0190	.0034	.33	.0000	.0000	.38	1.0
27890	July 25	V. slight.	V. slight.	.09	3.15	1.35	.0002	.0166	.0158	.0008	.33	.0030	.0000	.33	1.3
28390	Aug. 28	V. slight.	V. slight.	.11	3.30	1.65	.0004	.0194	.0182	.0012	.29	.0000	.0000	.34	0.8
28723	Sept. 24	V. slight.	V. slight.	.12	3.30	1.00	.0008	.0198	.0178	.0020	.34	.0010	.0000	.29	1.4
29118	Oct. 24	V. slight.	V. slight.	.09	3.50	1.35	.0012	.0172	.0162	.0010	.30	.0040	.0000	.32	1.3
29440	Nov. 20	V. slight.	V. slight.	.10	3.40	1.30	.0004	.0192	.0180	.0012	.35	.0010	.0000	.26	1.0
29781	Dec. 26	Slight.	Slight.	.09	3.25	1.10	.0000	.0196	.0182	.0014	.29	.0010	.0000	.27	1.4
Av...	....	....	....	.14	3.42	1.35	.0008	.0185	.0169	.0016	.32	.0021	.0000	.34	1.1

Odor, faintly vegetable or none. On heating, the odor of nearly all of the samples was vegetable, and in November fishy and unpleasant. —— Nos. 27179, 28723, 29440 and 29781 were collected from a faucet at the pumping station; the others, from the pond.

Microscopical Examination of Water from Great Pond, North Andover.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	24	21	21	25	22	27	26	29	26	25	20	27
Number of sample,	26003	26266	26530	26898	27179	27588	27890	28390	28723	29118	29440	29781
PLANTS.												
Diatomaceæ,	1,880	1,994	10	73	136	23	25	38	21	293	521	1,351
Asterionella,	1,608	1,944	8	31	75	0	0	16	0	180	286	896
Tabellaria,	288	41	0	18	42	16	10	12	0	86	224	426
Cyanophyceæ,	0	0	0	0	0	9	16	22	0	8	0	0
Microcystis,	0	0	0	0	0	1	16	8	0	0	0	0
Algæ,	2	1	0	29	5	12	22	48	0	1	0	0

NORTH ANDOVER.

Microscopical Examination of Water from Great Pond, North Andover — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda, Difflugia,	0	0	0	0	0	0	0	1	0	0	0	0
Infusoria,	70	0	2	19	17	115	58	3	0	14	0	0
Cryptomonas,	60	0	0	0	0	80	0	0	0	1	0	0
Dinobryon,	0	0	0	17	14	33	58	0	0	7	0	0
Vermes,	0	0	1	1	1	2	0	0	0	2	0	0
Crustacea,	pr.	0	0	0	pr.	pr.	0	pr.	0	0	0	0
Cyclops,	pr.	0	0	0	pr.	pr.	0	pr.	0	0	0	0
Daphnia,	0	0	0	0	0	0	0	pr.	0	0	0	0
Miscellaneous, Zoöglœa,	3	3	5	20	3	3	3	7	3	3	0	3
TOTAL,	1,955	1,998	18	142	162	164	126	119	24	321	521	1,354

WATER SUPPLY OF NORTH ATTLEBOROUGH.

Chemical Examination of Water from the Wells of the North Attleborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27224	May 23	None.	None.	.02	6.60	.0000	.0014	.61	.0480	.0000	.04	2.6	.0040
27663	July 5	V. slight.	None.	.01	8.00	.0006	.0006	.66	.0480	.0000	.01	3.8	.0050
27910	July 26	None.	None.	.01	7.70	.0006	.0014	.66	.0470	.0000	.01	3.3	.0070
28917	Oct. 6	None.	None.	.03	6.70	.0000	.0014	.57	.0420	.0000	.03	3.0	.0020
Av*.	....	....	....	.02	7.05	.0002	.0013	.62	.0458	.0000	.03	3.0	.0040

Odor, none. —— The samples were collected from a faucet at the pumping station.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

WATER SUPPLY OF NORTHBOROUGH.

Chemical Examination of Water from the Upper Reservoir of the Northborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26801	Feb 22	Slight.	V. slight.	.32	3.00	1.25	.0058	.0186	.0114	.0022	.20	.0040	.0001	0.44	0.6
27196	May 22	Slight.	V. slight.	.34	3.55	1.75	.0002	.0218	.0190	.0028	.18	.0000	.0000	0.82	0.5
28300	Aug. 22	Decided.	Slight.	.32	3.85	1.30	.0000	.0320	.0254	.0066	.33	.0020	.0002	0.53	1.0
29468	Nov. 22	V. slight.	None.	.77	4.96	2.10	.0008	.0232	.0222	.0010	.20	.0010	.0000	1.04	1.1

Averages by Years.

-	1896	-	-	1.03	4.00	1.86	.0018	.0236	.0215	.0021	.19	.0044	.0001	0.99	0.9
-	1897	-	-	0.96	4.45	1.85	.0011	.0214	.0197	.0017	.28	.0048	.0000	0.82	1.3
-	1898	-	-	0.84	3.67	1.67	.0007	.0205	.0192	.0013	.22	.0038	.0000	0.74	0.8
-	1899	-	-	0.56	3.84	1.60	.0017	.0226	.0195	.0031	.21	.0017	.0001	0.71	0.8

NOTE to analyses of 1899: Odor, faintly vegetable, becoming stronger on heating.

Microscopical Examination of Water from the Upper Reservoir of the Northborough Water Works.

[Number of organisms per cubic centimeter.]

	1899. Feb.	1899. May.	1899. Aug.	1899. Nov.
Day of examination,	23	23	23	23
Number of sample,	26801	27196	28300	29468
PLANTS.				
Diatomaceæ,	33	18	80	4
Synedra,	13	10	66	0
Cyanophyceæ,	0	0	6	0
Algæ,	0	0	50	0
ANIMALS.				
Rhizopoda, Difflugia,	0	0	1	0
Infusoria,	0	0	88	2
Ciliated infusorian,	0	0	18	0
Dinobryon,	0	0	12	0
Peridinium,	0	0	34	0
Vermes,	0	0	3	0
Miscellaneous, Zoöglœa,	10	7	20	0
TOTAL,	43	25	248	6

NORTHBOROUGH.

Chemical Examination of Water from the Lower Reservoir of the Northborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26302	Feb. 22	Slight.	Slight.	.30	3.00	1.05	.0070	.0106	.0094	.0012	.18	.0010	.0001	.36	0.8
27197	May 22	Slight.	Cons.	.64	3.25	1.45	.0002	.0220	.0192	.0028	.17	.0010	.0001	.63	0.8
28301	Aug. 22	Slight.	Slight.	.35	3.70	1.55	.0000	.0290	.0234	.0056	.19	.0020	.0002	.59	0.8
29464	Nov. 22	V. slight.	V. slight.	.53	4.15	1.65	.0028	.0258	.0238	.0020	.25	.0010	.0000	.79	1.1
Av...	....	....	....	.45	3.52	1.42	.0025	.0218	.0189	.0029	.20	.0012	.0001	.59	0.9

Odor, faintly vegetable, becoming also grassy or earthy in the last two samples on heating.

Microscopical Examination of Water from the Lower Reservoir of the Northborough Water Works.

[Number of organisms per cubic centimeter.]

	1899.			
	Feb.	May.	Aug.	Nov.
Day of examination,	23	23	23	23
Number of sample,	26302	27197	28301	29464
PLANTS.				
Diatomaceæ,	14	452	312	234
Asterionella,	0	6	28	183
Melosira,	0	200	26	0
Synedra,	2	184	176	4
Tabellaria,	0	52	76	40
Algæ,	0	3	26	16
ANIMALS.				
Infusoria,	0	407	17	225
Dinobryon,	0	392	0	209
Peridinium,	0	4	16	0
Uroglena,	0	1	0	8
Vermes,	0	8	7	2
Miscellaneous, Zoöglœa,	10	25	10	3
TOTAL,	24	895	372	480

NORTH BROOKFIELD.

Water Supply of North Brookfield.

Chemical Examination of Water from Doane Pond, North Brookfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25982	Jan. 18	Decided.	Slight.	.50	3.40	1.25	.0154	.0174	.0156	.0018	.13	.0040	.0002	.48	0.6
26718	Apr. 11	Decided.	Slight.	.14	1.75	1.20	.0068	.0284	.0238	.0046	.10	.0040	.0001	.21	0.0
27787	July 17	Slight.	Cons.	.68	3.15	1.55	.0014	.0334	.0294	.0040	.11	.0010	.0000	.67	0.5

Averages by Years.

Number.	Year.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Albuminoid Dissolved.	Albuminoid Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1894	-	-	.91	4.24	1.77	.0110	.0353	.0280	.0073	.19	.0054	.0001	.62	1.1
-	1895	-	-	.51	4.92	1.60	.0076	.0365	.0285	.0080	.22	.0102	.0002	.51	1.7
-	1896	-	-	.43	3.74	1.48	.0012	.0288	.0247	.0041	.15	.0064	.0000	.51	1.1
-	1897	-	-	.57	3.59	1.52	.0031	.0305	.0254	.0051	.16	.0058	.0000	.50	0.8
-	1898	-	-	.55	3.50	1.53	.0069	.0241	.0204	.0037	.16	.0043	.0001	.51	0.9
-	1899	-	-	.44	2.77	1.33	.0079	.0264	.0229	.0035	.11	.0030	.0001	.45	0.4

Note to analyses of 1899: Odor, faintly vegetable, becoming stronger in the last two samples on heating.

Microscopical Examination of Water from Doane Pond, North Brookfield.

[Number of organisms per cubic centimeter.]

	1899. Jan.	1899. April.	1899. July.
Day of examination,	19	12	18
Number of sample,	25982	26718	27787
PLANTS.			
Diatomaceæ,	6	19	60
Cyanophyceæ, Oscillaria,	0	0	2
Algæ,	0	1	24
ANIMALS.			
Infusoria,	20	4	1,710
Dinobryon,	0	2	1,700
Peridinium,	16	1	2
Crustacea, Cyclops,	0	0	pr.
Miscellaneous, Zoöglœa,	3	15	30
Total,	29	39	1,826

NORTH BROOKFIELD.

Chemical Examination of Water from North Pond, North Brookfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26006	Jan. 23	Slight.	Slight.	.43	3.00	1.25	.0006	.0258	.0214	.0044	.13	.0030	.0002	.57	0.5
26714	Apr. 11	Slight.	Cons.	.29	1.85	1.10	.0086	.0268	.0170	.0098	.07	.0040	.0001	.36	0.0
27788	July 17	Slight.	Cons.	.30	2.60	1.25	.0004	.0228	.0198	.0030	.12	.0010	.0000	.51	1.0
29061	Oct. 18	Decided.	Cons.	.63	3.95	2.10	.0084	.0528	.0186	.0342	.12	.0010	.0000	.64	0.8
29112	Oct. 23	Decided	Cons.	.65	3.90	2.00	.0192	.0536	.0408	.0128	.16	.0040	.0000	.80	0.3
Av.*.	....	....	....	.42	2.84	1.41	.0046	.0322	.0220	.0102	.11	.0026	.0001	.54	0.5

Odor, vegetable.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Microscopical Examination of Water from North Pond, North Brookfield.

[Number of organisms per cubic centimeter.]

	1899. Jan.	1899. April.	1899. July.	1899. Oct.	1899. Oct.
Day of examination,	24	12	18	19	24
Number of sample,	26006	26714	27788	29061	29112
PLANTS.					
Diatomaceæ,	0	2	604	288	338
Asterionella,	0	0	464	64	166
Tabellaria,	0	0	140	200	156
Algæ,	0	0	178	7,024	4
Arthrodesmus,	0	0	94	0	0
Protococcus,	0	0	0	7,000	0
ANIMALS.					
Infusoria,	19	242	55	40	188
Cryptomonas,	0	0	0	0	52
Dinobryon,	0	50	49	28	60
Euglena,	1	66	4	0	2
Peridinium,	18	120	0	0	14
Uroglena,	0	0	0	0	30
Vermes,	0	2	0	8	12
Anuræa,	0	0	0	4	10
Crustacea, Cyclops,	0	pr.	0	0	0
Miscellaneous, Zoöglœa,	3	7	20	20	25
TOTAL,	22	253	857	7,380	545

Water Supply of Norwood.

Chemical Examination of Water from Buckmaster Pond, Dedham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25842	Jan. 4	V. slight.	V. slight.	.18	3.50	1.15	.0086	.0266	.0220	.0046	.36	.0070	.0001	.32	0.6
26104	Feb. 1	Slight.	V. slight.	.16	2.75	1.10	.0016	.0180	.0146	.0034	.30	.0050	.0001	.34	0.5
26365	Feb. 28	V. slight.	V. slight.	.11	3.00	0.85	.0084	.0182	.0156	.0026	.30	.0070	.0001	.27	0.5
26668	Apr. 4	Slight.	V. slight.	.12	2.75	0.80	.0038	.0126	.0108	.0018	.28	.0110	.0000	.26	0.2
26992	May 1	V. slight.	V. slight.	.11	2.65	1.15	.0012	.0134	.0128	.0006	.26	.0050	.0001	.28	0.3
27329	June 5	V. slight.	V. slight.	.10	2.25	1.25	.0002	.0164	.0128	.0036	.27	.0030	.0000	.30	0.2
27639	July 5	V. slight.	Slight.	.09	2.50	0.90	.0006	.0202	.0176	.0026	.26	.0020	.0000	.27	0.5
27922	July 31	V. slight.	Slight.	.07	2.85	1.00	.0004	.0228	.0202	.0026	.25	.0020	.0000	.28	0.5
28468	Sept. 5	Slight.	Slight.	.12	3.10	1.25	.0006	.0286	.0222	.0064	.26	.0020	.0000	.28	0.3
28843	Oct. 2	Decided.	Cons.	.08	2.75	1.20	.0038	.0298	.0232	.0066	.29	.0040	.0000	.29	0.5
29220	Nov. 2	Slight.	Slight.	.12	3.00	1.05	.0036	.0384	.0230	.0154	.32	.0020	.0001	.22	0.5
29561	Dec. 4	Decided.	Cons.	.20	3.06	0.85	.0234	.0210	.0152	.0058	.29	.0010	.0001	.12	0.5

Averages by Years.

-	1888	-	-	.15	2.66	0.95	.0069	.0248	-	-	.29	.0065	.0001	-	-
-	1889	-	-	.11	2.47	0.79	.0024	.0199	.0174	.0025	.30	.0068	.0001	-	-
-	1890	-	-	.05	2.59	0.99	.0015	.0180	.0147	.0033	.30	.0075	.0000	-	1.0
-	1891	-	-	.06	2.48	0.97	.0014	.0166	.0140	.0026	.28	.0075	.0000	-	0.7
-	1892	-	-	.07	2.88	1.24	.0019	.0219	.0172	.0047	.32	.0067	.0000	-	0.7
-	1893	-	-	.07	2.62	1.08	.0052	.0199	.0156	.0043	.33	.0028	.0000	.25	0.7
-	1894	-	-	.10	2.82	1.13	.0055	.0182	.0153	.0029	.36	.0028	.0000	.24	0.5
-	1895	-	-	.16	2.95	1.24	.0047	.0220	.0174	.0046	.36	.0066	.0000	.29	0.5
-	1896	-	-	.15	2.83	1.09	.0048	.0203	.0168	.0035	.37	.0046	.0000	.30	0.7
-	1897	-	-	.13	2.80	1.12	.0037	.0185	.0164	.0021	.36	.0054	.0000	.24	0.6
-	1898	-	-	.17	2.97	1.27	.0046	.0195	.0163	.0032	.35	.0027	.0000	.29	0.7
-	1899	-	-	.12	2.85	1.05	.0047	.0222	.0175	.0047	.29	.0042	.0000	.27	0.4

Note to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of some of the samples became stronger.

NORWOOD.

Microscopical Examination of Water from Buckmaster Pond, Dedham.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	July.	Sept.	Oct.	Nov.	Dec.
Day of examination,	5	2	2	6	8	7	5	31	5	8	8	5
Number of sample,	25842	26104	26365	26668	26992	27829	27639	27922	28468	28843	29220	29561
PLANTS.												
Diatomaceæ,	1	1	0	13	6	20	12	8	32	58	64	63
Asterionella,	0	0	0	0	2	0	0	8	0	12	10	50
Cyanophyceæ,	0	0	0	0	0	1	28	68	46	68	4	0
Anabæna,	0	0	0	0	0	0	24	3	0	56	2	0
Microcystis,	0	0	0	0	0	0	2	60	44	0	2	0
Algæ,	0	0	0	0	0	12	668	8	16	53	22	7
Protococcus,	0	0	0	0	0	0	600	8	16	40	0	0
Raphidium,	0	0	0	0	0	11	88	0	0	8	18	7
ANIMALS.												
Infusoria,	5	53	2	12	1	5	18	2	2	22	40	7
Dinobryon,	5	52	0	11	0	0	0	0	0	0	0	0
Mallomonas,	0	0	0	0	1	0	0	1	0	8	34	4
Vorticella,	0	0	0	0	0	0	12	0	0	8	0	0
Crustacea, Cyclops,	0	0	0	0	0	0	0	0	0	0	0	pr.
Miscellaneous, Zoöglœa,	5	0	5	3	7	5	3	8	20	12	5	8
TOTAL,	11	54	7	28	14	43	749	94	118	211	135	85

Chemical Examination of Water from Colburn Brook, Westwood.

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
								ALBUMINOID.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25843	Jan. 4	V. slight.	V. slight	0.60	3.15	1.25	.0000	.0096	.0090	.0006	.25	.0010	.0000	0.66	0.2
26105	Feb. 1	None.	V. slight.	0.37	3.25	1.25	.0004	.0090	.0076	.0014	.29	.0000	.0000	0.47	0.2
26366	Feb. 28	V. slight.	Slight.	0.60	2.75	1.30	.0020	.0206	.0156	.0050	.23	.0020	.0000	0.71	0.3
26669	Apr. 4	V. slight.	V. slight.	0.43	2.25	1.05	.0002	.0122	.0114	.0008	.15	.0000	.0000	0.50	0.0
26993	May 1	V. slight.	V. slight.	1.20	3.10	1.75	.0014	.0210	.0192	.0018	.18	.0080	.0000	1.44	0.0
27330	June 5	V. slight.	V. slight.	1.05	3.60	1.95	.0010	.0204	.0188	.0016	.22	.0030	.0000	1.14	0.0
27640	July 5	V. slight.	Slight.	0.71	4.15	1.55	.0036	.0230	.0194	.0036	.24	.0000	.0000	0.74	0.3
27921	July 31	V. slight.	V. slight.	0.69	4.35	1.55	.0026	.0194	.0188	.0006	.24	.0020	.0000	0.83	0.5
28467	Sept. 5	Slight.	Slight.	0.63	4.00	1.45	.0068	.0176	.0146	.0030	.26	.0030	.0000	0.55	0.3
28844	Oct 2	V. slight.	V. slight.	0.72	5.25	2.10	.0010	.0188	.0178	.0010	.26	.0040	.0000	0.97	1.0
29219	Nov. 2	V. slight.	V. slight.	1.54	8.30	3.95	.0006	.0386	.0282	.0104	.44	.0020	.0000	1.92	1.7
29562	Dec. 4	None.	V. slight.	1.00	5.15	2.30	.0004	.0202	.0192	.0010	.27	.0010	.0000	1.18	0.6
Av...	....	....	....	0.79	4.11	1.79	.0017	.0192	.0166	.0026	.25	.0017	.0000	0.93	0.4

Odor, generally faintly vegetable; in March, distinctly disagreeable. On heating, the odor of some of the samples became stronger.

WATER SUPPLY OF ORANGE.

Chemical Examination of Water from the Distributing Reservoir of the Orange Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27500	June 19	V. slight.	V. slight.	.05	3.00	0.75	.0018	.0050	.0044	.0006	.11	.0020	.0000	.18	0.6
28667	Sept. 19	V. slight.	V. slight.	.18	3.60	1.30	.0012	.0130	.0100	.0030	.11	.0000	.0001	.30	0.5
29724	Dec. 20	V. slight.	V. slight.	.20	3.40	1.10	.0010	.0086	.0082	.0004	.14	.0010	.0000	.35	0.3
Av...	....	....	....	.14	3.33	1.05	.0013	.0089	.0075	.0014	.12	.0010	.0000	.26	0.5

Odor, faintly vegetable or none.

WATER SUPPLY OF PALMER FIRE DISTRICT, PALMER. — PALMER WATER COMPANY.

Chemical Examination of Water from the Upper and Lower Reservoirs of the Palmer Water Company.

Upper Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26448	Mar. 10	V. slight.	Slight.	.10	2.95	0.90	.0014	.0064	.0054	.0010	.14	.0010	.0001	.16	0.3
27037	May 9	Slight.	Slight.	.22	3.35	1.10	.0010	.0198	.0188	.0010	.13	.0020	.0000	.37	0.3
28107	Aug. 9	V. slight.	V. slight	.19	3.65	0.95	.0010	.0106	.0074	.0032	.13	.0010	.0000	.21	1.0
29251	Nov. 6	V. slight.	V. slight.	.36	3.55	1.20	.0004	.0136	.0120	.0016	.15	.0020	.0000	.40	0.5
Av...	....	....	....	.22	2.87	1.04	.0009	.0126	.0109	.0017	.14	.0015	.0000	.28	0.6

Lower Reservoir.

26449	Mar. 10	Slight.	Cons.	.15	2.55	0.75	.0020	.0164	.0124	.0040	.13	.0040	.0000	.28	0.3
27038	May 9	Slight.	Cons.	.27	3.25	0.95	.0004	.0184	.0146	.0038	.12	0000	.0000	.36	0.3
28106	Aug. 9	V slight.	V. slight.	.18	3.75	0.85	.0000	.0082	.0070	.0012	.13	.0000	.0000	.22	0.8
29252	Nov. 6	Slight.	V. slight.	.39	3.65	1.25	.0002	.0140	.0132	.0008	.15	.0060	.0000	.48	0.5
Av...	....	....	....	.25	3.30	0.95	.0006	.0142	.0118	.0024	.13	.0025	.0000	.32	0.5

Odor, faintly vegetable or none. On heating, the odor of the sample from the Lower Reservoir, collected in May, became distinctly fishy.

Microscopical Examination.

The organism *Uroglena* was found in the sample collected from the Lower Reservoir in May.

PEABODY.

WATER SUPPLY OF PEABODY.

Chemical Examination of Water from Brown's Pond, Peabody.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26177	Feb. 7	V. slight.	Slight.	.17	3.10	1.20	.0020	.0124	.0102	.0022	.54	.0110	.0000	.27	0.3
27049	May 9	V. slight.	V. slight.	.11	2.50	0.85	.0006	.0128	.0108	.0020	.42	.0010	.0001	.27	0.3
28129	Aug. 10	V. slight.	V. slight.	.11	2.95	1.05	.0000	.0186	.0168	.0018	.52	.0020	.0000	.33	0.3
29315	Nov. 9	Slight.	Slight.	.09	2.70	1.10	.0004	.0172	.0158	.0014	.52	.0010	.0004	.21	0.3

Averages by Years.

-	1895	-	-	.16	3.08	1.18	.0018	.0167	.0141	.0026	.58	.0040	.0000	.29	0.6
-	1896	-	-	.15	2.97	1.07	.0002	.0140	.0120	.0020	.55	.0037	.0000	.24	0.6
-	1897	-	-	.14	2.99	1.09	.0005	.0177	.0146	.0031	.58	.0055	.0000	.28	0.7
-	1898	-	-	.20	2.87	1.30	.0008	.0183	.0153	.0030	.55	.0043	.0000	.31	0.7
-	1899	-	-	.12	2.81	1.05	.0007	.0152	.0134	.0018	.50	.0037	.0001	.27	0.4

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none.

Microscopical Examination.

The organism *Uroglena* was found in small quantities in the sample collected in May.

Chemical Examination of Water from Spring Pond, Peabody.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26447	Mar. 10	V. slight.	Slight.	.02	3.85	0.85	.0046	.0132	.0104	.0028	.68	.0020	.0001	.18	1.3
27060	May 9	V. slight.	Slight.	.05	3.85	1.25	.0014	.0162	.0124	.0038	.57	.0020	.0000	.17	1.1
28095	Aug. 8	V. slight.	Slight.	.04	3.90	1.25	.0004	.0120	.0112	.0008	.68	.0020	.0000	.19	1.4
29316	Nov. 9	V. slight.	Slight.	.09	3.90	1.25	.0088	.0168	.0148	.0020	.69	.0010	.0000	.14	1.3

Averages by Years.

-	1891	-	-	.01	3.69	0.99	.0006	.0123	.0097	.0027	.55	.0041	.0000	-	1.3
-	1895	-	-	.03	4.03	1.20	.0010	.0139	.0109	.0030	.78	.0018	.0000	.18	1.7
-	1896	-	-	.03	3.65	1.11	.0008	.0136	.0103	.0033	.70	.0025	.0000	.18	1.2
-	1897	-	-	.04	3.55	1.09	.0021	.0167	.0114	.0053	.73	.0035	.0000	.16	1.3
-	1898	-	-	.05	3.96	1.39	.0024	.0159	.0129	.0030	.74	.0023	.0000	.17	1.4
-	1899	-	-	.05	3.87	1.15	.0038	.0145	.0122	.0023	.65	.0017	.0000	.17	1.3

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none.

Pembroke.

Chemical Examination of Water from Silver Lake, in Pembroke, collected near the Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25847	Jan. 4	V. slight.	Slight.	.17	3.10	1.25	.0000	.0114	.0112	.0002	.64	.0010	.0000	.30	0.3
26369	Mar. 1	V. slight.	V. slight.	.16	2.75	1.20	.0004	.0136	.0124	.0012	.63	.0020	.0000	.31	0.5
27014	May 3	V. slight.	Slight.	.15	3.30	1.35	.0002	.0124	.0110	.0014	.61	.0030	.0000	.32	0.2
27670	July 6	V. slight.	V. slight.	.13	2.65	0.60	.0008	.0126	.0106	.0020	.60	.0030	.0000	.23	0.3
28491	Sept. 5	V. slight.	V. slight.	.09	3.35	1.20	.0010	.0138	.0134	.0004	.64	.0010	.0000	.27	0.3
29209	Nov. 1	V. slight.	V. slight.	.07	2.95	1.30	.0018	.0132	.0126	.0006	.66	.0020	.0000	.23	0.3
Av...	....	....	....	.13	3.02	1.15	.0007	.0128	.0119	.0009	.63	.0020	.0000	.28	0.4

Odor, generally none. A vegetable odor was developed in all of the samples on heating. —— The samples were collected from the lake, off Gunner's Point.

Microscopical Examination of Water from Silver Lake, in Pembroke, collected near the Surface.

[Number of organisms per cubic centimeter.]

	1899. Jan.	March.	May.	July.	Sept.	Nov.
Day of examination,	5	2	4	7	6	2
Number of sample,	25847	26369	27014	27670	28491	29209
PLANTS.						
Diatomaceæ,	1,357	754	84	1	34	128
Melosira,	1,300	752	33	0	0	120
Cyanophyceæ,	0	0	0	22	0	0
Algæ,	0	0	0	0	4	0
ANIMALS.						
Infusoria,	1	4	10	1	0	2
Vermes,	0	1	5	2	1	0
Crustacea, Cyclops,	0	0	pr.	0	3	0
Miscellaneous, Zoöglœa,	3	5	5	5	3	3
Total,	1,361	764	104	31	42	133

PEMBROKE.

Chemical Examination of Water from Silver Lake, in Pembroke, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25348	Jan. 4	V. slight.	Slight.	.17	3.20	1.25	.0004	.0120	.0116	.0004	.63	.0010	.0000	.31	0.3
26370	Mar. 1	V. slight.	V. slight.	.15	3.15	1.85	.0008	.0114	.0104	.0010	.65	.0010	.0000	.30	0.5
27015	May 3	V. slight.	V. slight	.15	2.90	1.25	.0000	.0142	.0128	.0014	.63	.0000	.0000	.30	0.3
27671	July 6	V. slight.	V. slight.	.15	3.00	1.00	.0006	.0108	.0088	.0020	.60	.0000	.0000	.28	0.3
28492	Sept. 5	V. slight.	V. slight.	.10	3.35	1.05	.0000	.0132	.0114	.0018	.62	.0010	.0000	.28	0.3
29210	Nov. 1	V. slight.	V. slight.	.11	3.05	1.45	.0010	.0130	.0126	.0004	.66	.0020	.0000	.24	0.3
Av.	....	....	....	.14	3.11	1.31	.0005	.0124	.0113	.0011	.63	.0008	.0000	.28	0.5

Odor, faintly vegetable. —— The samples were collected from the lake, off Gunner's Point.

Chemical Examination of Water from Oldham Pond, Pembroke.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26126	Feb. 5	Slight.	Slight.	.41	3.75	1.50	.0024	.0238	.0184	.0054	.63	.0040	.0002	.57	0.6
27021	May 7	V. slight.	V. slight	.37	3.55	1.10	.0024	.0190	.0176	.0014	.57	.0040	.0000	.48	0.5
28064	Aug. 6	Slight.	Slight.	.16	3.55	1.10	.0012	.0194	.0182	.0012	.62	.0010	.0000	.38	0.6
29238	Nov. 5	V. slight.	V. slight.	.15	3.35	1.25	.0008	.0212	.0192	.0020	.64	.0020	.0000	.30	0.3
Av.	....	....	....	.27	3.55	1.24	.0017	.0208	.0183	.0025	.61	.0027	.0000	.43	0.5

Odor of the second and third samples, distinctly vegetable; of the others, faintly vegetable. —— The samples were collected from the pond, near its outlet.

PEMBROKE.

Microscopical Examination of Water from Oldham Pond, Pembroke.

[Number of organisms per cubic centimeter.]

	1899.			
	Feb.	May.	Aug.	Nov.
Day of examination,	6	8	8	6
Number of sample,	26126	27021	28064	29238
PLANTS.				
Diatomaceæ,	118	55	6	12
Synedra,	68	14	2	12
Cyanophyceæ,	0	3	234	0
Anabæna,	0	3	212	0
Merismopœdia,	0	0	16	0
Algæ,	0	3	10	9
ANIMALS.				
Infusoria,	68	3	12	25
Ciliated infusorian,	26	0	0	0
Dinobryon,	18	1	0	22
Vermes,	0	2	0	0
Crustacea,	0	0	pr.	0
Cyclops,	0	0	pr.	0
Miscellaneous, Zoöglœa,	5	7	5	3
TOTAL,	191	73	267	49

WATER SUPPLY OF PITTSFIELD.

Chemical Examination of Water from Sacket Brook Reservoir, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Suspended.					
	1899.														
26557	Mar. 21	V. slight.	V. slight	.05	5.60	1.00	.0020	.0224	.0216	.0008	.08	.0070	.0001	.15	4.2
27600	June 27	V. slight.	V. slight.	.09	7.35	1.15	.0004	.0120	.0098	.0022	.06	.0080	.0002	.14	6.6
28783	Sept. 27	V. slight.	Slight.	.68	7.15	3.25	.0016	.0224	.0198	.0026	.09	.0080	.0000	.96	3.8
29600	Dec. 27	None.	V. slight.	.03	6.85	1.45	.0000	.0040	.0040	.0000	.08	.0120	.0000	.13	4.1
Av...	....	....	....	.21	6.74	1.71	.0010	.0152	.0138	.0014	.08	.0087	.0001	.34	4.7

Odor, faintly vegetable or none.

PITTSFIELD.

Chemical Examination of Water from Sacket Brook in the Vicinity of the Pumping Station of the Pittsfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26556	Mar. 21	V. slight.	Cons., earthy.	.05	6.50	1.10	.0002	.0046	.0034	.0012	.08	.0120	.0001	.10	5.6
27599	June 27	V. slight.	V. slight.	.07	9.35	1.75	.0030	.0136	.0116	.0020	.21	.0190	.0002	.16	7.9
28787	Sept. 27	V. slight.	Slight.	.35	10.00	2.00	.0016	.0152	.0128	.0024	.12	.0060	.0001	.45	8.6
29799	Dec. 27	None.	V. slight.	.02	10.25	1.85	.0004	.0034	.0034	.0000	.08	.0250	.0000	.09	8.9
Av.	....	....	....	.12	9.02	1.67	.0013	.0092	.0078	.0014	.12	.0155	.0001	.20	7.7

Odor, faintly vegetable or none.

Chemical Examination of Water from Ashley Brook Reservoir, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26553	Mar. 21	None.	V. slight.	.02	6.60	1.25	.0010	.0044	.0042	.0002	.09	.0110	.0001	.11	5.6
27596	June 27	V. slight.	None.	.16	5.60	1.35	.0026	.0106	.0098	.0008	.05	.0060	.0000	.25	4.0
28784	Sept. 27	Decided.	Slight.	.50	5.85	2.40	.0024	.0236	.0204	.0032	.10	.0050	.0000	.81	3.1
29796	Dec. 27	None.	None.	.10	7.15	1.25	.0002	.0050	.0050	.0000	.10	.0170	.0000	.15	5.7
Av.	....	....	....	.19	6.30	1.56	.0015	.0109	.0098	.0011	.08	.0098	.0000	.33	4.6

Odor, faintly vegetable or none.

Chemical Examination of Water from Hathaway Brook Reservoir, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26554	Mar. 21	V. slight.	Slight.	.02	6.95	1.40	.0000	.0046	.0028	.0018	.09	.0160	.0000	.09	6.1
27597	June 27	None.	V. slight.	.02	10.00	2.00	.0000	.0046	.0042	.0004	.09	.0090	.0000	.06	8.1
28785	Sept. 27	Decided.	Cons.	.35	8.25	2.15	.0016	.0176	.0128	.0048	.12	.0060	.0000	.36	6.0
29797	Dec. 27	None.	V. slight.	.10	9.10	2.10	.0000	.0034	.0034	.0000	.11	.0200	.0000	.12	7.9
Av.	....	....	....	.12	8.57	1.91	.0004	.0075	.0058	.0017	.10	.0127	.0000	.16	7.0

Odor of the third sample, faintly unpleasant, becoming stronger on heating; of the others, none.

PITTSFIELD.

Chemical Examination of Water from Mill Brook Reservoir, Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26555	Mar. 21	None.	V. slight.	.00	3.35	0.75	.0000	.0026	.0026	.0000	.07	.0080	.0000	.10	2.7
27598	June 27	None.	V. slight.	.00	6.15	0.90	.0004	.0038	.0038	.0000	.06	.0080	.0000	.05	4.0
28786	Sept. 27	V. slight.	V. slight.	.10	6.00	1.25	.0010	.0118	.0118	.0000	.14	.0060	.0000	.22	3.9
29798	Dec. 27	V. slight.	V. slight.	.12	5.30	1.15	.0000	.0032	.0032	.0000	.08	.0110	.0000	.10	4.0
Av...	....	....	....	.05	5.32	1.01	.0003	.0053	.0053	.0000	.09	.0082	.0000	.12	3.1

Odor, none.

Water Supply of Plymouth.

Chemical Examination of Water from Little South Pond, Plymouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25911	Jan. 10	None.	Slight.	.01	2.40	1.05	.0012	.0124	.0112	.0012	.69	.0010	.0000	.11	0.0
26422	Mar. 8	V. slight.	Slight.	.01	2.25	0.80	.0024	.0110	.0098	.0012	.76	.0030	.0000	.18	0.0
26782	Apr. 12	V. slight.	V. slight.	.08	2.45	1.05	.0008	.0112	.0106	.0006	.71	.0020	.0000	.14	0.0
27086	May 9	V. slight.	V. slight.	.00	2.50	0.85	.0022	.0142	.0132	.0010	.75	.0020	.0000	.10	0.0
27420	June 13	V. slight.	V. slight.	.01	2.15	0.85	.0006	.0130	.0114	.0016	.77	.0020	.0000	.15	0.0
27720	July 11	V. slight.	Slight.	.00	2.40	0.50	.0006	.0168	.0152	.0016	.73	.0020	.0000	.18	0.0
28094	Aug. 8	None.	V. slight.	.03	2.75	0.90	.0006	.0158	.0128	.0030	.74	.0030	.0000	.21	0.2
28613	Sept. 13	V. slight.	V. slight.	.03	3.00	0.90	.0014	.0182	.0162	.0020	.79	.0010	.0000	.11	0.2
28946	Oct. 11	V. slight.	V slight.	.05	2.35	0.75	.0022	.0170	.0154	.0016	.76	.0020	.0000	.14	0.2
29296	Nov. 8	V. slight.	V. slight.	.00	2.50	0.75	.0002	.0172	.0148	.0024	.75	.0020	.0000	.15	0.2
29630	Dec. 12	V. slight.	V. slight.	.04	2.75	0.80	.0010	.0162	.0142	.0020	.77	.0050	.0000	.12	0.0

Averages by Years.

-	1894	-	-	.03	2.39	0.83	.0010	.0138	.0114	.0024	.66	.0008	.0000	.12	0.2
-	1895	-	-	.02	2.36	0.78	.0002	.0155	.0124	.0031	.65	.0027	.0000	.12	0.3
-	1896	-	-	.02	2.38	0.78	.0006	.0148	.0126	.0022	.66	.0016	.0000	.13	0.1
-	1897	-	-	.03	2.42	0.80	.0014	.0159	.0142	.0017	.67	.0019	.0000	.10	0.1
-	1898	-	-	.05	2.41	0.96	.0009	.0148	.0126	.0022	.68	.0005	.0000	.13	0.3
-	1899	-	-	.02	2.50	0.84	.0012	.0148	.0132	.0016	.75	.0023	.0000	.14	0.1

NOTE to analyses of 1899: Odor in March and September, very faintly vegetable; at other times, none. On heating, the odor of most of the samples became faintly vegetable, and in January, May and July, fishy and oily.

PLYMOUTH.

Microscopical Examination of Water from Little South Pond, Plymouth.

[Number of organisms per cubic centimeter.]

	1899.										
	Jan.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
Day of examination,	11	9	12	10	15	12	9	14	11	9	12
Number of sample,	25011	26422	26722	27036	27430	27720	28004	28512	28846	29296	29620
PLANTS.											
Diatomaceæ,	25	6	8	13	27	2	9	19	10	46	31
Cyanophyceæ,	0	0	0	0	33	30	6	2	2	0	0
Anabæna,	0	0	0	0	33	0	0	0	0	0	0
Rivularia,	0	0	0	0	0	30	0	0	0	0	0
Algæ,	0	0	0	0	6	24	46	4	10	11	86
Protococcus,	0	0	0	0	0	24	46	0	10	11	86
ANIMALS.											
Infusoria,	50	54	15	6	21	20	9	6	18	25	19
Dinobryon,	46	52	14	2	20	20	0	0	8	16	16
Uroglena,	4	0	1	0	0	0	0	0	3	0	0
Vermes,	0	0	0	1	0	0	0	0	1	0	0
Crustacea, Cyclops,	0	0	0	pr.	pr.	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	7	3	3	0	3	5	3	3	3	3
TOTAL,	75	67	26	23	87	79	86	34	44	84	139

The advice of the State Board of Health to the board of health of Plymouth, with reference to the quality of the water of Elder Brewster Spring in that town, may be found on pages 36 and 37 of this volume. The results of an analysis of a sample of water from the spring are given in the following table: —

PLYMOUTH.

Chemical Examination of Water from Elder Brewster Spring in Plymouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
27567	1899. June 24	None.	None.	.00	7.00	.0006	.0006	1.13	.1000	.0000	.00	1.1	.0010

Odor, none.——The sample was collected from a faucet at a public drinking fountain on Leyden Street, near head of Main Street, which is supplied with water from Elder Brewster Spring.

WATER SUPPLY OF PROVINCETOWN.

The advice of the State Board of Health to the town of Provincetown, with reference to the removal of iron and organic matter from the public water supply of that town, may be found on pages 37 to 39 of this volume.

Chemical Examination of Water from the Open Basin of the Provincetown Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25851	Jan. 4	Decided.	Heavy.	0.75	10.90	.0170	.0164	2.42	.0060	.0001	.68	2.9	.4200
26169	Feb. 6	Decided.	Cons.	0.75	10.70	.0188	.0142	2.38	.0010	.0002	.64	3.3	.3400
26389	Mar. 6	Decided.	Cons.	0.80	10.00	.0158	.0266	2.54	.0050	.0001	.67	2.7	.3200
26677	Apr. 5	Decided.	Heavy.	1.00	11.50	.0230	.0202	2.62	.0050	.0000	.76	3.1	.5400
27011	May 3	Decided.	Heavy.	-	12.00	.0258	.0200	2.62	.0030	.0000	.88	3.5	.6800
27348	June 7	Decided.	Heavy.	1.15	10.20	.0122	.0160	2.81	.0020	.0000	.73	2.3	.3400
27686	July 6	Decided.	Heavy.	1.30	11.10	.0054	.0182	2.60	.0060	.0000	.81	2.2	.2800
28039	Aug. 2	Slight	Cons.	1.18	10.50	.0006	.0260	2.60	.0040	.0001	.78	2.5	.3600
28518	Sept. 6	Decided.	Cons.	1.40	11.40	.0100	.0210	2.63	.0080	.0001	.87	2.3	.7200
28891	Oct. 4	Decided.	Heavy.	2.00	11.80	.0234	.0168	2.60	.0020	.0001	.85	3.0	.4800
29216	Nov. 1	Decided.	Cons.	*1.05	9.20	.0110	.0196	2.54	.0110	.0001	.69	2.3	.2400
29600	Dec. 9	Decided.	Heavy.	1.60	12.40	.0276	.0180	2.59	.0050	.0001	.86	2.5	.6000
Av...	1899	....	....	1.18	10.97	.0159	.0194	2.58	.0048	.0001	.77	2.8	.4433
Av...	1898	....	....	0.66	9.42	.0054	.0151	2.50	.0047	.0001	.62	2.1	.2289

NOTE to analyses of 1899: Odor, in August, faintly mouldy and unpleasant; at other times, faintly earthy or none.

* Filtered.

RANDOLPH AND HOLBROOK.

WATER SUPPLY OF RANDOLPH AND HOLBROOK.

Chemical Examination of Water from Inlet of Great Pond.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25887	Jan. 9	None.	V. slight.	.10	2.50	1.00	.0000	.0050	.0044	.0006	.33	.0010	.0000	.18	0.5
26167	Feb. 6	None.	V. slight.	.06	2.00	0.55	.0002	.0032	.0028	.0004	.32	.0000	.0000	.14	0.3
26408	Mar. 7	V. slight.	V. slight.	.15	2.50	1.00	.0004	.0054	.0044	.0010	.36	.0010	.0000	.23	0.0
26730	Apr. 11	None.	Slight.	.13	1.60	0.25	.0000	.0048	.0048	.0000	.28	.0010	.0000	.20	0.0
27051	May 9	V. slight.	Slight.	.26	2.55	1.10	.0000	.0110	.0104	.0006	.32	.0020	.0001	.36	0.0
27421	June 13	V. slight.	V. slight.	.14	2.60	1.00	.0002	.0102	.0088	.0014	.36	.0020	.0000	.29	0.6
27724	July 11	V. slight.	Slight.	.21	3.15	1.05	.0006	.0160	.0140	.0020	.35	.0030	.0000	.35	0.3
28097	Aug. 8	V. slight.	Slight.	.21	3.65	1.10	.0006	.0132	.0108	.0024	.37	.0010	.0000	.34	0.3
28577	Sept. 12	V. slight.	V. slight.	.23	4.75	1.70	.0006	.0170	.0156	.0014	.45	.0040	.0000	.41	0.3
28947	Oct. 10	V. slight.	V. slight.	.32	3.40	1.25	.0004	.0108	.0104	.0004	.40	.0010	.0000	.49	0.3
29279	Nov. 7	V. slight.	V. slight	.18	2.95	1.00	.0000	.0062	.0052	.0010	.33	.0010	.0001	.29	0.3
29641	Dec. 12	None.	Slight.	.18	2.85	0.70	.0002	.0074	.0062	.0012	.34	.0010	.0000	.24	0.2
Av...	....	....	....	.18	2.87	0.97	.0003	.0092	.0082	.0010	.35	.0015	.0000	.29	0.3

Odor, generally vegetable, frequently none, sometimes unpleasant or mouldy.

Chemical Examination of Water from Great Pond in Randolph and Braintree.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25888	Jan. 9	V. slight.	V. slight.	.50	4.25	2.00	.0004	.0158	.0152	.0006	.52	.0090	.0000	.57	1.0
26168	Feb. 6	None	V. slight.	.11	2.50	0.85	.0002	.0052	.0046	.0006	.36	.0010	.0000	.25	1.1
26409	Mar. 7	V. slight.	Slight.	.38	3.95	1.40	.0018	.0158	.0132	.0026	.44	.0070	.0001	.46	1.1
26731	Apr. 11	V. slight.	None.	.32	3.25	1.40	.0000	.0122	.0118	.0004	.33	.0070	.0000	.38	0.8
27052	May 9	V. slight.	V. slight.	.37	2.90	1.15	.0004	.0132	.0126	.0006	.42	.0040	.0000	.44	0.5
27422	June 13	V. slight.	V. slight	.25	2.75	1.00	.0002	.0182	.0170	.0012	.48	.0050	.0000	.42	1.3
27725	July 11	V. slight.	V. slight.	.20	3.25	1.35	.0008	.0184	.0178	.0006	.43	.0000	.0000	.37	0.8
28098	Aug. 8	Slight.	V. slight.	.20	3.95	1.15	.0000	.0190	.0184	.0006	.50	.0030	.0000	.38	1.0
28578	Sept. 12	Slight.	Slight.	.20	3.70	1.45	.0006	.0260	.0234	.0026	.46	.0060	.0000	.35	0.5
28948	Oct. 10	V. slight.	V. slight.	.21	3.85	1.20	.0006	.0196	.0188	.0008	.43	.0010	.0000	.40	0.8
29280	Nov. 7	V slight.	V. slight.	.32	4.20	1.70	.0028	.0262	.0210	.0052	.50	.0030	.0002	.54	0.6
29642	Dec. 12	V. slight.	V. slight.	.40	4.25	1.35	.0006	.0206	.0190	.0016	.51	.0010	.0000	.48	0.8

Averages by Years.

-	1893	-	-	.48	4.73	1.84	.0017	.0236	.0176	.0060	.58	.0050	.0000	.51	1.1
-	1894	-	-	.47	4.16	1.68	.0004	.0156	.0137	.0019	.68	.0020	.0000	.45	1.2
-	1895	-	-	.53	3.92	1.70	.0013	.0221	.0195	.0026	.54	.0065	.0001	.58	0.8
-	1897	-	-	.48	4.01	1.62	.0004	.0190	.0167	.0023	.58	.0064	.0000	.53	1.1
-	1898	-	-	.68	4.28	1.96	.0007	.0202	.0186	.0016	.54	.0041	.0000	.65	1.1
-	1899	-	-	.29	3.57	1.33	.0007	.0175	.0161	.0014	.45	.0039	.0000	.42	0.8

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of some of the samples became stronger, and in January and March faintly fishy. — Nos. 26409, 26731, 27725, 28098 and 29642 were collected from a faucet in the pumping station; the others, from the pond.

RANDOLPH AND HOLBROOK.

Microscopical Examination of Water from Great Pond, in Randolph and Braintree.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	10	8	8	13	10	15	12	10	18	11	8	13
Number of sample,	25833	26168	26409	26731	27052	27422	27725	28098	28578	28948	29280	29642
PLANTS.												
Diatomaceæ,	182	3	1	27	30	214	10	6	4	2	23	59
Cyclotella,	0	0	0	0	0	134	7	2	0	1	19	58
Melosira,	180	0	0	0	7	0	0	0	0	0	0	0
Synedra,	1	1	1	15	10	79	2	0	2	1	1	1
Cyanophyceæ,	0	0	0	0	0	1	0	110	16	4	0	0
Anabæna,	0	0	0	0	0	0	0	86	8	0	0	0
Microcystis,	0	0	0	0	0	1	0	24	8	4	0	0
Algæ,	0	0	0	0	0	5	3	42	26	25	0	0
Fungi, Crenothrix,	0	0	0	0	0	0	0	0	0	15	0	0
ANIMALS.												
Infusoria,	0	173	40	12	0	12	1	0	2	0	2	0
Dinobryon,	0	160	0	12	0	12	0	0	0	0	0	0
Peridinium,	0	1	40	0	0	0	1	0	0	0	0	0
Vermes, Polyarthra,	0	0	0	0	0	0	1	0	0	1	0	0
Crustacea, Cyclops,	pr.	0	0	0	0	0	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	3	3	0	0	3	3	0	3	5	3	3	0
TOTAL,	185	179	41	39	33	235	15	161	53	50	28	59

The advice of the State Board of Health to the board of health of Randolph, relative to the quality of the water of a well used for the supply of several families in that town, may be found on page 39 of this volume. The results of an analysis of the sample of water collected from the well is given in the following table: —

Chemical Examination of Water from a Well on Ward Street, Randolph.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
27352	1899. June 8	None.	V. slight.	.00	15.20	.0446	.0056	2.41	.4950	.0024	.05	4.7	.0020

Odor, faintly unpleasant, becoming stronger on heating. —— The sample was collected from a well on the premises of Alice Kenney, on Ward Street.

READING.

WATER SUPPLY OF READING.

Chemical Examination of Water from the Filter-gallery of the Reading Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25883	Jan. 9	Decided.	Heavy.	.60	8.50	.0080	.0120	.41	.0010	.0000	.54	2.8	.2150
26136	Feb. 6	Decided.	Cons.	.70	8.30	.0088	.0116	.40	.0030	.0001	.51	2.7	.2350
26418	Mar. 8	Decided.	Heavy.	.65	8.00	.0090	.0112	.39	.0000	.0000	.52	2.6	.2200
26700	Apr. 10	Decided.	Cons.	.70	6.70	.0100	.0126	.36	.0040	.0000	.48	2.7	.1700
27019	May 6	Decided.	Cons.	.55	7.50	.0080	.0112	.32	.0030	.0000	.53	2.5	.1100
27335	June 6	Decided.	Cons.	.80	7.10	.0076	.0140	.39	.0040	.0000	.65	2.0	.1200
27675	July 6	Decided.	Cons.	.80	7.00	.0096	.0104	.40	.0020	.0000	.56	2.0	.1200
28073	Aug. 7	Decided, milky.	Cons.	.55	6.90	.0088	.0072	.48	.0020	.0000	.45	2.2	.0850
28476	Sept. 5	Decided, floc.	Cons., floc.	.60	7.40	.0112	.0092	.50	.0040	.0000	.41	2.0	.1800
28934	Oct. 10	Decided.	Heavy.	.52	8.00	.0136	.0128	.50	.0010	.0001	.54	2.0	.2400
29241	Nov. 5	Decided.	Cons.	.80	9.30	.0120	.0084	.52	.0040	.0000	.39	2.3	.1700
29614	Dec. 11	Decided.	Cons.	.65	8.00	.0118	.0106	.52	.0020	.0000	.38	2.6	.2000

Averages by Years.

-	1891	-	-	.18	12.96	.0016	.0063	.48	.0094	.0001	-	5.1	-
-	1892	-	-	.44	9.25	.0042	.0073	.54	.0071	.0001	-	3.4	-
-	1893	-	-	.64	10.08	.0034	.0067	.56	.0032	.0001	.35	3.9	.1251
-	1894	-	-	.45	12.76	.0043	.0107	.68	.0029	.0000	.35	5.0	.2642
-	1895	-	-	.61	13.88	.0088	.0114	.72	.0048	.0000	.44	5.5	.2277
-	1896	-	-	.52	11.50	.0060	.0089	.51	.0059	.0001	.40	4.1	.2696
-	1897	-	-	.76	11.12	.0090	.0110	.53	.0058	.0001	.44	4.0	.2644
-	1898	-	-	.82	9.61	.0095	.0141	.44	.0008	.0000	.64	3.0	.2254
-	1899	-	-	.67	7.80	.0099	.0109	.44	.0025	.0000	.50	2.4	.1721

NOTE to analyses of 1899: Odor, generally none, sometimes earthy or unpleasant on heating.

READING.

Chemical Examination of Water from Reading Filter-gallery after passing through the Mechanical Filter.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25884	Jan. 9	V. slight.	None.	.29	16.00	.0012	.0106	.41	.0050	.0012	.40	9.9	.0080
26137	Feb. 6	Slight.	None.	.27	15.00	.0034	.0108	.43	.0030	.0004	.36	9.0	.0200
26419	Mar. 8	V. slight.	None.	.20	15.00	.0032	.0076	.41	.0030	.0008	.31	8.9	.0130
26701	Apr. 10	None.	None.	.29	14.30	.0060	.0090	.31	.0030	.0004	.33	8.6	.0160
27020	May 6	V. slight.	V. slight.	.31	13.80	.0022	.0104	.32	.0060	.0005	.38	8.1	.0120
27336	June 6	Slight, milky.	None.	.34	13.50	.0052	.0104	.30	.0020	.0020	.43	8.0	.0150
27676	July 6	V. slight.	None.	.21	14.20	.0022	.0052	.43	.0040	.0015	.32	8.6	.0080
28074	Aug. 7	None.	None.	.26	14.20	.0040	.0042	.48	.0040	.0020	.33	8.6	.0080
28477	Sept. 5	None.	None.	.20	14.40	.0058	.0070	.54	.0020	.0024	.29	7.4	.0040
28935	Oct. 10	V. slight.	None.	.14	14.60	.0024	.0074	.54	.0080	.0060	.24	8.6	.0020
29242	Nov. 5	None.	None.	.12	15.80	.0054	.0050	.52	.0050	.0018	.19	7.9	.0020
29615	Dec. 11	None.	None.	.08	14.40	.0070	.0080	.57	.0060	.0012	.25	7.1	.0080

Averages by Years.

-	1896	-	-	.15	19.42	.0035	.0067	.56	.0043	.0016	.24	11.3	.0091
-	1897	-	-	.23	18.54	.0034	.0084	.52	.0062	.0010	.29	12.7	.0087
-	1898	-	-	.27	16.82	.0028	.0108	.45	.0060	.0006	.34	10.0	.0132
-	1899	-	-	.23	14.60	.0040	.0080	.45	.0042	.0016	.32	8.4	.0084

Note to analyses of 1899: Odor, none.

Water Supply of Rockland.

(See *Abington*.)

ROCKPORT.

Water Supply of Rockport.

Chemical Examination of Water from Cape Pond, Rockport.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25955	Jan. 16	V. slight.	V. slight.	.54	11.40	2.00	.0226	.0366	.0232	.0034	4.40	.0060	.0003	.47	1.0
26239	Feb. 17	Slight.	Slight.	.46	11.25	2.25	.0090	.0220	.0204	.0016	4.05	.0160	.0003	.40	1.0
26540	Mar. 21	Slight.	V. slight.	.38	10.70	2.40	.0084	.0296	.0228	.0068	4.05	.0100	.0001	.50	0.6
26899	Apr. 24	Slight.	Cons.	.30	9.50	2.00	.0086	.0336	.0196	.0140	4.05	.0020	.0000	.35	0.8
27196	May 22	Decided.	Cons.	.30	9.75	2.00	.0086	.0358	.0242	.0116	4.39	.0010	.0001	.37	0.8
27521	June 20	Decided.	Cons.	.35	10.15	2.35	.0025	.0337	.0256	.0081	3.92	.0020	.0001	.45	0.6
27801	July 17	Decided.	Cons.	.34	10.15	1.70	.0090	.0314	.0256	.0058	4.12	.0030	.0000	.42	1.0
28299	Aug. 22	Decided.	Slight.	.30	10.15	2.30	.0002	.0282	.0236	.0046	4.50	.0060	.0000	.37	1.1
28665	Sept. 18	Decided.	Cons.	.24	10.25	2.00	.0024	.0372	.0242	.0130	4.42	.0010	.0000	.31	1.0
29101	Oct. 23	Decided.	Slight.	.33	10.10	1.85	.0016	.0344	.0238	.0106	4.23	.0040	.0000	.39	0.8
29369	Nov. 13	Decided.	Cons.	.29	9.60	1.35	.0002	.0312	.0238	.0074	4.09	.0010	.0000	.35	0.5
29689	Dec. 18	Slight.	Slight.	.33	9.50	1.45	.0002	.0254	.0194	.0060	4.11	.0010	.0000	.31	0.8

Averages by Years.

-	1894	-	-	.22	12.85	1.91	.0001	.0225	.0163	.0062	5.56	.0010	.0000	.25	1.3
-	1895	-	-	.25	12.61	2.31	.0025	.0302	.0198	.0104	5.42	.0037	.0000	.32	1.2
-	1896	-	-	.29	11.67	2.11	.0008	.0198	.0149	.0049	4.97	.0089	.0000	.24	1.0
-	1897	-	-	.39	10.94	2.10	.0034	.0261	.0196	.0065	4.60	.0068	.0000	.31	1.1
-	1898	-	-	.44	10.43	2.17	.0049	.0336	.0231	.0105	4.34	.0025	.0001	.38	1.0
-	1899	-	-	.35	10.21	2.06	.0049	.0308	.0230	.0078	4.24	.0043	.0001	.39	0.8

NOTE to analyses of 1899: Odor, generally vegetable, occasionally unpleasant or grassy. A faintly fishy odor was developed in the March and April samples on heating. — The samples were collected from a faucet at the pumping station.

Microscopical Examination of Water from Cape Pond, Rockport.

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	17	18	21	25	24	22	18	22	21	24	14	19
Number of sample,	25955	26239	26540	26899	27196	27521	27801	28299	28665	29101	29369	29689
PLANTS.												
Diatomaceæ,	346	752	768	5,014	7,050	854	2,516	1,534	5,036	5,468	2,352	1,818
Asterionella,	342	752	768	5,000	7,000	828	16	14	36	468	632	1,744
Melosira,	3	0	0	14	50	26	2,500	1,520	5,000	5,000	1,720	74
Cyanophyceæ, Anabæna,	0	0	0	0	112	0	0	70	4	36	78	106
Algæ,	58	1	60	0	12	6,102	2	8	460	221	122	52
Protococcus,	58	0	0	0	0	6,000	0	0	0	40	62	44
Scenedesmus,	0	0	0	0	0	94	2	2	8	152	2	0
Staurastrum,	0	0	0	0	2	6	0	6	448	12	2	0
Zoöspores,	0	0	60	0	0	0	0	0	0	0	0	0

ROCKPORT.

Microscopical Examination of Water from Cape Pond, Rockport — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Infusoria,	11	6	28	136	84	4	172	132	108	140	22	38
Cryptomonas,	8	0	0	40	0	0	0	0	0	40	0	0
Dinobryon,	0	0	0	0	0	0	0	0	0	8	10	22
Peridinium,	2	1	22	92	0	0	0	4	20	8	2	6
Trachelomonas,	1	5	0	4	84	4	172	128	88	84	8	6
Vermes,	0	1	2	8	4	5	6	2	1	0	0	0
Crustacea,	0	pr.	pr.	0	pr.	0	0	pr.	pr.	pr.	pr.	0
Bosmina,	0	0	0	0	0	0	0	0	pr.	pr.	0	0
Cyclops,	0	0	0	0	pr.	0	0	pr.	0	pr.	pr.	0
Daphnia,	0	pr.	pr.	0	pr.	0	0	pr.	pr.	pr.	0	0
Miscellaneous, Zoöglœa,	0	0	0	10	20	0	5	15	40	15	15	5
TOTAL,	415	763	858	5,178	7,292	6,971	2,715	1,763	5,673	5,896	2,593	1,817

RUSSELL.

The advice of the State Board of Health to William B. Shelley of Russell, with reference to a proposed water supply for that town, may be found on pages 39 and 40 of this volume. The results of the analysis of a sample of water collected from the proposed source of supply is given in the following table: —

Chemical Examination of Water from Black Brook, in Russell.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
27578	1899. June 26	V. slight.	V. slight.	.12	3.20	0.85	.0010	.0078	.0064	.0014	.07	.0070	.0000	.24	0.6

Odor, none. —— The sample was collected from the brook, at site of proposed reservoir, 1 mile from centre of village.

RUTLAND.

WATER SUPPLY OF RUTLAND.

Chemical Examination of Water from Muschopauge Lake, Rutland, collected near the Surface.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25937	Jan. 12	V. slight.	Cons.	.07	2.20	1.10	.0028	.0468	.0232	.0236	.19	.0020	.0001	.22	0.6
26595	Mar. 25	V. slight.	V. slight.	.05	2.25	0.75	.0082	.0220	.0190	.0030	.14	.0050	.0000	.10	0.5
27418	June 10	V. slight.	V. slight.	.01	2.15	0.75	.0016	.0120	.0110	.0010	.15	.0030	.0000	.16	0.5
27809	July 14	V. slight.	Slight., floc.	.02	2.75	1.00	.0058	.0136	.0122	.0014	.18	.0010	.0000	.19	0.5
28862	Sept. 28	None.	V. slight.	.00	1.75	0.75	.0036	.0126	.0114	.0012	.14	.0020	.0000	.16	0.3
29452	Nov. 20	Slight.	Slight.	.05	2.05	0.85	.0048	.0138	.0126	.0012	.15	.0010	.0000	.14	0.2
Av...	....	....	....	.03	2.19	0.87	.0045	.0201	.0149	.0052	.16	.0023	.0000	.16	0.4

Odor, faintly vegetable or none.

Microscopical Examination of Water from Muschopauge Lake, Rutland, collected near the Surface.

[Number of organisms per cubic centimeter.]

	1899.					
	Jan.	Mar.	June.	July.	Oct.	Nov.
Day of examination, ...	14	29	13	19	4	22
Number of sample, ...	25937	26595	27418	27809	28862	29452
PLANTS.						
Diatomaceæ, ...	614	87	66	236	21	6
Asterionella, ...	330	68	8	6	6	0
Cyclotella, ...	68	3	47	210	8	1
Melosira, ...	90	0	3	18	0	4
Synedra, ...	56	16	2	2	5	0
Cyanophyceæ, ...	0	0	0	6	0	3
Algæ, Raphidium, ...	0	0	0	8	0	0
ANIMALS.						
Infusoria, ...	52	7	5	52	0	0
Dinobryon, ...	42	2	4	52	0	0
Peridinium, ...	10	1	1	0	0	0
Crustacea, ...	pr.	0	0	0	0	0
Cyclops, ...	pr.	0	0	0	0	0
Daphnia, ...	pr.	0	0	0	0	0
Miscellaneous, Zoöglœa, ...	60	7	3	8	3	0
TOTAL, ...	726	101	74	305	24	9

RUTLAND.

Chemical Examination of Water from Muschopauge Lake, collected near the Bottom.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25938	Jan. 12	V. slight.	V. slight.	.07	2.15	1.00	.0020	.0128	.0124	.0004	.16	.0020	.0000	.18	0.6
26596	Mar. 25	V. slight.	V. slight.	.05	2.00	0.75	.0010	.0118	.0096	.0022	.15	.0030	.0000	.17	0.5
27414	June 10	V. slight.	V. slight.	.02	1.65	0.75	.0020	.0132	.0110	.0022	.15	.0040	.0000	.18	0.5
27810	July 14	V. slight.	V. slight.	.04	1.60	0.55	.0016	.0112	.0096	.0016	.18	.0010	.0000	.19	0.5
28863	Sept. 28	None.	Slight.	.00	1.70	0.70	.0040	.0128	.0124	.0004	.14	.0020	.0000	.15	0.5
29453	Nov. 20	Slight.	Slight.	.04	2.10	0.85	.0074	.0220	.0194	.0026	.16	.0010	.0000	.15	0.2
Av.	....	....	....	.04	1.87	0.77	.0030	.0140	.0124	.0016	.16	.0022	.0000	.17	0.5

Odor, generally faintly vegetable, sometimes faintly unpleasant or disagreeable.

Water Supply of Salem and Beverly.

The advice of the State Board of Health to the city of Salem, with reference to the quality of the water furnished from the various sources of supply, may be found on pages 40 to 42 of this volume.

Chemical Examination of Water from Wenham Lake, in Beverly and Wenham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25903	Jan. 10	V. slight.	V. slight.	.13	5.50	1.70	.0012	.0166	.0138	.0028	.76	.0130	.0001	.27	2.2
26179	Feb. 7	V. slight.	Slight.	.12	5.40	2.00	.0020	.0142	.0122	.0020	.69	.0120	.0001	.26	2.5
26424	Mar. 8	V. slight.	V. slight.	.12	5.40	1.85	.0038	.0140	.0130	.0010	.68	.0090	.0002	.28	2.1
26739	Apr. 11	V. slight.	V. slight.	.16	5.55	1.95	.0032	.0132	.0122	.0010	.72	.0080	.0002	.31	2.0
27048	May 9	V. slight.	V. slight.	.18	5.25	1.65	.0008	.0146	.0134	.0012	.70	.0100	.0001	.31	2.0
27462	June 16	V. slight.	Slight.	.12	5.25	1.60	.0046	.0232	.0204	.0028	.68	.0020	.0002	.28	2.0
27719	July 11	V. slight.	Slight.	.08	5.00	1.05	.0008	.0222	.0182	.0040	.67	.0010	.0001	.27	2.1
28193	Aug. 12	V. slight.	Slight.	.05	5.15	2.30	.0036	.0174	.0152	.0022	.68	.0050	.0001	.25	1.8
28573	Sept. 12	V. slight.	V. slight.	.10	5.25	1.45	.0014	.0234	.0190	.0044	.79	.0070	.0000	.26	1.8
29038	Oct. 10	V. slight.	V. slight.	.07	5.35	1.50	.0032	.0208	.0160	.0048	.79	.0010	.0001	.27	2.2
29283	Nov. 7	Slight.	V. slight.	.23	5.80	1.50	.0158	.0216	.0190	.0026	.80	.0050	.0008	.28	2.6
29638	Dec. 12	Decided.	Cons.	.15	5.55	1.90	.0114	.0198	.0136	.0062	.82	.0100	.0000	.24	2.3

SALEM AND BEVERLY.

Chemical Examination of Water from Wenham Lake, in Beverly and Wenham — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
-	1888	-	-	.05	4.67	0.97	.0020	.0146	-	-	.73	.0058	.0001	-	-
-	1889	-	-	.06	4.23	1.05	.0014	.0173	.0138	.0035	.72	.0052	.0002	-	-
-	1890	-	-	.05	4.57	0.90	.0016	.0154	.0125	.0029	.74	.0104	.0001	-	2.5
-	1891	-	-	.07	4.70	1.12	.0006	.0147	.0113	.0034	.72	.0125	.0000	-	1.9
-	1892	-	-	.03	4.85	1.10	.0016	.0137	.0103	.0034	.75	.0077	.0000	-	2.2
-	1893	-	-	.04	5.49	1.26	.0033	.0130	.0100	.0030	.77	.0055	.0001	.16	2.6
-	1894	-	-	.07	6.69	1.53	.0030	.0148	.0114	.0034	.82	.0023	.0001	.14	3.0
-	1895	-	-	.21	6.75	1.97	.0026	.0177	.0146	.0031	.81	.0059	.0001	.30	3.1
-	1896	-	-	.15	6.30	1.82	.0020	.0213	.0152	.0061	.80	.0063	.0001	.28	2.7
-	1897	-	-	.13	6.09	1.60	.0027	.0206	.0170	.0036	.82	.0048	.0001	.29	2.7
-	1898	-	-	.15	5.61	1.73	.0025	.0181	.0151	.0030	.80	.0040	.0001	.29	2.3
-	1899	-	-	.18	5.37	1.70	.0043	.0184	.0155	.0029	.73	.0069	.0002	.27	2.1

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of most of the samples was stronger and sometimes also grassy or unpleasant.—The first three samples were collected from a faucet at the pumping station; the others, from the lake.

Microscopical Examination of Water from Wenham Lake, in Beverly and Wenham.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	11	8	9	13	10	19	12	15	13	8	8	13
Number of sample,	25903	26179	26424	26739	27048	27462	27719	28193	28573	28938	29283	29633
PLANTS.												
Diatomaceæ,	1,206	250	35	73	142	204	76	452	72	252	122	748
Asterionella,	616	174	2	17	62	18	0	110	28	68	2	240
Cyclotella,	44	7	12	4	0	148	2	4	0	10	19	122
Melosira,	316	30	13	23	18	0	0	0	12	22	86	244
Synedra,	6	6	4	11	8	32	2	52	0	14	0	2
Tabellaria,	222	33	0	2	32	6	72	270	22	138	15	120
Cyanophyceæ,	0	0	0	0	0	36	198	84	56	186	0	0
Anabæna,	0	0	0	0	0	28	40	12	48	174	0	0
Aphanizomenon,	0	0	0	0	0	0	0	18	0	0	0	0
Microcystis,	0	0	0	0	0	8	152	26	0	10	0	0
Algæ,	4	0	0	2	2	16	32	62	6	40	21	30
Protococcus,	0	0	0	0	0	15	32	60	0	36	10	16

SALEM AND BEVERLY.

Microscopical Examination of Water from Wenham Lake, in Beverly and Wenham —Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Infusoria, ...	12	2	6	8	88	6	0	8	2	46	11	4
Dinobryon, ...	2	0	3	6	88	0	0	4	0	30	4	0
Vermes, ...	0	0	1	0	2	1	0	0	0	0	1	0
Crustacea, Cyclops, ...	0	0	0	0	pr.	0	pr.	0	0	pr.	0	0
Miscellaneous, Zoöglœa, ...	0	3	3	8	5	7	3	12	3	7	3	3
TOTAL, ...	1,222	255	45	92	239	270	309	598	189	583	158	785

Chemical Examination of Water from Longham Brook Reservoir, in Beverly and Wenham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25902	Jan. 10	Slight.	Slight.	0.42	4.30	1.55	.0044	.0152	.0140	.0012	0.69	.0120	.0002	0.48	1.0
26178	Feb. 7	Slight.	Slight.	0.45	5.00	2.10	.0040	.0156	.0136	.0020	0.75	.0170	.0002	0.50	1.3
26423	Mar. 8	Decided.	Slight.	0.38	3.55	1.70	.0080	.0180	.0148	.0032	0.53	.0050	.0002	0.44	0.5
26738	Apr. 11	Slight.	Cons.	0.42	3.45	1.70	.0034	.0194	.0168	.0026	0.52	.0040	.0001	0.46	0.3
27047	May 9	Slight.	Cons.	0.74	5.35	2.20	.0038	.0336	.0297	.0039	0.68	.0060	.0000	0.82	1.3
27461	June 16	Slight.	Cons.	1.25	6.45	3.00	.0214	.0738	.0522	.0216	0.84	.0020	.0001	1.10	1.3
27718	July 11	Slight.	Cons.	1.00	5.85	2.05	.0044	.0504	.0390	.0114	0.71	.0060	.0001	0.88	1.0
28192	Aug. 12	Slight.	Cons.	0.96	6.10	3.15	.0086	.0472	.0404	.0068	0.79	.0030	.0000	0.86	1.3
28572	Sept. 12	Decided.	Slight.	0.98	6.15	2.65	.0056	.0540	.0440	.0100	0.84	.0070	.0000	0.79	1.0
28937	Oct. 10	Decided.	Cons.	0.54	6.15	1.90	.0052	.0368	.0314	.0054	0.90	.0080	.0002	0.52	1.8
29282	Nov. 7	Decided.	Slight.	1.00	7.15	2.30	.0096	.0388	.0334	.0054	0.92	.0060	.0004	0.83	1.6
29494	Nov. 24	V. slight.	V. slight.	1.10	6.65	3.15	.0026	.0300	.0284	.0016	0.82	.0040	.0001	1.20	1.6
29632	Dec. 12	Decided.	Cons.	0.71	6.35	1.85	.0318	.0404	.0228	.0176	0.83	.0110	.0001	0.68	1.8
29739	Dec. 21	Decided.	Cons.	0.95	6.85	2.30	.0160	.0312	.0252	.0060	0.82	.0080	.0000	0.90	1.6
29814	Dec. 30	Decided.	Cons.	1.20	8.25	2.90	.0132	.0332	.0248	.0084	1.09	.0180	.0001	1.02	2.1
Av.*.	....	....	....	0.76	5.58	2.26	.0079	.0361	.0293	.0068	0.75	.0073	.0001	0.73	1.2

Odor, generally vegetable, sometimes none. On heating, the odor of most of the samples was distinctly vegetable.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

SALEM AND BEVERLY.

Microscopical Examination of Water from Longham Brook Reservoir, in Beverly and Wenham.

[Number of organisms per cubic centimeter.]

	1890.							
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
Day of examination,	11	8	9	13	10	19	12	15
Number of sample,	25982	26173	26423	26735	27047	27461	27718	28192
PLANTS.								
Diatomaceæ,	12	44	18	222	60	9	218	60
Synedra,	4	18	7	15	22	9	216	60
Tabellaria,	6	9	7	180	20	0	0	0
Cyanophyceæ, Oscillaria,	0	0	0	0	0	0	0	0
Algæ,	0	0	0	4	4	2	4	7
Fungi, Crenothrix,	0	0	0	0	5	0	0	4
ANIMALS.								
Rhizopoda, Actinophrys,	0	0	0	0	0	2	0	2
Infusoria,	0	0	4	22	13	27	16	12
Dinobryon,	0	0	0	0	1	0	0	8
Mallomonas,	0	0	0	0	0	0	0	0
Monas,	0	0	0	10	4	0	0	0
Peridinium,	0	0	4	10	4	20	12	0
Vermes,	0	0	0	0	0	71	0	2
Anurea,	0	0	0	0	0	66	0	2
Crustacea,	0	0	pr.	0	0	pr.	0	pr.
Cyclops,	0	0	0	0	0	0	0	pr.
Daphnia,	0	0	0	0	0	pr.	0	0
Entomostracan ova,	0	0	pr.	0	0	0	0	0
Miscellaneous, Zoöglœa,	3	8	20	100	7	300	100	60
TOTAL,	15	52	42	348	89	411	338	147

SALEM AND BEVERLY.

Microscopical Examination of Water from Longham Brook Reservoir, in Beverly and Wenham— Concluded.

[Number of organisms per cubic centimeter.]

	1899.						1900.
	Sept.	Oct.	Nov.	Nov.	Dec.	Dec.	Jan.
Day of examination,	13	11	8	27	13	22	1
Number of sample,	28572	28937	29282	29494	29632	29739	29814
PLANTS.							
Diatomaceæ,	6	12	17	18	42	12	25
Synedra,	6	6	5	7	4	1	3
Tabellaria,	0	1	1	5	17	5	9
Cyanophyceæ, Oscillaria,	2	0	0	0	0	0	0
Algæ,	8	0	1	0	0	2	0
Fungi, Crenothrix,	0	4	0	0	0	0	6
ANIMALS.							
Rhizopoda, Actinophrys,	2	0	0	0	0	0	0
Infusoria,	472	88	21	1	0	0	0
Dinobryon,	462	77	0	0	0	0	0
Mallomonas,	6	8	20	0	0	0	0
Monas,	0	0	1	0	0	0	0
Peridinium,	0	0	0	1	0	0	0
Vermes,	0	1	2	0	0	0	0
Anuræa,	0	0	2	0	0	0	0
Crustacea,	0	pr.	pr.	0	0	0	0
Cyclops,	0	pr.	pr.	0	0	0	0
Daphnia,	0	0	0	0	0	0	0
Entomostracan ova,	0	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	5	7	0	3	160	20	100
TOTAL,	495	107	41	20	202	34	131

WATER SUPPLY OF SAUGUS.

(See *Lynn*.)

WATER SUPPLY OF SHARON.

Chemical Examination of Water from the Well of the Sharon Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27226	May 25	None.	V. slight.	.00	8.00	.0000	.0000	1.06	.2520	.0000	.02	2.9	.0000
27602	June 27	None.	None.	.00	8.00	.0000	.0000	1.02	.2450	.0000	.01	2.7	.0000
27860	July 25	None.	None.	.00	9.40	.0000	.0006	1.02	.2450	.0001	.00	2.9	.0010
28791	Sept. 27	None.	None.	.00	8.50	.0000	.0000	1.13	.1800	.0000	.03	3.1	.0000
29006	Oct. 5	None.	None.	.03	9.50	.0000	.0000	1.11	.2500	.0000	.02	3.3	.0000
Av.				.01	8.82	.0000	.0006	1.07	.2350	.0000	.02	3.0	.0020

Odor, none. — Nos. 27226 and 28791 were collected from the well; the others, from a faucet at the pumping station.

WATER SUPPLY OF SHEFFIELD. — SHEFFIELD WATER COMPANY.

Chemical Examination of Water from a Faucet in Sheffield, supplied from the Works of the Sheffield Water Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
28391	Aug. 28	None.	None.	.00	3.10	0.55	.0000	.0012	.0012	.0000	.09	.0050	.0000	.05	2.0

Odor, none.

WATER SUPPLY OF SOMERVILLE.

(See *Metropolitan Water District*, pages 127–152.)

SOUTHBRIDGE.

WATER SUPPLY OF SOUTHBRIDGE. — SOUTHBRIDGE WATER COMPANY.

Chemical Examination of Water from the Hatchet Brook Reservoir of the Southbridge Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26406	Mar. 7	V. slight.	V. slight.	.19	2.35	1.10	.0010	.0166	.0154	.0012	.18	.0010	.0001	.34	0.2
27417	June 13	Slight.	Slight.	.20	2.30	1.35	.0064	.0184	.0146	.0038	.14	.0030	.0000	.45	0.3
28574	Sept. 12	Decided.	Cons.	.29	3.45	2.10	.0016	.0376	.0240	.0136	.11	.0070	.0000	.71	0.8
29640	Dec. 12	Decided.	Cons.	.63	4.10	1.50	.0068	.0290	.0220	.0070	.20	.0020	.0000	.60	0.8
Av.	....	....	....	.33	3.05	1.51	.0024	.0254	.0190	.0064	.14	.0032	.0000	.52	0.5

Odor of the first sample, none, becoming very faintly vegetable on heating; of the second, faintly vegetable and unpleasant, becoming distinctly unpleasant and fishy on heating; of the third, faintly vegetable, becoming stronger on heating; of the last, none, becoming faintly fishy on heating.

WATER SUPPLY OF SOUTH HADLEY FALLS FIRE DISTRICT, SOUTH HADLEY.

Chemical Examination of Water from Leaping Well Reservoir, South Hadley.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26114	Feb. 1	V. slight.	Slight.	.07	2.75	1.10	.0002	.0060	.0044	.0016	.11	.0010	.0000	.10	0.6
27376	June 10	Slight.	V. slight.	.05	2.25	0.70	.0000	.0074	.0062	.0012	.13	.0020	.0000	.10	0.2
27862	July 21	V. slight.	V. slight.	.05	2.45	0.75	.0042	.0124	.0114	.0010	.14	.0040	.0000	.12	0.2
28902	Oct. 4	Decided.	Slight.	.09	2.50	1.25	.0012	.0236	.0166	.0070	.12	.0000	.0000	.17	0.3
29492	Nov. 23	V. slight.	V. slight.	.08	2.05	0.70	.0000	.0118	.0094	.0024	.10	.0010	.0000	.12	0.3
Av.	....	....	....	.07	2.40	0.90	.0011	.0122	.0096	.0026	.12	.0016	.0000	.12	0.3

Odor, faintly vegetable or none; in October, distinctly grassy.

SOUTH HADLEY.

Microscopical Examination of Water from Leaping Well Reservoir, South Hadley.

[Number of organisms per cubic centimeter.]

	1899.				
	Feb.	June.	July.	Oct.	Nov.
Day of examination,	8	13	24	6	27
Number of sample,	26114	27376	27862	28902	29492
PLANTS.					
Diatomaceæ,	84	11	2	6	11
Asterionella,	83	0	0	0	0
Cyanophyceæ,	0	0	3	300	0
Anabæna,	0	0	2	300	0
Algæ,	0	0	237	1,321	0
Protococcus,	0	0	236	1,300	0
ANIMALS.					
Infusoria,	26	0	0	0	6
Vermes,	1	0	0	0	0
Miscellaneous, Zoöglœa,	3	8	3	3	5
TOTAL,	114	19	245	1,630	22

WATER SUPPLY OF SPENCER.

Chemical Examination of Water from Shaw Pond, Spencer.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26306	Feb. 22	V. slight.	None.	.06	2.50	1.10	.0084	.0102	.0098	.0004	.16	.0010	.0001	.19	0.8
27178	May 21	Slight.	Cons.	.10	2.10	0.60	.0000	.0188	.0164	.0024	.16	.0020	.0000	.19	0.2
28289	Aug. 21	V. slight.	V. slight.	.05	2.25	0.55	.0002	.0222	.0196	.0026	.16	.0060	.0000	.21	0.6
29469	Nov. 23	Slight.	V. slight.	.04	2.50	1.00	.0120	.0220	.0200	.0020	.17	.0110	.0000	.15	0.5
Av...	....	....	....	.07	2.34	0.81	.0039	.0183	.0164	.0019	.16	.0050	.0000	.18	0.5

Odor, vegetable or none. —— No. 27178 was collected from the pond; the others, from a faucet.

WATER SUPPLY OF SPRINGFIELD.

The advice of the State Board of Health to the city of Springfield, with reference to the quality of certain sources from which it was proposed to obtain a supplementary water supply while the water of Ludlow Reservoir was drawn off, may be found on pages 42 and 43 of this volume.

During the spring of 1899 the water was drawn out of Ludlow Reservoir in order to make investigations with regard to the condition of the bottom of the reservoir, and during the latter part of the year a supplementary supply of water was obtained from Chapin and Five Mile ponds by pumping from the ponds into one of the mains leading from Ludlow basin to the city.

Chemical Examination of Water from Ludlow Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25899	Jan. 9	V. slight.	V. slight.	.25	3.10	1.25	.0156	.0252	.0214	.0038	.12	.0060	.0001	.36	0.6
26164	Feb. 6	Slight.	Cons.	.20	3.40	1.30	.0034	.0420	.0228	.0192	.19	.0080	.0003	.39	1.0
26429	Mar. 8	Slight.	Cons.	.15	2.20	1.10	.0010	.0282	.0126	.0156	.11	.0020	.0001	.30	0.5
26699	Apr. 10	Slight.	Cons.	.16	2.00	1.00	.0030	.0204	.0106	.0098	.11	.0040	.0001	.30	0.5
27069	May 10	Decided.	Cons.	.24	2.25	1.00	.0002	.0318	.0186	.0132	.13	.0010	.0000	.33	0.2
27412	June 12	Slight.	Cons.	.48	3.50	1.50	.0012	.0546	.0286	.0260	.14	.0030	.0000	.51	0.3
27707	July 10	Decided.	Heavy.	.40	2.90	1.40	.0005	.0840	.0345	.0495	.09	.0020	.0000	.64	0.3

Averages by Years.

-	1888	-	-	.13	2.91	1.20	.0019	.0332	-	-	.12	.0047	.0001	-	-
-	1889	-	-	.12	2.42	1.08	.0028	.0461	.0237	.0224	.10	.0038	.0002	-	-
-	1890	-	-	.15	2.96	1.54	.0029	.0387	.0210	.0177	.10	.0065	.0001	-	0.9
-	1891	-	-	.20	3.00	1.42	.0050	.0425	.0228	.0197	.09	.0050	.0001	-	0.8
-	1894	-	-	.37	3.39	1.47	.0009	.0221	.0165	.0056	.16	.0018	.0000	.42	1.1
-	1895	-	-	.29	3.35	1.55	.0028	.0315	.0201	.0114	.18	.0030	.0000	.41	1.1
-	1896	-	-	.26	3.25	1.41	.0042	.0404	.0220	.0184	.15	.0031	.0000	.37	1.0
-	1897	-	-	.33	3.28	1.67	.0039	.0453	.0267	.0186	.15	.0028	.0000	.43	0.8
-	1898	-	-	.29	2.90	1.44	.0020	.0378	.0218	.0155	.15	.0016	.0000	.38	0.7
-	1899	-	-	.27	2.76	1.22	.0036	.0409	.0213	.0196	.13	.0037	.0001	.40	0.5

NOTE to analyses of 1899: Odor of the last sample, offensive; of the others, generally faintly vegetable, sometimes unpleasant or disagreeable, becoming stronger, and in March decidedly fishy, on heating.

SPRINGFIELD.

Microscopical Examination of Water from Ludlow Reservoir.

[Number of organisms per cubic centimeter.]

	1899.						
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
Day of examination,	10	7	9	11	11	13	11
Number of sample,	25899	26164	26429	26690	27060	27412	27707
PLANTS.							
Diatomaceæ,	27	0	0	24	1,677	992	738
Asterionella,	24	0	0	2	560	160	64
Cyclotella,	0	0	0	6	76	8	52
Melosira,	0	0	0	9	800	804	568
Synedra,	1	0	0	3	116	8	4
Tabellaria,	2	0	0	4	116	8	20
Cyanophyceæ,	5	4	0	0	34	136	1,526
Anabæna,	3	0	0	0	28	56	0
Clathrocystis,	0	0	0	0	0	60	1,526
Microcystis,	0	0	0	0	0	20	0
Algæ,	2	0	0	0	72	388	1,500
Pediastrum,	0	0	0	0	4	52	248
Scenedesmus,	1	0	0	0	52	248	1,208
Staurastrum,	0	0	0	0	12	72	16
ANIMALS.							
Infusoria,	36	6,844	6,401	14	1,385	58	12
Chlamydomonas,	0	0	0	0	0	12	0
Ciliated infusorian,	0	100	0	0	0	0	0
Cryptomonas,	2	0	0	1	60	4	0
Dinobryon,	17	6,680	6,400	11	1,284	0	0
Mallomonas,	3	50	0	0	0	24	0
Monas,	0	0	0	0	20	0	0
Peridinium,	14	10	0	2	0	0	4
Uroglena,	0	2	0	0	8	0	0
Vorticella,	0	0	0	0	12	0	0
Vermes,	0	48	0	0	6	44	16
Polyarthra,	0	0	0	0	1	40	0
Synchæta,	0	42	0	0	0	0	0
Crustacea,	0	0	0	0	pr.	pr.	pr.
Bosmina,	0	0	0	0	pr.	0	0
Cyclops,	0	0	0	0	pr.	pr.	pr.
Daphnia,	0	0	0	0	0	pr.	0
Miscellaneous, Zoöglœa,	5	0	0	30	160	200	800
TOTAL,	75	6,894	6,401	68	3,336	1,813	4,592

SPRINGFIELD.

Chemical Examination of Water from the Receiving Basin of the Springfield Water Works, at Ludlow.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25898	Jan. 9	V. slight.	V. slight.	.27	3.10	1.10	.0004	.0092	.0082	.0010	.11	.0070	.0000	.35	0.8
26163	Feb. 6	V. slight.	V. slight.	.15	3.40	1.10	.0006	.0082	.0074	.0008	.15	.0050	.0002	.23	1.1
26428	Mar. 8	Slight.	Slight.	.22	2.55	1.15	.0002	.0132	.0116	.0016	.09	.0060	.0000	.38	0.5
26698	Apr. 10	V. slight.	V. slight.	.26	2.05	0.90	.0000	.0152	.0134	.0018	.09	.0010	.0001	.38	0.5
27068	May 10	Slight.	Slight.	.41	3.00	1.25	.0010	.0190	.0162	.0028	.13	.0020	.0000	.52	0.6
27411	June 12	Slight	Slight.	.41	3.00	1.15	.0024	.0266	.0200	.0066	.15	.0050	.0001	.46	0.6
27706	July 10	Slight.	V. slight.	.53	3.65	1.60	.0032	.0266	.0232	.0034	.11	.0020	.0001	.78	1.0
28079	Aug. 7	V. slight.	Slight.	.52	3.85	1.75	.0024	.0194	.0180	.0014	.18	.0030	.0000	.65	1.0
28582	Sept. 12	Slight.	Slight.	.51	4.15	1.75	.0006	.0244	.0212	.0032	.12	.0050	.0000	.62	0.8
29009	Oct. 12	Slight.	V. slight.	.28	4.05	1.25	.0030	.0160	.0152	.0008	.16	.0070	.0000	.39	1.0
29250	Nov. 6	Slight.	Slight.	.62	4.40	1.85	.0006	.0216	.0194	.0022	.20	.0050	.0000	.76	0.8
29606	Dec. 11	Slight.	V. slight.	.36	4.00	1.50	.0022	.0134	.0126	.0008	.14	.0050	.0000	.40	1.1

Averages by Years.

-	1891	-	-	.31	3.27	1.20	.0011	.0225	.0147	.0078	.09	.0049	.0001	-	1.0
-	1892	-	-	.44	3.79	1.39	.0004	.0164	.0127	.0037	.14	.0089	.0001	-	1.3
-	1893	-	-	.49	3.76	1.39	.0009	.0204	.0146	.0058	.15	.0026	.0001	.51	1.2
-	1894	-	-	.49	3.68	1.42	.0010	.0196	.0151	.0045	.16	.0027	.0000	.46	1.6
-	1895	-	-	.47	3.86	1.61	.0019	.0212	.0162	.0050	.18	.0050	.0000	.50	1.3
-	1896	-	-	.43	3.71	1.37	.0012	.0182	.0150	.0032	.15	.0051	.0000	.50	1.1
-	1897	-	-	.51	3.49	1.40	.0013	.0185	.0154	.0031	.16	.0051	.0000	.51	1.0
-	1898	-	-	.45	3.54	1.54	.0011	.0162	.0131	.0031	.15	.0048	.0000	.45	0.9
-	1899	-	-	.38	3.43	1.36	.0014	.0177	.0155	.0022	.18	.0044	.0000	.49	0.8

Note to analyses of 1899: Odor, generally faintly vegetable, occasionally none. On heating, the odor of most of the samples became distinctly vegetable.

SPRINGFIELD.

Chemical Examination of Water from Chapin Pond, Ludlow.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance: Turbidity.	Appearance: Sediment.	Appearance: 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.
	1899.														
[illegible]	Jan. 9	V. slight.	Slight.	.14	2.30	1.10	[illegible]	[illegible]	[illegible]	.0015	.08	.0010	.0000	.22	0.5
[illegible]	Feb. 6	Slight.	V. slight.	.17	2.45	0.30	[illegible]	[illegible]	[illegible]	[illegible]	.11	[illegible]	.0000	.26	0.6
[illegible]	Mar. 6	V. slight.	V. slight.	[illegible]	1.90	0.90	[illegible]	[illegible]	[illegible]	.0086	.04	.0060	.0000	[illegible]	0.0
[illegible]	Apr. 10	V. slight.	Slight.	[illegible]	2.15	0.85	[illegible]	[illegible]	[illegible]	.0064	[illegible]	.0040	.0000	.22	0.3
[illegible]	May 14	V. slight.	Slight.	[illegible]	2.15	1.30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.25	0.5
[illegible]	June 12	V. slight.	Slight.	[illegible]	1.85	1.30	[illegible]	[illegible]	[illegible]	.0044	.12	[illegible]	[illegible]	[illegible]	0.3
[illegible]	July 10	Slight.	Slight.	.16	2.45	1.10	[illegible]	[illegible]	[illegible]	[illegible]	.14	[illegible]	[illegible]	.32	0.5
[illegible]	Aug. 7	V. slight.	V. slight.	.05	2.45	0.85	[illegible]	[illegible]	[illegible]	[illegible]	.10	[illegible]	[illegible]	.35	0.5
[illegible]	Sept. 12	V. slight.	V. slight.	.17	2.40	0.45	[illegible]	[illegible]	[illegible]	[illegible]	.13	[illegible]	[illegible]	.19	0.3
[illegible]	Oct. 12	V. slight.	V. slight.	.14	2.40	1.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.21	0.5
[illegible]	Nov. 6	Slight.	Slight.	[illegible]	2.50	0.30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.17	0.3
[illegible]	Dec. 11	V. slight.	Cons.	.14	3.00	1.30	[illegible]	[illegible]	[illegible]	[illegible]	.12	[illegible]	[illegible]	.22	0.6

Averages by Years.

-	1897	-	-	.12	2.35	0.96	[illegible]	[illegible]	[illegible]	.0030	.13	[illegible]	.0000	.25	0.6
-	1898	-	-	.10	2.29	1.06	[illegible]	.0212	.0190	[illegible]	.12	.0023	.0000	.27	0.6
-	1899	-	-	.06	2.32	0.94	[illegible]	.0150	.0155	[illegible]	.10	[illegible]	.0000	.23	0.4

NOTE to analyses of 1899: Odor, generally faintly vegetable or none; in June, distinctly fishy and oily. On heating, the odor in January, February, April, June and December was fishy; at other times, vegetable.

Chemical Examination of Water from Five Mile Pond, Springfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance: Turbidity.	Appearance: Sediment.	Appearance: 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.
	1899.														
25606	Jan. 9	V. slight.	Slight.	.10	2.25	1.00	.0046	.0236	.0230	.0006	.12	.0010	.0000	.28	0.5
26161	Feb. 6	V. slight.	V. slight.	.10	2.15	1.05	.0052	.0208	.0196	.0012	.11	.0010	.0003	.29	0.6
26426	Mar. 8	V. slight.	Slight.	.09	1.75	0.90	.0054	.0192	.0158	.0034	.09	.0020	.0001	.26	0.0
26606	Apr. 10	V. slight.	V. slight.	.10	1.55	0.75	.0020	.0178	.0156	.0022	.09	.0040	.0001	.24	0.3
27066	May 10	V. slight.	Slight.	.13	2.20	1.90	.0000	.0244	.0192	.0052	.14	.0020	.0000	.32	0.2
27409	June 12	V. slight.	V. slight	.10	2.00	1.25	.0000	.0248	.0228	.0020	.14	.0020	.0000	.35	0.2
27704	July 10	V. slight.	Slight.	.10	2.00	1.05	.0006	.0268	.0210	.0058	.09	.0010	.0000	.30	0.3
28077	Aug. 7	V. slight.	V. slight.	.08	2.40	1.25	.0002	.0218	.0186	.0032	.12	.0040	.0000	.33	0.5
28078	Aug. 7	Slight.	V. slight.	.20	2.10	0.90	.0072	.0176	.0152	.0024	.12	.0050	.0000	.24	0.5
28680	Sept. 12	V. slight.	Slight.	.10	2.55	1.25	.0030	.0260	.0246	.0014	.15	.0060	.0000	.30	0.3
29008	Oct. 12	Slight.	V. slight	.19	2.35	1.00	.0120	.0208	.0186	.0022	.12	.0010	.0000	.23	0.3
29247	Nov. 6	Slight.	Cons.	.09	2.65	1.05	.0202	.0214	.0176	.0038	.12	.0060	.0000	.22	0.2
29604	Dec. 11	V. slight.	Slight.	.12	2.85	1.15	.0426	.0216	.0172	.0044	.14	.0060	.0000	.21	0.5

SPRINGFIELD.

Chemical Examination of Water from Five Mile Pond, Springfield — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1897	-	-	.09	2.05	1.05	.0016	.0230	.0207	.0023	.14	.0017	.0000	.31	0.4
-	1898	-	-	.14	2.24	1.20	.0015	.0252	.0222	.0030	.15	.0019	.0000	.34	0.5
-	1899*	-	-	.11	2.21	1.04	.0088	.0222	.0193	.0029	.12	.0030	.0000	.27	0.8

NOTE to analyses of 1899: Odor, generally faintly vegetable, occasionally none; in May and December, fishy or oily. On heating, the odor in January, February, April, May, June, October, November and December was fishy or oily, at other times, vegetable, and sometimes unpleasant.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Loon Pond, Springfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25897	Jan. 9	V. slight.	Slight.	.05	2.35	1.00	.0014	.0154	.0144	.0010	.22	.0080	.0000	.18	1.0
26162	Feb. 6	Slight.	Slight.	.05	2.65	1.10	.0036	.0166	.0146	.0020	.24	.0070	.0001	.17	0.8
26427	Mar. 8	Slight.	Slight.	.08	2.40	1.05	.0040	.0162	.0136	.0026	.19	.0090	.0001	.16	0.5
26697	Apr. 10	V. slight.	V. slight.	.05	2.00	1.00	.0006	.0138	.0118	.0020	.14	.0060	.0001	.15	0.5
27067	May 10	V slight.	Slight.	.05	2.55	1.00	.0010	.0168	.0156	.0012	.19	.0020	.0002	.14	0.5
27410	June 12	V. slight.	V. slight.	.02	2.50	1.10	.0002	.0174	.0162	.0012	.19	.0020	.0000	.15	0.8
27705	July 10	Slight.	Slight.	.04	2.30	0.50	.0000	.0218	.0176	.0042	.17	.0020	.0000	.16	0.8
28561	Sept. 12	V. slight.	Slight.	.04	2.65	0.90	.0028	.0230	.0196	.0034	.24	.0070	.0000	.19	0.5
29010	Oct. 12	V. slight.	V. slight.	.03	2.55	0.95	.0010	.0206	.0188	.0018	.24	.0020	.0000	.21	0.5
29249	Nov. 6	V. slight.	Slight.	.03	2.40	0.85	.0004	.0180	.0172	.0008	.24	.0050	.0000	.19	0.5
29605	Dec. 11	V. slight.	V. slight.	.03	2.90	1.35	.0014	.0198	.0184	.0014	.23	.0010	.0000	.24	1.0

Averages by Years.

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1897	-	-	.04	2.47	0.97	.0009	.0200	.0175	.0025	.21	.0015	.0000	.18	0.7
-	1898	-	-	.06	2.50	1.12	.0018	.0194	.0168	.0026	.23	.0085	.0000	.18	0.8
-	1899	-	-	.04	2.48	0.98	.0015	.0181	.0162	.0019	.21	.0042	.0000	.18	0.7

NOTE to analyses of 1899: Odor, generally none, occasionally very faintly vegetable. On heating, the odor in March, April, May and November was fishy or oily; at other times, vegetable or unpleasant. This pond is not used as a source of water supply.

STOCKBRIDGE.

WATER SUPPLY OF STOCKBRIDGE. — STOCKBRIDGE WATER COMPANY.

Chemical Examination of Water from Lake Averic, Stockbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
26274	Feb. 20	Slight.	Cons.	.11	7.65	1.30	.0086	.0136	.0110	.0026	.06	.0050	.0003	.22	5.6
26905	Apr. 24	V. slight.	V. slight.	.07	5.10	0.85	.0002	.0080	.0050	.0030	.07	.0040	.0001	.10	3.5
27582	June 26	V. slight.	V. slight	.08	5.50	1.25	.0010	.0164	.0142	.0022	.05	.0000	.0000	.25	3.8
28332	Aug. 22	None.	V. slight.	.09	6.35	1.50	.0004	.0176	.0156	.0020	.04	.0000	.0000	.35	3.5
29130	Oct. 24	V. slight	Slight.	.05	6.70	1.30	.0012	.0240	.0214	.0026	.07	.0040	.0000	.33	4.6
29774	Dec. 26	V. slight.	V. slight.	.14	7.20	1.55	.0006	.0208	.0198	.0010	.09	.0020	.0000	.28	5.0
Av...	....	....	....	.09	6.42	1.29	.0020	.0167	.0145	.0022	.06	.0025	.0001	.25	4.3

Odor, faintly vegetable or none. On heating, the odor was generally vegetable, and in February and October, fishy and oily.

Microscopical Examination.

The organism *Uroglena* was found in small numbers in the samples collected in June and October.

WATER SUPPLY OF STONEHAM.

(See *Wakefield.*)

WATER SUPPLY OF STOUGHTON.

The advice of the State Board of Health to the town of Stoughton with reference to certain proposed changes and improvements in the system of water supply of that town may be found on pages 43 to 45 of this volume.

Chemical Examination of Water from the Well of the Stoughton Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25817	Jan. 2	V. slight.	V. slight.	.19	4.00	.0002	.0034	.34	.0060	.0001	.26	0.8	.0020
27144	May 18	Slight.	V. slight	.15	3.00	.0000	.0059	.32	.0080	.0000	.16	0.5	.0030
27631	June 30	V. slight.	Slight.	.23	3.10	.0018	.0104	.29	.0030	.0000	.31	0.3	-
27919	July 29	V. slight.	None.	.23	3.75	.0008	.0064	.33	.0050	.0001	.33	0.8	-
28500	Sept. 6	V. slight.	V. slight.	.10	3.55	.0004	.0060	.37	.0060	.0000	.16	1.0	-
28883	Oct. 4	V. slight.	V. slight.	.32	4.50	.0004	.0092	.36	.0040	.0000	.38	0.8	-
Av...	....	....	....	.20	3.65	.0006	.0075	.33	.0045	.0000	.27	0.7	.0025

Odor of the first two samples, none; of the others, faintly vegetable.

STOUGHTON.

Chemical Examination of Water from Various Ponds and Brooks in Stoughton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
28347	Aug. 23	V. slight.	V. slight.	.09	3.45	1.15	.0024	.0076	.0066	.0010	.32	.0010	.0000	.19	1.0
28348	Aug. 23	V. slight.	V. slight.	.08	3.25	1.00	.0024	.0082	.0066	.0016	.30	.0030	.0001	.17	0.5
28350	Aug. 23	V. slight.	Slight.	.09	3.60	1.35	.0038	.0116	.0084	.0032	.32	.0000	.0001	.18	0.6
28349	Aug. 23	None.	V. slight.	.10	3.45	1.10	.0008	.0042	.0040	.0002	.40	.0100	.0001	.14	0.8

Odor of No. 28350, distinctly disagreeable; of the others, faintly vegetable. —— The first sample was collected from the brook flowing from Muddy Pond, opposite the collecting well of the Stoughton water works, about 1,400 feet below the pond; the second, from the brook flowing from Muddy Pond, at a point about 700 feet below the pond; the third, from the outlet of Muddy Pond; the last, from Drake's Brook.

Chemical Examination of Water from Springs and Tubular Test Wells near Muddy Pond in Stoughton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
28351	Aug. 23	V. slight.	Slight.	.02	2.70	.0000	.0062	.28	.0000	.0001	.05	0.5	.0050
28439	Aug. 31	None.	None.	.00	3.10	.0000	.0006	.27	.0080	.0000	.02	0.0	.0020
28440	Aug. 31	None.	V. slight.	.00	2.90	.0000	.0010	.26	.0050	.0000	.04	0.0	.0010
28441	Aug. 31	None.	None.	.00	2.90	.0000	.0006	.25	.0060	.0000	.03	0.3	.0010

Odor, none. —— The first sample was collected from a large spring on the north-westerly side of Muddy Pond; the second, from the most northerly of a group of tubular test wells situated in the upper end of the meadow in which Muddy Pond is located; the third, from the spring near the northerly test well; the last, from the most southerly test well, situated at the upper end of the meadow in which Muddy Pond is located.

SWAMPSCOTT AND NAHANT.

WATER SUPPLY OF SWAMPSCOTT AND NAHANT. — MARBLEHEAD WATER COMPANY.

(See also *Metropolitan Water District*, pages 127 to 152.)

Chemical Examination of Water from the Wells of the Swampscott Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25044	Jan. 13	None.	None.	.00	41.90	.0002	.0020	12.70	.3350	.0000	.06	17.0	.0010
26118	Feb. 2	None.	None.	.00	50.50	.0000	.0016	16.40	.4500	.0000	.06	21.0	.0010
26411	Mar. 6	None.	V. slight.	.01	54.50	.0000	.0020	17.32	.5000	.0000	.07	19.5	.0020
26636	Apr. 6	V. slight.	V. slight.	.00	43.00	.0000	.0022	12.65	.4800	.0000	.06	16.0	.0050
27035	May 8	None.	V. slight.	.00	69.50	.0000	.0020	19.40	.5200	.0000	.07	12.6	.0000
27692	July 8	None.	None.	.00	106.20	.0000	.0020	33.10	.9600	.0000	.12	30.0	.0080
28125	Aug. 8	None.	None.	.00	16.30	.0000	.0006	1.71	.0050	.0000	.30	6.9	.0010
Av.	....	....	....	.00	53.56	.0000	.0018	16.18	.4757	.0000	.11	17.6	.0026

Odor, none.—No. 27692 was collected from a faucet in the town, and the others from a faucet at the pumping station. The samples generally represent water from the large well, mixed with water from the wells in Paradise Road.

Chemical Examination of Water from Tubular Wells at the Southerly End of Thompson Meadow, in Swampscott and Salem.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25043	Jan. 12	None.	None.	.00	19.50	.0004	.0020	1.10	.0300	.0000	.08	11.2	.0000
26119	Feb. 2	None.	None.	.01	18.50	.0000	.0024	1.10	.0270	.0000	.06	10.9	.0010
26412	Mar. 6	None.	V. slight.	.00	18.50	.0006	.0036	1.13	.0370	.0000	.05	10.0	.0000
26867	Apr. 6	None.	None.	.00	17.30	.0002	.0000	1.20	.0310	.0000	.05	9.3	.0020
27634	May 8	None.	None.	.00	16.40	.0008	.0036	1.10	.0260	.0000	.06	8.9	.0050
Av.	....	....	....	.00	18.04	.0004	.0023	1.13	.0302	.0000	.06	10.1	.0016

Odor, none.—The samples were collected from a faucet at the pumping station in Thompson meadow.

Water Supply of Taunton.

Chemical Examination of Water from Assawompsett Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25957	Jan. 16	V. slight.	V. slight.	.67	3.75	2.20	.0006	.0212	.0188	.0024	.53	.0010	.0000	.96	0.5
26538	Mar. 20	Slight.	Slight.	.52	3.30	1.70	.0014	.0188	.0162	.0026	.44	.0010	.0000	.75	0.3
27194	May 22	Slight.	V. slight.	.52	3.25	1.55	.0006	.0178	.0166	.0012	.45	.0000	.0000	.68	0.2
27514	June 20	V. slight.	V. slight.	.38	3.35	1.50	.0016	.0202	.0184	.0018	.45	.0010	.0000	.59	0.5
27792	July 17	V. slight.	V. slight.	.23	3.05	1.30	.0022	.0170	.0160	.0010	.48	.0020	.0000	.51	0.3
28649	Sept. 18	V. slight.	Slight.	.20	3.10	1.25	.0004	.0216	.0194	.0022	.46	.0000	.0000	.33	0.3
29372	Nov. 13	V. slight.	V. slight.	.13	3.00	1.30	.0006	.0198	.0182	.0016	.45	.0010	.0000	.37	0.2

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1894	-	-	.33	3.22	1.26	.0003	.0157	.0132	.0025	.51	.0021	.0000	.43	0.7
-	1895	-	-	.36	3.34	1.54	.0005	.0185	.0157	.0028	.53	.0013	.0000	.50	0.7
-	1896	-	-	.33	3.58	1.47	.0008	.0179	.0160	.0019	.54	.0032	.0000	.52	0.9
-	1897	-	-	.36	3.56	1.57	.0011	.0206	.0177	.0029	.57	.0027	.0000	.52	0.9
-	1898	-	-	.47	3.38	1.63	.0007	.0198	.0171	.0027	.58	.0012	.0000	.60	0.7
-	1899	-	-	.38	3.26	1.54	.0011	.0195	.0177	.0018	.47	.0009	.0000	.60	0.3

Note to analyses of 1899: Odor, generally vegetable, sometimes none. A fishy odor was developed in the first two samples on heating.

Microscopical Examination of Water from Assawompsett Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1899. Jan.	March.	May.	June.	July.	Sept.	Nov.
Day of examination,	17	21	23	22	18	19	14
Number of sample,	25957	26538	27194	27514	27792	28649	29372
PLANTS.							
Diatomaceæ,	95	400	123	47	26	84	31
Asterionella,	65	344	18	4	8	19	7
Cyanophyceæ,	0	0	1	35	30	28	3
Anabæna,	0	0	1	35	2	0	0
Microcystis,	0	0	0	0	22	28	3
Algæ,	0	40	0	6	6	58	163
Protococcus,	0	0	0	0	0	58	162

TAUNTON.

Microscopical Examination of Water from Assawompsett Pond, Lakeville — Concluded.

[Number of organisms per cubic centimeter.]

	1899.						
	Jan.	March.	May.	June.	July.	Sept.	Nov.
ANIMALS.							
Rhizopoda, Actinophrys,	0	0	0	1	0	0	0
Infusoria, ...	37	794	2	1	0	5	0
Dinobryon, . . .	33	758	0	0	0	4	0
Synura, ...	0	22	0	0	0	0	0
Uroglena, ...	0	2	0	0	0	0	0
Vermes, ...	1	6	0	0	0	0	0
Crustacea, Bosmina, .	0	pr.	0	0	0	0	0
Miscellaneous, Zoöglœa, .	3	8	10	5	3	3	3
TOTAL, ...	186	1,248	136	95	65	158	200

Chemical Examination of Water from Elder's Pond, Lakeville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25958	Jan. 16	V. slight.	V. slight.	.06	2.60	1.25	.0006	.0144	.0136	.0008	.48	.0010	.0000	.27	0.5
26539	Mar. 20	V. slight.	V. slight.	.03	2.65	1.00	.0014	.0138	.0122	.0016	.48	.0010	.0000	.21	0.3
27195	May 22	V. slight.	Slight.	.07	2.50	1.00	.0004	.0154	.0130	.0024	.48	.0000	.0000	.21	0.2
27515	June 20	V. slight.	V. slight.	.06	2.65	1.25	.0002	.0166	.0154	.0012	.45	.0020	.0000	.24	0.3
27793	July 17	V. slight.	V. slight.	.03	2.45	0.95	.0000	.0168	.0146	.0022	.49	.0020	.0000	.28	0.3
28650	Sept. 18	V. slight.	Slight.	.10	2.85	1.25	.0010	.0206	.0190	.0016	.44	.0000	.0000	.28	0.5
29373	Nov. 13	V. slight.	Slight.	.07	2.65	1.20	.0022	.0190	.0164	.0026	.46	.0040	.0000	.22	0.2

Averages by Years.

-	1894	-	-	.04	2.32	0.94	.0004	.0135	.0120	.0015	.42	.0015	.0000	.17	0.4
-	1895	-	-	.05	2.57	0.98	.0001	.0161	.0143	.0018	.46	.0018	.0000	.22	0.5
-	1896	-	-	.05	2.70	0.96	.0005	.0169	.0139	.0030	.50	.0017	.0000	.22	0.5
-	1897	-	-	.06	2.61	1.09	.0013	.0154	.0142	.0012	.53	.0032	.0000	.23	0.6
-	1898	-	-	.08	2.71	1.07	.0007	.0168	.0151	.0017	.55	.0012	.0000	.25	0.6
-	1899	-	-	.06	2.62	1.13	.0008	.0167	.0149	.0018	.47	.0014	.0000	.24	0.3

NOTE to analyses of 1899: Odor, generally vegetable, sometimes none. On heating, the odor of the first and third samples became distinctly fishy and oily.

TAUNTON.

Microscopical Examination of Water from Elder's Pond, Lakeville.

[Number of organisms per cubic centimeter.]

	1899.						
	Jan.	Mar.	May.	June.	July.	Sept.	Nov.
Day of examination,	17	21	23	22	18	19	14
Number of sample,	25958	26539	27195	27515	27793	28650	29373
PLANTS.							
Diatomaceæ,	14	72	28	32	42	43	32
Asterionella,	12	51	9	0	6	7	6
Cyanophyceæ,	0	0	12	8	36	15	0
Anabæna,	0	0	12	6	20	0	0
Microcystis,	0	0	0	2	16	15	0
Algæ,	0	0	1	8	26	47	4
ANIMALS.							
Infusoria,	2,178	20	21	84	2	0	4
Dinobryon,	2,170	19	1	0	0	0	0
Peridinium,	2	0	1	82	0	0	0
Uroglena,	4	1	6	0	0	0	0
Vermes,	0	1	0	2	0	1	1
Crustacea, Cyclops,	0	pr.	0	0	0	0	0
Miscellaneous, Zoöglœa,	0	5	5	5	6	3	3
TOTAL,	2,192	98	67	139	112	109	44

WATER SUPPLY OF TISBURY. — VINEYARD HAVEN WATER COMPANY.

Chemical Examination of Water from the Filter-gallery at Tashmoo Spring.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
28333	1899. Aug. 22	None.	None.	.00	4.80	.0000	.0002	.97	.0040	.0000	.03	0.5	.0030

Odor, none.

TYNGSBOROUGH.

TYNGSBOROUGH.

The advice of the State Board of Health to the town of Tyngsborough with reference to certain proposed sources of supply for the village of Tyngsborough may be found on pages 45 and 46 of this volume.

Chemical Examination of Water from a Well in Tyngsborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
28728	Sept. 25	Decided.	Slight.	.15	4.90	.0244	.0150	.20	.0100	.0015	.18	1.7	.0130
28912	Oct. 6	V. slight.	V. slight.	.14	4.20	.0046	.0048	.21	.0110	.0007	.07	2.3	.0200

Odor, distinctly unpleasant, becoming also musty on heating. —— The first sample was collected from the well; the second from a faucet supplied with water from the well.

WATER SUPPLY OF WAKEFIELD AND STONEHAM. — WAKEFIELD WATER COMPANY.

Chemical Examination of Water from Crystal Lake, Wakefield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26602	Mar. 29	V. slight.	V. slight.	.12	4.15	1.50	.0024	.0154	.0118	.0036	.57	.0320	.0003	.25	1.8
27618	June 28	V. slight.	Slight.	.16	4.25	1.25	.0014	.0208	.0172	.0036	.56	.0060	.0002	.31	1.7
28793	Sept. 27	Slight.	Slight.	.15	4.75	1.75	.0016	.0206	.0184	.0022	.60	.0010	.0000	.24	2.0
29591	Dec. 5	Slight.	Slight.	.12	3.85	1.05	.0006	.0208	.0160	.0048	.60	.0050	.0001	.27	1.6
29785	Dec. 26	Slight.	Cons.	.09	4.25	1.20	.0030	.0194	.0160	.0034	.65	.0050	.0000	.21	2.0
Av.*.	....	....	....	.13	4.30	1.40	.0018	.0192	.0158	.0034	.59	.0110	.0001	.26	1.8

Odor of the first three samples, faintly vegetable; of the last two, none. A distinctly vegetable odor was developed in the last three samples on heating. —— The samples were collected from a faucet in the pumping station.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

WAKEFIELD AND STONEHAM.

Microscopical Examination of Water from Crystal Lake, Wakefield.

[Number of organisms per cubic centimeter.]

	1899.				
	March.	June.	Sept.	Dec.	Dec.
Day of examination,	31	29	29	7	27
Number of sample,	26602	27618	28793	29591	29785
PLANTS.					
Diatomaceæ,	5	18	550	1,090	938
Asterionella,	0	0	380	170	66
Cyclotella,	1	10	10	98	112
Melosira,	0	0	122	150	14
Tabellaria,	4	0	14	594	722
Cyanophyceæ,	0	41	8	0	0
Microcystis,	0	34	0	0	0
Algæ,	0	124	8	20	64
Protococcus,	0	120	0	14	64
ANIMALS.					
Infusoria,	27	4	8	60	90
Dinobryon,	18	4	4	58	84
Peridinium,	12	0	0	0	0
Vermes, Anurea,	1	0	0	0	2
Crustacea, Cyclops,	pr.	0	8	0	pr.
Miscellaneous, Zoöglœa,	5	0	8	8	8
TOTAL,	38	187	580	1,178	1,102

WATER SUPPLY OF WALPOLE.

Chemical Examination of Water from the Wells of the Walpole Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
27199	May 23	None.	None.	.00	3.50	.0000	.0008	.31	.0030	.0000	.01	0.8	.0010
27609	June 28	None.	None.	.00	3.30	.0004	.0006	.31	.0070	.0000	.02	1.1	.0020
27917	July 27	None.	None.	.01	3.90	.0000	.0012	.32	.0110	.0000	.01	1.0	.0020
28404	Aug. 28	None.	None.	.00	3.60	.0000	.0008	.29	.0040	.0000	.03	1.0	.0010
28757	Sept. 27	None.	None.	.00	3.50	.0000	.0008	.30	.0100	.0000	.01	0.9	.0050
29140	Oct. 25	None.	None.	.00	3.60	.0000	.0004	.30	.0130	.0000	.00	1.0	.0010
Av...	....	....	....	.00	3.65	.0001	.0008	.30	.0080	.0000	.01	1.0	.0020

Odor, none.

WALTHAM.

WATER SUPPLY OF WALTHAM.

Chemical Examination of Water from the Well and Filter-gallery of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25995	Jan. 20	None.	V. slight.	.05	7.00	.0026	.0020	.58	.0380	.0000	.07	3.5	.0100
26230	Feb. 15	V. slight.	Slight.	.05	7.90	.0044	.0016	.60	.0330	.0000	.05	3.5	.0110
26492	Mar. 15	None.	None.	.01	6.90	.0000	.0036	.63	.0620	.0000	.03	3.1	.0020
26909	Apr. 25	None.	None.	.00	7.20	.0000	.0024	.60	.0630	.0000	.02	2.7	.0010
27128	May 17	None.	None.	.01	6.50	.0000	.0018	.62	.0840	.0000	.06	3.3	.0020
27517	June 21	V. slight.	None.	.05	6.70	.0020	.0026	.56	.0350	.0000	.04	3.0	.0020
27830	July 19	None.	None.	.00	8.10	.0024	.0032	.57	.0340	.0000	.06	3.1	.0060
28230	Aug. 16	None.	V. slight.	.04	7.30	.0012	.0022	.50	.0220	.0000	.04	3.0	.0110
28682	Sept. 20	V. slight.	V. slight.	.04	6.80	.0034	.0052	.56	.0240	.0000	.05	2.9	.0060
29058	Oct. 18	None.	None.	.05	7.30	.0050	.0024	.55	.0220	.0000	.05	3.4	.0200
29414	Nov. 15	None.	V. slight.	.01	6.90	.0034	.0028	.57	.0140	.0000	.07	2.9	.0100
29715	Dec. 20	None.	None.	.02	7.60	.0046	.0028	.57	.0140	.0000	.07	3.3	.0170

Averages by Years.

-	1888	-	-	.00	6.70	.0009	.0054	.46	.0273	.0008	-	-	-
-	1892	-	-	.00	6.81	.0033	.0027	.45	.0162	.0000	-	3.4	.0034
-	1893	-	-	.01	6.86	.0036	.0022	.47	.0179	.0000	.06	3.4	.0020
-	1894	-	-	.02	6.75	.0028	.0019	.51	.0192	.0000	.06	3.1	.0044
-	1895	-	-	.03	7.15	.0036	.0024	.53	.0198	.0000	.05	3.4	.0082
-	1896	-	-	.03	7.36	.0034	.0018	.55	.0194	.0000	.06	3.6	.0157
-	1897	-	-	.04	7.15	.0031	.0035	.57	.0222	.0001	.06	3.6	.0108
-	1898	-	-	.07	7.31	.0034	.0028	.59	.0280	.0000	.07	3.4	.0162
-	1899	-	-	.03	7.22	.0024	.0027	.58	.0371	.0000	.05	3.1	.0082

NOTE to analyses of 1899: Odor, none.

WALTHAM.

Chemical Examination of Water from the Distributing Reservoir of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25996	Jan. 20	V. slight.	None.	.05	7.60	.0004	.0024	.58	.0210	.0000	.09	3.5	.0050
26493	Mar. 15	V. slight.	V. slight.	.05	6.90	.0032	.0018	.55	.0280	.0000	.04	3.5	.0090
26910	Apr. 25	V. slight.	Cons., clayey.	.05	7.30	.0002	.0092	.58	.0210	.0002	.08	3.4	.0120
27127	May 17	Slight, milky.	Slight.	.09	7.90	.0000	.0110	.55	.0240	.0000	.11	3.1	.0070
27518	June 21	Slight, milky.	Slight.	.15	7.80	.0000	.0168	.53	.0110	.0001	.12	3.0	.0050
27831	July 19	V. slight.	Slight.	.06	7.30	.0012	.0138	.56	.0140	.0000	.12	3.1	.0070
28231	Aug. 16	Slight.	Cons., clayey.	.10	7.60	.0010	.0110	.51	.0120	.0001	.13	3.0	.0130
28683	Sept. 20	V. slight.	Cons.	.12	7.10	.0010	.0150	.58	.0100	.0000	.14	3.0	.0080
29415	Nov. 15	V. slight.	Slight.	.05	7.00	.0026	.0030	.57	.0170	.0000	.08	2.7	.0170
29716	Dec. 20	None.	V. slight.	.10	7.60	.0036	.0042	.56	.0140	.0000	.07	3.3	.0280

Averages by Years

-	1888	-	-	.00	6.45	.0003	.0075	.46	.0248	.0003	-	-	-
-	1892	-	-	.01	6.28	.0006	.0082	.44	.0119	.0001	-	3.0	.0070
-	1893	-	-	.04	6.72	.0006	.0074	.47	.0127	.0001	.10	3.1	.0019
-	1894	-	-	.08	6.80	.0007	.0140	.51	.0078	.0001	.09	3.1	.0032
-	1895	-	-	.04	7.00	.0016	.0085	.53	.0161	.0000	.09	3.3	.0045
-	1896	-	-	.05	7.40	.0013	.0083	.55	.0172	.0001	.07	3.4	.0099
-	1897	-	-	.06	7.20	.0011	.0117	.57	.0135	.0001	.09	3.5	.0035
-	1898	-	-	.08	7.35	.0018	.0114	.59	.0140	.0001	.10	3.3	.0071
-	1899	-	-	.08	7.41	.0013	.0088	.55	.0172	.0000	.10	3.2	.0111

Note to analyses of 1899: Odor in July and September, unpleasant; at other times, none. A vegetable odor was developed in most of the samples on heating.

Microscopical Examination of Water from the Distributing Reservoir of the Waltham Water Works.

[Number of organisms per cubic centimeter.]

	1899.									
	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
Day of examination,	23	16	25	18	22	19	17	21	16	21
Number of sample,	25996	26493	26910	27127	27518	27831	28231	28683	29415	29716
PLANTS.										
Diatomaceæ,	1,568	1	15,003	3,130	1,252	3,318	7,516	4,000	4	43
Asterionella,	1,448	0	15,000	624	4	18	16	0	0	3
Synedra,	120	1	3	2,500	1,248	3,280	7,500	4,000	4	40
Algæ,	42	0	2	2	0	1	0	0	0	8
Fungi, Crenothrix,	0	0	0	0	10	0	0	8	24	0

WALTHAM.

Microscopical Examination of Water from the Distributing Reservoir of the Waltham Water Works — Concluded.

[Number of organisms per cubic centimeter.]

	1899.									
	Jan.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Nov.	Dec.
ANIMALS.										
Rhizopoda, Actinophrys,	0	0	0	0	1	0	0	0	0	0
Infusoria,	2	0	0	2	0	23	0	0	0	0
Monas,	0	0	0	2	0	23	0	0	0	0
Vermes, Anurea,	0	0	0	0	0	0	2	0	0	0
Miscellaneous, Zoöglœa,	3	5	0	5	3	0	0	3	3	3
TOTAL,	1,615	6	15,005	3,139	1,266	3,348	7,518	4,003	31	46

WATER SUPPLY OF WARE.

The advice of the State Board of Health to the town of Ware, relative to the quality of the water of certain springs and wells used as sources of water supply for a number of families in that town, may be found on pages 46 to 48 of this volume.

The advice of the Board relative to the use of Mineral Spring Pond in Ware as a source of ice supply may be found on pages 109 and 110 of this volume.

Chemical Examination of Water from the Large Well of the Ware Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
27455	June 14	None.	None.	.00	9.30	.0000	.0010	0.96	.4200	.0000	.01	3.4	.0010
27688	July 6	None.	None.	.00	8.70	.0000	.0010	0.80	.3550	.0000	.01	2.7	.0030
28187	Aug. 9	None.	None.	.00	9.40	.0000	.0006	0.81	.3000	.0000	.01	2.6	.0000
28618	Sept. 13	None.	None.	.00	10.30	.0000	.0006	0.80	.3440	.0000	.01	3.0	.0010
28944	Oct. 10	None.	None.	.02	16.80	.0002	.0014	1.70	.7600	.0000	.02	4.9	.0010
Av...	....	....	....	.00	10.90	.0000	.0009	1.01	.4358	.0000	.01	3.3	.0010

Odor, none.

WARE.

Chemical Examination of Water from Springs and Wells in Ware.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27481	June 19	V. slight.	V. slight.	.02	14.20	.0000	.0036	0.60	0.3150	.0000	.04	6.0	.0040
27482	June 19	V. slight.	Slight.	.02	13.00	.0014	.0080	0.96	0.3075	.0003	.08	4.4	.0180
27483	June 19	V. slight.	V. slight	.02	57.80	.0004	.0112	9.67	1.9400	.0004	.14	15.5	.0010
27484	June 19	None.	V. slight.	.01	20.10	.0000	.0062	0.78	0.7300	.0000	.07	8.3	.0010
27632	July 3	None.	V. slight.	.05	14.30	.0002	.0040	0.61	0.4300	.0000	.03	6.0	.0010
27633	July 3	None.	V. slight.	.02	18.50	.0006	.0084	0.76	0.6800	.0000	.04	7.6	.0010

Odor of the first two and fifth samples, none; of the third, none, becoming faintly earthy on heating; of the fourth, faintly disagreeable; of the last, faintly musty.——The first two samples were collected from an iron tank on the premises of the Geo. H. Gilbert Manufacturing Company, supplied with water from a spring between Chestnut and South streets. The third and fourth samples were collected from a wooden tank on the premises of the C. A. Stevens Company, supplied with water from a spring between Chestnut and South streets. The fifth sample was collected from a well in the rear of a row of houses belonging to the Geo. H. Gilbert Manufacturing Company, and the sixth from a well on the premises of Arthur R. Kane on Water Street.

Chemical Examination of Water from Mineral Spring Pond and its Principal Feeder in Ware.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
28040	Oct. 10	None.	V. slight.	.02	3.20	-	.0012	.0018	-	-	.14	.0010	.0000	.02	0.8
28039	Oct. 10	V. slight.	Slight.	.20	3.75	1.10	.0004	.0092	.0058	.0034	.16	.0000	.0001	.19	0.5

Odor of the first sample, faintly disagreeable; of the last, none, becoming very faintly unpleasant on heating.——The first sample was collected from a spring which is the principal feeder of Mineral Spring Pond; the last, from Mineral Spring Pond.

Warren.

The advice of the State Board of Health to John S. Gould and others, of Warren, relative to a proposed water supply for that town may be found on pages 48 and 49 of this volume.

WAYLAND.

WATER SUPPLY OF WAYLAND.

Chemical Examination of Water from the Filter-gallery of the Wayland Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
26116	Feb. 2	None.	None.	.35	4.25	.0060	.0112	.26	.0160	.0001	.39	1.6	.0180
26676	Apr. 5	V. slight.	V. slight.	.30	2.95	.0020	.0100	.23	.0230	.0000	.33	0.6	.0200
27354	June 8	Slight.	Slight.	.51	4.15	.0066	.0272	.28	.0030	.0001	.68	1.1	.0250
28037	Aug. 2	V. slight.	V. slight.	.49	4.25	.0050	.0306	.32	.0030	.0001	.66	1.4	.0300
28897	Oct. 4	Decided.	Cons.	.26	4.45	.0080	.0300	.32	.0030	.0000	.44	1.7	.0150
29597	Dec. 8	Slight.	V. slight.	.45	5.70	.0080	.0264	.32	.0190	.0001	.61	2.0	.0350
Av...	....	....	....	.39	4.29	.0059	.0226	.29	.0112	.0001	.52	1.4	.0238

Odor, faintly vegetable, becoming stronger on heating. A fishy odor was observed in the last two samples. —— The samples were collected from a faucet in the gate-house.

Microscopical Examination of Water from the Filter-gallery of the Wayland Water Works.

[Number of organisms per cubic centimeter.]

	1899.					
	Feb.	April.	June.	Aug.	Oct.	Dec.
Day of examination,	3	6	9	3	6	8
Number of sample,	26116	26676	27354	28037	28897	29597
PLANTS.						
Diatomaceæ,	8	25	194	430	430	121
Asterionella,	0	0	16	248	4	0
Cyclotella,	0	0	22	144	46	0
Melosira,	0	0	124	36	246	16
Synedra,	2	11	22	0	108	100
Cyanophyceæ,	0	0	13	14	30	0
Anabæna,	0	0	8	10	30	0
Algæ,	0	0	60	24	86	8
Fungi, Crenothrix,	0	0	4	0	0	0

WAYLAND.

Microscopical Examination of Water from the Filter-gallery of the Wayland Water Works — Concluded.

[Number of organisms per cubic centimeter.]

	1899.					
	Feb.	April.	June.	Aug.	Oct.	Dec.
ANIMALS.						
Rhizopoda, Difflugia,	0	0	0	0	1	0
Infusoria,	5	2	41	481	12	94
Chlamydomonas,	0	0	20	0	0	0
Dinobryon,	5	0	8	396	0	94
Monas,	0	0	4	80	0	0
Vermes,	0	1	1	8	4	4
Crustacea, Cyclops,	0	0	0	0	pr.	0
Miscellaneous, Zoöglœa,	3	7	10	25	15	3
TOTAL,	15	35	323	982	578	228

Chemical Examination of Water from the Storage Reservoir of the Wayland Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
26115	Feb. 2	None.	V. slight.	.40	4.50	1.75	.0014	.0188	.0168	.0020	.32	.0060	.0000	.47	1.3
26675	Apr. 5	V. slight.	V. slight.	.34	2.70	1.25	.0000	.0142	.0135	.0007	.19	.0030	.0000	.33	0.3
27358	June 8	Slight.	Slight.	.52	3.75	1.70	.0026	.0334	.0258	.0076	.22	.0020	.0000	.72	1.1
28086	Aug. 2	V. slight.	Slight.	.51	4.05	1.85	.0016	.0370	.0314	.0056	.32	.0010	.0000	.69	1.6
28896	Oct. 4	Decided.	Cons.	.33	4.75	1.90	.0068	.0540	.0390	.0150	.30	.0050	.0000	.56	2.0
29596	Dec. 8	Slight.	Slight.	.60	5.95	2.40	.0092	.0376	.0282	.0094	.32	.0160	.0001	.70	2.0
Av.	....	....	....	.45	4.28	1.81	.0039	.0325	.0258	.0067	.29	.0055	.0000	.59	1.4

Odor, vegetable, becoming stronger on heating. A fishy odor was observed in the last two samples.

WAYLAND.

Microscopical Examination of Water from the Storage Reservoir of the Wayland Water Works.

[Number of organisms per cubic centimeter.]

	1899.					
	Feb.	Apr.	June.	Aug.	Oct.	Dec.
Day of examination,	3	6	9	3	6	8
Number of sample,	26115	26675	27363	29036	29036	29036
PLANTS.						
Diatomaceæ,	2	16	102	1,104	928	144
Asterionella,	0	0	32	1,056	8	0
Cyclotella,	0	2	2	0	90	0
Melosira,	0	0	62	26	534	44
Synedra,	2	3	0	22	244	84
Tabellaria,	0	3	2	0	52	6
Cyanophyceæ,	0	0	88	34	14	9
Anabæna,	0	0	70	12	12	0
Clathrocystis,	0	0	4	22	2	0
Merismopœdia,	0	0	14	0	0	9
Algæ,	0	0	108	52	154	3
Protococcus,	0	0	80	0	0	0
ANIMALS.						
Infusoria,	15	22	54	1,472	20	66
Dinobryon,	13	17	28	1,456	0	56
Uroglena,	0	0	4	0	18	0
Vorticella,	0	0	12	0	2	0
Vermes,	0	0	5	0	0	14
Anuræa,	0	0	4	0	0	10
Crustacea,	0	0	pr.	0	pr.	pr.
Cyclops,	0	0	pr.	0	pr.	pr.
Daphnia,	0	0	0	0	pr.	0
Miscellaneous, Zoöglœa,	3	3	0	28	25	3
TOTAL,	20	41	350	2,690	1,153	235

WATER SUPPLY OF WEBSTER.

Chemical Examination of Water from the Well of the Webster Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
27018	May 5	None.	None.	.00	4.00	.0000	.0010	.29	.0260	.0000	.01	1.1	.0000
27398	June 10	None.	V. slight.	.00	4.00	.0000	.0010	.25	.0140	.0000	.02	1.3	.0000
27709	July 10	None.	None.	.00	3.30	.0000	.0008	.23	.0080	.0000	.01	1.4	.0010
28057	Aug. 5	None.	None.	.00	3.60	.0000	.0012	.23	.0070	.0000	.02	1.7	.0000
28562	Sept. 11	None.	None.	.00	4.10	.0000	.0020	.23	.0070	.0000	.00	1.0	.0020
28909	Oct. 6	None.	V. slight.	.00	4.50	.0000	.0010	.25	.0060	.0000	.00	1.3	.0020
29246	Nov. 6	None.	None.	.02	3.00	.0000	.0008	.20	.0100	.0000	.01	1.0	.0020
Av...	....	....	....	.00	3.79	.0000	.0011	.24	.0111	.0000	.01	1.3	.0010

Odor, none.

WATER SUPPLY OF WELLESLEY.

The advice of the State Board of Health to the town of Wellesley relative to the water supply of that town may be found on pages 49 and 50 of this volume.

Chemical Examination of Water from the Filter-gallery of the Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
28384	Aug. 28	None.	None.	.00	7.10	.0010	.0022	.56	.0800	.0000	.04	2.9	.0010

Odor, none.

WELLESLEY.

Chemical Examination of Water from the Well of the Wellesley Water Works at Williams Spring.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albu-minoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
26036	Jan. 25	None.	V. slight.	.00	10.50	.0014	.0012	.87	.5400	.0000	.01	4.2	.0010
26600	Mar. 29	None.	None.	.00	9.30	.0018	.0008	.80	.4800	.0000	.02	3.4	.0000
27290	May 31	None.	None.	.00	8.50	.0010	.0010	.69	.3400	.0000	.01	2.7	.0020
27894	July 26	None.	None.	.00	8.80	.0032	.0018	.73	.9000	.0000	.02	2.9	.0030
28442	Aug. 31	None.	None.	.02	10.50	.0000	.0010	.78	.4200	.0000	.02	3.1	.0010
28443	Sept. 1	None.	V. slight.	.00	10.90	.0000	.0010	.73	.3800	.0000	.03	3.3	.0030
28766	Sept. 27	None.	V. slight.	.07	7.80	.0012	.0044	.64	.2500	.0001	.02	3.0	.0000
29528	Nov. 29	None.	None.	.00	10.00	.0006	.0012	.80	.4300	.0000	.01	3.0	.0020
Av.*.	....	....	....	.01	9.56	.0012	.0014	.76	.4893	.0000	.02	3.2	.0015

Odor, none. A faintly cucumber odor was developed in No. 27290 on heating.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from the Driven Wells of the Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albu-minoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
26038	Jan. 25	None.	V. slight.	.00	7.10	.0000	.0008	.54	.0900	.0000	.01	3.0	.0010
26601	Mar. 29	None.	V. slight.	.00	7.00	.0000	.0004	.55	.1260	.0000	.02	2.7	.0020
27289	May 31	None.	None.	.00	7.50	.0004	.0008	.55	.1200	.0000	.02	2.6	.0020
27895	July 26	None.	V. slight.	.00	7.30	.0006	.0028	.55	.1200	.0000	.03	2.5	.0040
28768	Sept. 27	None.	None.	.00	6.00	.0026	.0022	.57	.0990	.0002	.03	3.0	.0020
29530	Nov. 29	None.	None.	.01	6.60	.0004	.0020	.57	.0230	.0000	.01	2.7	.0020
Av...	....	....	....	.00	6.92	.0007	.0015	.55	.0962	.0000	.02	2.7	.0022

Odor, none.

WELLESLEY.

Chemical Examination of Water from the Covered Reservoir of the Wellesley Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26087	Jan. 25	None.	None.	.00	6.50	.0014	.0042	.56	.0840	.0000	.01	3.1	.0010
26608	Mar. 29	None.	V. slight.	.00	6.20	.0000	.0056	.58	.1100	.0000	.03	2.7	.0020
27288	May 31	None.	None.	.00	7.00	.0006	.0024	.56	.1240	.0000	.02	2.6	.0020
27893	July 26	None.	V. slight.	.00	7.80	.0026	.0062	.57	.1100	.0000	.03	2.6	.0050
28767	Sept. 27	None.	V. slight.	.01	6.50	.0010	.0078	.57	.0780	.0000	.02	3.0	.0010
29529	Nov. 29	None.	V. slight.	.00	7.10	.0006	.0066	.60	.0600	.0000	.02	3.0	.0020
Av...	....	....	....	.00	6.85	.0010	.0055	.57	.0943	.0000	.02	2.8	.0022

Odor, none.

Water Supply of Westborough.

Chemical Examination of Water from a Faucet supplied from the Westborough Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26265	Feb. 20	V. slight.	None.	.01	3.50	1.80	.0000	.0032	.0028	.0004	.20	.0000	.0000	.08	1.3
27227	May 24	None.	V. slight.	.01	3.00	0.75	.0004	.0072	.0056	.0016	.19	.0010	.0000	.13	0.8
28364	Aug. 25	None.	None.	.01	3.55	0.85	.0002	.0048	.0048	.0000	.19	.0040	.0000	.10	1.1
29430	Nov. 23	V. slight.	V. slight.	.05	3.25	0.70	.0060	.0100	.0096	.0004	.22	.0070	.0000	.10	1.7
Av...	....	....	....	.02	3.32	0.90	.0016	.0063	.0057	.0006	.20	.0030	.0000	.10	1.2

Odor, none.

WESTBOROUGH INSANE HOSPITAL.

Water Supply of Westborough Insane Hospital, Westborough.

Chemical Examination of Water from the Westborough Insane Hospital.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26936	Apr. 25	Decided, milky.	Slight.	.20	12.00	.1000	.0055	.35	.0020	.0002	.09	6.4	.1200
27610	June 27	Decided, milky.	Slight.	.45	12.30	.1812	.0048	.38	.0000	.0000	.10	6.0	.1100
28584	Sept. 12	Decided.	Cons.	.29	5.15	.0092	.0480	.41	.0010	.0000	.43	1.1	.0750
29150	Oct. 25	Decided.	Cons.	.25	5.00	.0098	.0460	.41	.0030	.0001	.42	1.4	.0200
29811	Dec. 27	Decided.	Cons.	.20	13.50	.1136	.0068	.38	.0020	.0001	.21	6.4	.4100

Odor of the first two samples, none; of the third and fourth, unpleasant; of the last, none, becoming faintly unpleasant and oily on heating.—— The samples were collected from a tap at the pumping station. The first two and last samples represent water from the tubular wells; the others, water from Chauncy Pond.

Water Supply of Westfield.

Chemical Examination of Water from the Storage Reservoir of the Westfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26308	Feb. 21	V. slight.	Slight.	.29	2.45	1.00	.0006	.0086	.0070	.0016	.12	.0020	.0001	0.42	0.3
27308	June 1	Slight.	Slight.	.34	1.65	1.05	.0002	.0186	.0164	.0022	.09	.0020	.0000	0.48	0.2
28271	Aug. 17	Slight.	Cons.	.51	2.45	1.45	.0050	.0360	.0274	.0086	.08	.0020	.0000	0.68	0.5
29406	Nov. 15	Decided.	Cons.	.90	4.00	2.20	.0036	.0416	.0322	.0094	.19	.0030	.0000	1.02	0.5
Av...	....	....	....	.51	2.64	1.42	.0023	.0262	.0207	.0055	.12	.0022	.0000	0.65	0.4

Odor of the first two samples, none, becoming faintly vegetable on heating; of the third, distinctly vegetable; of the last, distinctly unpleasant.

WESTFIELD.

Chemical Examination of Water from Tillotson Brook, in Granville.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25894	Jan. 9	None.	V. slight.	.07	2.30	0.60	.0004	.0034	.0034	.0000	.10	.0020	.0000	.12	0.5
26307	Feb. 21	None.	Slight.	.08	2.40	0.75	.0000	.0036	.0028	.0008	.12	.0030	.0002	.14	0.5
27307	June 1	V. slight.	V. slight.	.10	2.50	0.75	.0012	.0072	.0062	.0010	.13	.0050	.0000	.19	0.5
28270	Aug. 17	None.	V. slight.	.06	3.35	1.00	.0014	.0036	.0032	.0004	.12	.0050	.0000	.11	0.5
29405	Nov. 14	None.	V. slight.	.12	3.05	0.75	.0006	.0064	.0062	.0002	.13	.0060	.0000	.24	0.5
Av...	....	....	....	.09	2.72	0.77	.0007	.0048	.0043	.0005	.12	.0042	.0000	.16	0.5

Odor, faintly vegetable or none.

WATER SUPPLY OF WESTON. — WESTON AQUEDUCT COMPANY.

Chemical Examination of Water from the Well of the Weston Aqueduct Company.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
27400	June 12	None.	None.	.07	5.50	.0000	.0014	.37	.0480	.0000	.02	2.3	.0010
27764	July 13	V. slight.	Slight.	.08	6.20	.0000	.0074	.38	.0400	.0000	.04	2.5	.0330
28099	Aug. 8	None.	None.	.02	6.00	.0006	.0014	.38	.0430	.0000	.02	2.2	.0010
28583	Sept. 12	None.	V. slight.	.00	5.50	.0000	.0016	.46	.0280	.0000	.04	2.2	.0020
29004	Oct. 11	None.	None.	.01	6.20	.0000	.0014	.53	.0360	.0000	.03	2.6	.0020
Av...	....	....	....	.03	5.88	.0001	.0026	.42	.0390	.0000	.03	2.4	.0078

Odor of the first two samples, distinctly vegetable and unpleasant; of the others, none.

WATER SUPPLY OF WEST SPRINGFIELD.

The advice of the State Board of Health to the water commissioners of West Springfield relative to a proposed additional water supply for that town may be found on pages 51 to 56 of this volume.

WEST SPRINGFIELD.

Chemical Examination of Water from a Faucet supplied from Darby Brook Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
26516	Mar. 15	Slight.	Slight.	.11	4.60	1.15	.0010	.0116	.0052	.0064	.10	.0070	.0001	.18	2.1
28244	Aug. 16	Decided.	Cons.	.10	5.85	2.00	.0016	.0352	.0202	.0150	.21	.0020	.0000	.27	2.3
29277	Nov. 6	Slight.	Slight.	.29	6.00	1.80	.0034	.0190	.0148	.0042	.20	.0060	.0001	.39	2.9
Av.	....	....	....	.17	5.32	1.65	.0020	.0219	.0134	.0085	.17	.0050	.0001	.28	2.4

Odor, distinctly unpleasant or disagreeable.

Microscopical Examination of Water from a Faucet supplied from Darby Brook Reservoir.

[Number of organisms per cubic centimeter.]

	1899. Mar.	1899. Aug.	1899. Nov.
Day of examination,	17	18	8
Number of sample,	26516	28244	29277
PLANTS.			
Diatomaceæ,	44	2,208	28
Synedra,	26	2,200	26
Cyanophyceæ,	0	600	43
Anabæna,	0	600	40
Algæ,	0	40	6
ANIMALS.			
Infusoria,	166	370	12
Ciliated infusorian,	40	12	0
Peridinium,	118	344	2
Vermes,	0	7	5
Crustacea, Cyclops,	0	pr.	0
Miscellaneous, Zoöglœa,	120	20	10
TOTAL,	330	3,245	105

WEST SPRINGFIELD.

Chemical Examination of Water from the Receiving Well of the West Springfield Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26517	Mar. 15	V. slight.	V. slight.	.00	6.00	.0000	.0010	.36	.2350	.0000	.02	2.9	.0040
28245	Aug. 16	None.	None.	.00	6.50	.0000	.0004	.46	.1600	.0000	.02	2.5	.0010
29276	Nov. 6	None.	None.	.03	7.90	.0002	.0012	.60	.1800	.0000	.01	2.7	.0010
Av...	....	....	....	.01	6.80	.0001	.0009	.47	.1917	.0000	.02	2.7	.0020

Odor, none.

Chemical Examination of Water from Various Sources in West Springfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26092	Jan. 30	Slight.	Cons.	.09	6.90	1.70	.0018	.0098	.0054	.0044	.21	.0650	.0001	.14	3.5
26093	Jan. 30	V. slight.	Slight.	.11	7.30	1.90	.0014	.0086	.0062	.0024	.19	.0390	.0003	.17	4.0
26094	Jan. 30	Slight.	V. slight.	.11	7.60	2.20	.0020	.0100	.0078	.0022	.26	.0570	.0002	.23	3.9
26095	Jan. 30	V. slight.	Slight.	.15	6.75	1.75	.0016	.0256	.0198	.0058	.14	.0070	.0000	.29	3.9
26096	Jan. 30	V. slight.	Slight.	.05	4.25	0.95	.0014	.0120	.0094	.0026	.13	.0120	.0000	.12	2.0
26097	Jan. 30	V. slight.	Slight.	.02	9.75	1.10	.0000	.0012	.0006	.0006	.14	.0020	.0000	.04	7.7

Odor, none. A very faintly vegetable odor was developed in the third and fourth samples on heating. —— The first sample was collected from Bagg Brook; the second, from Block Brook a short distance north of the Westfield road; the third, from Block Brook 1,200 feet south of the Westfield road; the fourth, from the north branch of Hyde Brook; the fifth, from the south branch of Hyde Brook; and the last, from Pepper Brook.

Water Supply of Weymouth.

Chemical Examination of Water from Great Pond, in Weymouth.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
26074	Jan. 31	V. slight.	V. slight.	1.02	4.40	2.40	.0004	.0220	.0204	.0016	.60	.0020	.0000	1.19	0.6
26935	Apr. 26	V. slight.	V. slight.	0.90	3.00	1.50	.0010	.0166	.0164	.0002	.47	.0030	.0001	0.86	0.3
27891	July 26	Slight.	Cons.	0.53	3.70	1.60	.0000	.0090	.0080	.0010	.57	.0030	.0000	0.54	0.8
29164	Oct. 26	Decided.	V. slight.	0.50	3.50	1.50	.0018	.0242	.0216	.0026	.50	.0020	.0000	0.58	0.5
Av...	....	....	....	0.74	3.65	1.75	.0008	.0179	.0166	.0013	.53	.0025	.0000	0.79	0.5

Odor of the first two samples, faintly vegetable; of the others, faintly unpleasant.

Wilmington.

The advice of the State Board of Health to the town of Wilmington relative to the quality of the water used for drinking purposes at a certain school-house in that town may be found on page 56 of this volume.

Chemical Examination of Water from a Well in Wilmington.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
28713	1899. Sept. 22	Slight.	V. slight.	.06	6.40	.0064	.0106	.94	.0220	.0018	.11	1.8	.0120

Odor, very disagreeable, becoming offensive on heating.

Water Supply of Winchendon.

Chemical Examination of Water from the Well of the Winchendon Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
27152	1899. May 18	None.	V. slight.	.02	2.50	.0000	.0010	.10	.0100	.0000	.03	0.8	.0060
27581	June 26	None.	None.	.06	3.70	.0008	.0030	.10	.0060	.0000	.06	0.8	.0180
27871	July 24	V. slight.	None.	.02	3.80	.0000	.0014	.11	.0020	.0000	.01	0.8	.0070
28358	Aug. 24	Slight, milky.	None.	.05	2.40	.0000	.0008	.10	.0020	.0000	.02	0.8	.0250
28729	Sept. 25	None.	None.	.02	3.00	.0000	.0012	.09	.0030	.0000	.05	1.1	.0020
29149	Oct. 25	V. slight.	None.	.04	3.60	.0000	.0006	.10	.0060	.0000	.10	0.6	.0100
Av...	....	....	....	.03	3.17	.0001	.0013	.10	.0048	.0000	.04	0.8	.0113

Odor, none.

WINCHESTER.

Water Supply of Winchester.

Chemical Examination of Water from the North Reservoir of the Winchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25852	Jan. 5	Slight.	V. slight.	.09	4.40	1.60	.0028	.0208	.0172	.0036	.44	.0070	.0002	.28	2.0
26120	Feb. 3	V. slight.	V. slight.	.10	5.10	1.85	.0008	.0214	.0174	.0040	.61	.0100	.0001	.31	2.3
26373	Mar. 1	V. slight.	V. slight.	.08	2.25	0.85	.0058	.0110	.0084	.0026	.22	.0050	.0001	.14	0.8
26655	Apr. 4	Slight.	Slight.	.07	4.45	1.30	.0082	.0178	.0166	.0012	.42	.0080	.0003	.23	1.8
27004	May 3	Slight.	Slight.	.10	5.25	1.35	.0018	.0252	.0230	.0022	.46	.0050	.0003	.26	2.2
27324	June 6	V. slight.	V. slight.	.10	5.10	1.85	.0010	.0240	.0212	.0028	.53	.0030	.0000	.32	2.0
27711	July 11	V. slight.	V. slight.	.04	5.25	1.30	.0002	.0216	.0194	.0022	.47	.0030	.0000	.24	2.5
27944	Aug. 1	V. slight.	V. slight.	.06	5.70	1.60	.0004	.0218	.0180	.0038	.58	.0010	.0000	.32	2.5
28470	Sept. 5	V. slight.	Slight.	.08	5.60	1.90	.0002	.0260	.0238	.0022	.48	.0050	.0000	.28	2.3
28868	Oct. 3	Slight.	Cons.	.06	5.10	1.35	.0010	.0272	.0216	.0056	.58	.0010	.0000	.30	2.3
29204	Nov. 1	V. slight.	Slight.	.06	5.15	1.25	.0038	.0246	.0206	.0040	.60	.0050	.0000	.26	2.2
29556	Dec. 4	V. slight.	V. slight.	.12	5.15	1.35	.0016	.0218	.0192	.0026	.59	.0010	.0000	.24	2.2

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue: Total.	Residue: Loss on Ignition.	Ammonia: Free.	Albuminoid: Total.	Albuminoid: Dissolved.	Albuminoid: Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1888	-	-	.15	4.93	1.24	.0045	.0278	-	-	.47	.0131	.0003	-	-
-	1889	-	-	.14	4.52	1.18	.0022	.0222	.0175	.0047	.47	.0105	.0003	-	-
-	1890	-	-	.09	5.30	1.31	.0017	.0201	.0160	.0041	.52	.0153	.0002	-	2.7
-	1891	-	-	.10	4.94	1.39	.0034	.0222	.0109	.0053	.51	.0152	.0001	-	2.1
-	1892	-	-	.06	5.23	1.59	.0058	.0217	.0177	.0040	.60	.0192	.0002	-	2.5
-	1893	-	-	.07	5.13	1.62	.0055	.0252	.0172	.0080	.59	.0127	.0002	.27	2.3
-	1894	-	-	.09	5.85	1.86	.0017	.0198	.0160	.0038	.82	.0076	.0001	.25	2.5
-	1895	-	-	.11	6.50	2.05	.0024	.0203	.0169	.0034	.91	.0183	.0002	.29	2.6
-	1896	-	-	.12	6.32	1.94	.0022	.0242	.0184	.0058	.85	.0116	.0001	.32	2.6
-	1897	-	-	.10	6.70	1.88	.0048	.0256	.0225	.0031	.79	.0121	.0001	.31	2.7
-	1898	-	-	.11	5.79	1.87	.0038	.0228	.0191	.0037	.65	.0068	.0001	.29	2.5
-	1899	-	-	.08	4.87	1.46	.0019	.0219	.0189	.0030	.50	.0045	.0001	.26	2.1

Note to analyses of 1899: Odor, generally vegetable, becoming stronger and occasionally fishy or unpleasant on heating.

WINCHESTER.

Microscopical Examination of Water from the North Reservoir of the Winchester Water Works.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	6	3	2	5	4	6	12	2	6	4	1	5
Number of sample,	25852	26120	26373	26655	27004	27324	27711	27944	28470	28868	29204	29558
PLANTS.												
Diatomaceæ,	72	0	0	68	193	178	3	21	14	558	450	183
Asterionella,	52	0	0	8	26	0	0	0	0	436	376	155
Cyclotella,	10	0	0	46	78	166	0	3	10	96	44	16
Synedra,	10	0	0	8	55	4	0	4	0	0	6	4
Cyanophyceæ,	0	30	2	0	2	14	0	43	15	60	4	1
Anabæna,	0	2	0	0	0	0	0	4	0	36	0	0
Cœlosphærium,	0	28	2	0	2	4	0	4	1	6	4	1
Microcystis,	0	0	0	0	0	6	0	36	14	18	0	0
Algæ,	10	0	0	2	0	127	43	23	32	24	57	8
Protococcus,	0	0	0	0	0	96	46	10	26	0	52	5
ANIMALS.												
Infusoria,	0	3,408	0	9	5	38	11	8	48	131	14	25
Dinobryon,	0	2,836	0	4	0	30	0	0	12	104	6	20
Euglena acus,	0	42	0	0	0	0	0	0	0	0	0	0
Peridinium,	0	444	0	0	5	0	1	2	18	0	0	0
Synura,	0	66	0	0	0	0	0	0	0	0	0	0
Trachelomonas,	0	14	0	2	0	0	5	0	10	20	6	2
Vermes,	0	6	0	0	6	3	0	0	0	2	0	0
Crustacea, Cyclops,	0	0	0	0	pr.	0	0	0	0	pr.	0	pr.
Miscellaneous, Zoöglœa,	5	0	0	10	10	7	3	10	5	15	10	3
TOTAL,	87	3,444	2	89	216	363	63	111	112	790	535	218

WINCHESTER.

Chemical Examination of Water from the South Reservoir of the Winchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25853	Jan. 5	Slight.	V. slight.	.11	3.15	1.50	.0094	.0274	.0252	.0022	.29	.0010	.0001	.29	1.4
26121	Feb. 8	V. slight.	Slight.	.13	3.30	1.20	.0056	.0194	.0140	.0054	.26	.0030	.0001	.26	1.3
26374	Mar. 1	Slight.	Slight.	.11	2.85	1.25	.0108	.0276	.0246	.0030	.24	.0020	.0001	.21	0.8
26656	Apr. 4	Slight.	Cons.	.22	3.55	1.65	.0002	.0348	.0248	.0100	.24	.0020	.0000	.38	0.8
27005	May 3	V. slight.	V. slight.	.08	3.15	1.20	.0010	.0240	.0160	.0080	.27	.0010	.0001	.28	1.0
27325	June 6	V. slight.	V. slight.	.05	3.10	1.45	.0010	.0181	.0160	.0021	.29	.0020	.0000	.30	1.3
27712	July 11	Slight.	Slight.	.06	3.30	1.45	.0002	.0240	.0227	.0013	.27	.0020	.0000	.24	1.7
27945	Aug. 1	V. slight.	V. slight.	.05	4.10	1.75	.0000	.0228	.0196	.0032	.33	.0010	.0000	.32	1.3
28471	Sept. 5	V. slight.	V. slight.	.09	4.25	1.80	.0010	.0248	.0214	.0034	.29	.0020	.0000	.36	1.0
28866	Oct. 3	Slight.	Slight.	.07	3.40	1.45	.0028	.0294	.0256	.0038	.29	.0010	.0001	.32	1.3
29205	Nov. 1	Slight.	Cons.	.19	3.45	1.20	.0076	.0314	.0262	.0052	.37	.0030	.0001	.34	1.4
29559	Dec. 4	Slight.	Slight.	.22	3.30	1.30	.0204	.0246	.0228	.0018	.29	.0010	.0000	.32	1.3

Averages by Years.

-	1892	-	-	.51	5.17	2.04	.0055	.0392	.0318	.0074	.38	.0118	.0002	-	2.2
-	1893	-	-	.34	4.78	1.86	.0064	.0291	.0216	.0075	.36	.0093	.0002	.49	2.1
-	1894	-	-	.18	4.56	1.76	.0049	.0267	.0232	.0035	.41	.0024	.0001	.45	1.9
-	1895	-	-	.18	4.44	1.77	.0039	.0261	.0226	.0035	.41	.0070	.0001	.41	1.9
-	1896	-	-	.18	4.22	1.75	.0040	.0326	.0256	.0070	.37	.0086	.0000	.43	1.6
-	1897	-	-	.15	3.82	1.56	.0061	.0282	.0230	.0052	.39	.0065	.0001	.35	1.4
-	1898	-	-	.17	3.87	1.64	.0047	.0254	.0221	.0033	.40	.0026	.0000	.31	1.6
-	1899	-	-	.11	3.41	1.43	.0050	.0257	.0216	.0041	.29	.0017	.0000	.30	1.2

NOTE to analyses of 1899: Odor, generally faintly vegetable, becoming stronger and occasionally unpleasant or fishy on heating.

WINCHESTER.

Microscopical Examination of Water from the South Reservoir of the Winchester Water Works.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	6	3	2	5	4	0	12	2	6	4	1	5
Number of sample,	25863	26121	26374	26656	27006	27325	27712	27945	28471	28896	29205	29550
PLANTS.												
Diatomaceæ,	5	2	0	132	324	3	14	38	78	120	16	158
Asterionella,	2	0	0	104	70	0	0	16	0	0	0	128
Cyclotella,	2	0	0	0	136	2	6	0	28	0	4	17
Synedra,	0	1	0	8	72	0	3	4	2	8	0	1
Tabellaria,	0	0	0	20	46	1	5	18	48	90	14	0
Cyanophyceæ,	2	2	2	4	6	16	0	82	31	12	0	0
Anabæna,	0	0	0	0	4	14	0	78	4	8	0	0
Microcystis,	0	0	0	0	0	0	0	0	20	2	0	0
Algæ,	6	1	0	0	2	283	12	640	44	28	16	36
Protococcus,	0	0	0	0	0	280	0	60	36	0	0	0
Raphidium,	6	1	0	0	0	0	7	532	4	10	6	34
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	6	6	0	0	0	0	2	0	0
Infusoria.	33	521	0	272	62	7	8	481	8	16	96	28
Cryptomonas,	0	0	0	100	0	0	0	0	0	0	0	0
Dinobryon,	32	506	0	0	56	0	5	474	0	2	0	0
Monas,	0	0	0	60	0	0	0	0	0	0	0	0
Peridinium,	0	1	0	72	2	0	0	4	0	0	0	0
Trachelomonas,	0	0	0	28	0	0	3	0	2	2	2	10
Uroglena,	0	0	0	0	0	6	0	0	0	4	40	9
Vermes,	0	0	0	16	4	3	6	1	0	1	0	0
Crustacea,	0	0	0	0	pr.	pr.	0	pr.	0	0	0	pr.
Bosmina,	0	0	0	0	0	pr.	0	0	0	0	0	0
Cyclops,	0	0	0	0	pr.	0	0	pr.	0	0	0	pr.
Miscellaneous, Zoöglœa,	3	0	0	10	29	7	5	10	5	15	10	7
TOTAL,	49	526	2	434	418	319	39	1,252	166	186	94	218

WINCHESTER.

Chemical Examination of Water from the Middle Reservoir of the Winchester Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25854	Jan. 5	Slight.	V. slight.	.12	3.30	1.85	.0006	.0334	.0272	.0062	.24	.0010	.0000	.35	1.0
26122	Feb. 3	Decided.	Cons.	.11	3.60	1.85	.0004	.0508	.0286	.0222	.33	.0010	.0001	.40	1.7
26375	Mar. 1	Slight.	Slight.	.08	2.10	0.85	.0122	.0352	.0278	.0074	.24	.0030	.0001	.27	0.5
26657	Apr. 4	V. slight.	V. slight.	.10	3.40	1.50	.0046	.0182	.0162	.0020	.28	.0060	.0000	.27	1.0
27006	May 3	Decided.	Cons.	.30	3.75	1.50	.0012	.0356	.0254	.0102	.31	.0010	.0000	.42	0.8
27326	June 6	Slight.	Cons.	.25	3.30	2.05	.0004	.0390	.0344	.0046	.26	.0020	.0001	.60	1.0
27713	July 11	Decided.	Cons., green.	.28	3.60	1.80	.0012	.0592	.0298	.0294	.26	.0020	.0000	.56	1.3
27946	Aug. 1	Decided.	Cons.	.26	4.70	2.65	.0006	.0316	.0176	.0140	.28	.0020	.0000	.72	1.3
28472	Sept. 5	Decided.	Cons.	.26	5.10	2.55	.0060	.0820	.0470	.0350	.30	.0030	.0000	.52	1.7
28867	Oct. 3	Decided.	Heavy.	.20	4.00	1.90	.0012	.0788	.0436	.0352	.25	.0010	.0000	.52	1.3
29206	Nov. 1	Decided.	Cons.	.34	3.80	2.00	.0024	.0780	.0476	.0304	.30	.0030	.0000	.58	1.3
29560	Dec. 4	Decided.	Cons.	.40	3.55	2.15	.0004	.0628	.0460	.0168	.29	.0010	.0000	.62	1.0

Averages by Years.

-	1895	-	-	.41	4.84	2.58	.0054	.0693	.0462	.0231	.41	.0065	.0001	.70	1.3
-	1896	-	-	.41	4.45	2.28	.0004	.0524	.0373	.0151	.36	.0053	.0000	.69	1.3
-	1897	-	-	.41	4.22	2.15	.0028	.0541	.0359	.0182	.38	.0067	.0000	.58	1.2
-	1898	-	-	.26	3.84	2.00	.0031	.0521	.0319	.0202	.38	.0030	.0001	.48	1.2
-	1899	-	-	.22	3.68	1.89	.0026	.0504	.0326	.0178	.28	.0022	.0000	.49	1.2

Note to analyses of 1899: Odor, vegetable or unpleasant, becoming stronger and sometimes offensive on heating.

WINCHESTER.

Microscopical Examination of Water from the Middle Reservoir of the Winchester Water Works.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	6	3	2	5	4	6	12	2	6	4	1	5
Number of sample,	25854	26122	26375	26657	27006	27326	27713	27946	28472	28867	29206	29560
PLANTS.												
Diatomaceæ,	3	0	0	30	286	80	2,320	208	130	4,160	668	2,852
Asterionella,	0	0	0	16	206	52	52	0	0	0	48	2,480
Cyclotella,	1	0	0	8	20	0	0	0	0	88	0	8
Synedra,	2	0	0	5	10	16	2,240	208	130	4,000	620	364
Tabellaria,	0	0	0	1	50	2	8	0	0	24	0	0
Cyanophyceæ,	19	0	19	0	32	34	56	2,776	352	220	168	166
Anabæna,	6	0	0	0	20	24	40	336	272	44	8	80
Cœlosphærium,	13	0	19	0	10	10	16	32	74	148	156	84
Microcystis,	0	0	0	0	0	0	0	8	0	20	0	0
Oscillaria,	0	0	0	0	0	0	0	2,400	0	0	0	0
Algæ,	0	0	0	10	20	6	20	178	184	761	48	116
Arthrodesmus,	0	0	0	0	4	0	8	0	108	0	4	0
Protococcus,	0	0	0	0	0	0	0	0	56	0	0	32
Raphidium,	0	0	0	6	4	4	4	88	0	632	40	64
Staurastrum,	0	0	0	0	0	2	4	80	8	124	0	0
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	0	1	0	0	0	0	0	0	0
Infusoria,	8	7	0	8	47	52	170	138	804	182	20	236
Chlamydomonas,	0	0	0	0	0	0	0	16	0	80	0	168
Cryptomonas,	0	0	0	0	6	10	4	80	0	60	0	36
Dinobryon,	7	0	0	0	12	0	0	0	0	0	0	0
Halteria,	0	0	0	0	0	2	0	32	0	4	4	0
Peridinium,	0	4	0	8	2	34	164	0	800	4	0	0
Trachelomonas,	1	1	0	0	6	0	0	8	2	20	0	12
Uroglena,	0	0	0	0	8	2	0	0	0	0	4	4
Vermes,	0	5	0	0	24	7	2	42	16	4	4	0
Anurea,	0	1	0	0	16	2	0	32	4	4	4	0
Crustacea,	0	pr.	0	0	0	pr.	0	0	pr.	0	pr.	pr.
Cyclops,	0	pr.	0	0	0	pr.	0	0	pr.	0	0	pr.
Daphnia,	0	0	0	0	0	0	0	0	pr.	0	pr.	0
Miscellaneous, Zoöglœa,	5	0	0	3	12	15	100	30	15	35	10	10
TOTAL,	35	12	19	46	424	194	2,668	3,370	1,501	5,362	918	3,382

Water Supply of Winthrop.

(See *Metropolitan Water District*, pages 127 to 152.)

Water Supply of Woburn.

Chemical Examination of Water from the Filter-Gallery of the Woburn Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25984	Jan. 18	None.	None.	.00	9.00	.0038	.0020	1.18	.0280	.0000	.04	4.3	.0010
26227	Feb. 15	None.	V. slight.	.00	9.60	.0032	.0014	1.21	.0360	.0000	.03	4.4	.0010
26500	Mar. 16	None.	V. slight.	.00	10.00	.0040	.0024	1.22	.0470	.0000	.04	4.7	.0010
26921	Apr. 25	None.	V. slight.	.00	9.30	.0030	.0020	1.14	.0380	.0000	.05	4.3	.0030
27133	May 17	None.	V. slight.	.00	9.50	.0030	.0022	1.14	.0380	.0000	.04	4.4	.0030
27547	June 22	None.	None.	.00	8.80	.0048	.0022	1.19	.0260	.0000	.06	4.2	.0010
27836	July 19	None.	None.	.00	9.40	.0048	.0020	1.18	.0220	.0000	.05	4.3	.0020
28254	Aug. 17	None.	None.	.00	10.20	.0044	.0026	1.18	.0150	.0000	.08	4.0	.0010
28698	Sept. 21	None.	None.	.04	9.80	.0054	.0030	1.20	.0200	.0000	.08	4.3	.0020
29075	Oct. 19	None.	None.	.00	9.10	.0052	.0032	1.18	.0140	.0000	.05	4.6	.0010
29409	Nov. 15	None.	None.	.01	9.80	.0050	.0036	1.21	.0140	.0000	.07	4.3	.0020
29720	Dec. 20	None.	None.	.05	9.60	.0058	.0034	1.23	.0120	.0000	.06	4.6	.0000

Averages by Years.

-	1888	-	-	.00	12.00	.0012	.0032	2.50	.0346	.0000	-	-	-
-	1889	-	-	.00	10.84	.0010	.0022	2.07	.0372	.0000	-	-	-
-	1890	-	-	.01	11.06	.0012	.0023	1.91	.0481	.0000	-	5.0	-
-	1891	-	-	.00	10.85	.0008	.0015	1.79	.0668	.0000	-	4.9	-
-	1892	-	-	.00	11.27	.0012	.0024	1.95	.0542	.0000	-	5.1	-
-	1893	-	-	.00	11.50	.0022	.0018	2.04	.0447	.0000	.05	5.3	.0004
-	1894	-	-	.01	11.02	.0026	.0018	1.94	.0362	.0000	.05	5.0	.0021
-	1895	-	-	.01	10.82	.0031	.0022	1.74	.0304	.0000	.06	4.9	.0023
-	1896	-	-	.01	10.49	.0033	.0031	1.56	.0242	.0000	.04	5.0	.0011
-	1897	-	-	.01	10.06	.0041	.0032	1.36	.0302	.0000	.04	5.0	.0012
-	1898	-	-	.02	10.15	.0041	.0026	1.27	.0252	.0000	.06	4.5	.0015
-	1899	-	-	.01	9.51	.0044	.0025	1.19	.0258	.0000	.05	4.4	.0015

Note to analyses of 1899: Odor, none.

WOBURN.

Chemical Examination of Water from Horn Pond, Woburn.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Suspended.					
	1899.														
25983	Jan. 18	Slight.	V. slight.	.30	7.75	2.80	.0066	.0184	.0158	.0026	0.88	.1960	.0018	.47	3.1
26226	Feb. 15	V. slight.	V. slight.	.19	8.65	3.40	.0114	.0124	.0112	.0012	0.80	.1120	.0014	.26	3.0
26508	Mar. 16	Slight.	Slight.	.26	6.30	2.40	.0144	.0166	.0136	.0030	0.56	.0640	.0017	.37	2.2
26920	Apr. 25	V. slight.	Cons.	.21	6.60	1.95	.0008	.0162	.0120	.0042	0.73	.1280	.0017	.36	2.6
27132	May 17	Slight.	Slight.	.23	6.85	1.60	.0010	.0258	.0200	.0058	0.73	.0400	.0017	.39	2.6
27546	June 22	Slight.	V. slight.	.20	8.00	1.75	.0008	.0252	.0232	.0020	0.86	.0500	.0018	.37	2.6
27835	July 19	Slight.	Slight.	.10	7.35	1.65	.0014	.0326	.0262	.0064	0.81	.0200	.0018	.42	3.0
28258	Aug. 17	Slight.	Slight.	.14	7.85	2.15	.0000	.0364	.0258	.0106	0.93	.0020	.0000	.35	3.3
28697	Sept. 21	Slight.	Cons.	.14	8.00	2.25	.0008	.0888	.0228	.0660	0.98	.0000	.0000	.35	3.0
29074	Oct. 19	Decided.	Cons.	.12	7.60	1.95	.0008	.0856	.0292	.0564	1.04	.0010	.0001	.38	3.5
29408	Nov. 15	Slight.	Slight.	.16	7.90	2.20	.0140	.0278	.0232	.0046	1.04	.0030	.0008	.39	3.3
29719	Dec. 20	Slight.	Cons.	.15	7.75	1.55	.0014	.0274	.0202	.0072	1.09	.0160	.0005	.33	3.0

Averages by Years.

-	1888	-	-	.32	11.28	1.71	.0186	.0383	-	-	2.98	.0398	.0015	-	-
-	1889	-	-	.30	8.37	2.03	.0092	.0376	.0216	.0160	1.98	.0498	.0015	-	-
-	1890	-	-	.27	10.76	2.07	.0080	.0380	.0211	.0169	1.98	.0542	.0008	-	3.4
-	1891	-	-	.22	8.90	2.06	.0129	.0453	.0237	.0216	1.76	.0502	.0009	-	2.9
-	1892	-	-	.25	10.57	2.13	.0110	.0358	.0216	.0142	2.42	.0621	.0008	-	3.3
-	1893	-	-	.30	9.83	2.51	.0061	.0455	.0247	.0208	2.10	.0472	.0009	.45	3.2
-	1894	-	-	.33	9.03	1.98	.0065	.0292	.0184	.0108	1.84	.0404	.0009	.40	3.3
-	1895	-	-	.36	9.43	2.84	.0087	.0297	.0205	.0092	1.53	.0623	.0014	.48	3.4
-	1896	-	-	.27	8.27	2.43	.0043	.0321	.0199	.0122	1.18	.0476	.0010	.39	3.1
-	1897	-	-	.41	7.95	2.30	.0062	.0355	.0224	.0131	1.02	.0389	.0008	.48	3.2
-	1898	-	-	.40	7.80	2.32	.0087	.0286	.0206	.0080	0.96	.0616	.0015	.48	3.0
-	1899	-	-	.18	7.56	2.14	.0046	.0344	.0203	.0141	0.87	.0527	.0011	.37	2.9

NOTE to analyses of 1899: Odor, vegetable, becoming stronger and occasionally unpleasant on heating.

WOBURN.

Microscopical Examination of Water from Horn Pond, Woburn.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	16	17	26	18	23	20	18	22	20	16	21
Number of sample,	25983	26226	26508	26920	27132	27546	27835	28253	28697	29074	29408	29719
PLANTS.												
Diatomaceæ,	242	18	101	6,836	3,332	122	72	4	116	68	1,074	2,844
Asterionella,	82	2	58	5,600	2,200	0	0	0	0	0	120	172
Cyclotella,	4	0	6	26	116	0	0	0	0	0	0	108
Diatoma,	0	0	0	0	40	0	0	0	0	0	0	116
Fragilaria,	12	0	0	0	164	0	56	0	0	0	32	0
Melosira,	100	7	18	28	144	0	6	0	72	60	884	2,416
Synedra,	36	9	24	700	648	120	2	4	44	4	30	32
Tabellaria,	2	0	0	480	20	0	8	0	0	4	8	0
Cyanophyceæ,	0	0	0	0	0	0	22	140	616	1,880	0	0
Anabæna,	0	0	0	0	0	0	22	108	600	1,880	0	0
Aphanizomenon,	0	0	0	0	0	0	0	22	0	0	0	0
Clathrocystis,	6	0	0	0	0	0	0	6	12	0	0	0
Algæ,	22	0	1	7	34	64	88	130	168	0	2	16
Protococcus,	0	0	0	0	0	20	64	0	0	0	0	0
Staurastrum,	20	0	0	2	20	28	0	128	156	0	2	4
ANIMALS.												
Rhizopoda, Difflugia,	0	1	0	0	0	0	0	0	0	0	0	0
Infusoria,	6	5	5	22	18	6	310	464	5,732	272	2	26
Ceratium,	0	0	0	0	0	0	10	0	12	0	0	0
Ciliated infusorian,	6	0	0	0	0	0	0	0	120	0	0	0
Dinobryon,	0	0	0	14	0	0	0	0	0	0	0	0
Peridinium,	0	0	2	2	1	2	268	464	5,600	272	0	8
Uroglena,	0	0	0	0	0	0	0	0	0	0	0	4
Vorticella,	0	0	0	0	12	2	32	0	0	0	0	0
Vermes,	0	0	0	2	12	0	2	8	0	4	2	12
Anuræa,	0	0	0	0	4	0	0	8	0	0	2	12
Crustacea,	0	0		0	0	pr.	0	0	0	0	0	0
Bosmina,	0	0	0	0	0	pr.	0	0	0	0	0	0
Cyclops,	0	0	0	0	0	pr.	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	5	5	12	15	12	5	3	0	20	0	3	10
TOTAL,	277	29	119	6,882	3,406	197	508	746	6,652	2,224	1,083	2,906

WORCESTER.

WATER SUPPLY OF WORCESTER.

Chemical Examination of Water from Lynde Brook Storage Reservoir, at Inlet.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25974	Jan. 17	Slight.	Cons.	.22	2.20	0.80	.0002	.0132	.0104	.0028	.10	.0030	.0000	.38	0.5
26327	Feb. 23	Slight.	Cons.	.21	2.60	1.15	.0006	.0132	.0098	.0034	.14	.0030	.0001	.38	0.6
26484	Mar. 14	V. slight.	V. slight.	.20	2.25	1.25	.0004	.0096	.0086	.0010	.12	.0040	.0000	.35	0.2
26928	Apr. 25	None.	V. slight.	.35	3.00	1.65	.0002	.0110	.0102	.0008	.12	.0030	.0000	.47	0.6
27120	May 16	None.	V. slight.	.42	3.25	1.50	.0006	.0152	.0138	.0014	.12	.0010	.0000	.57	0.5
27510	June 20	V. slight.	V. slight.	.29	4.00	1.25	.0006	.0160	.0148	.0012	.09	.0020	.0000	.52	0.8
27819	July 18	V. slight.	V. slight.	.12	3.45	1.05	.0040	.0110	.0104	.0006	.13	.0020	.0000	.34	0.8
28230	Aug. 15	None.	V. slight.	.10	3.70	1.05	.0002	.0044	.0040	.0004	.15	.0010	.0000	.20	0.8
28676	Sept. 19	V. slight.	V. slight.	.11	3.45	1.10	.0008	.0130	.0110	.0020	.11	.0010	.0001	.23	0.8
29044	Oct. 17	V. slight.	None.	.40	4.40	1.65	.0004	.0150	.0136	.0014	.26	.0020	.0000	.51	1.0
29394	Nov. 14	None.	V. slight.	.48	4.60	1.80	.0012	.0176	.0172	.0004	.22	.0030	.0000	.75	1.0
29702	Dec. 19	V. slight.	V. slight.	.39	3.75	1.40	.0004	.0136	.0124	.0012	.18	.0060	.0001	.52	0.8
Av.	....	....	....	.27	3.39	1.30	.0008	.0127	.0113	.0014	.14	.0026	.0000	.43	0.7

Odor of the first three and last three samples, none, becoming faintly vegetable on heating; of the others, faintly vegetable.

Chemical Examination of Water from Lynde Brook Storage Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25975	Jan. 17	V. slight.	V. slight.	.01	0.60	0.35	.0050	.0082	.0064	.0018	.04	.0030	.0001	.14	0.0
26328	Feb. 23	V. slight.	V. slight.	.19	2.60	1.00	.0026	.0100	.0094	.0006	.12	.0020	.0000	.32	0.5
26485	Mar. 14	Slight.	V. slight.	.20	2.40	1.10	.0032	.0118	.0096	.0022	.12	.0060	.0000	.31	0.3
26929	Apr. 25	Slight.	V. slight.	.18	2.30	1.00	.0024	.0124	.0098	.0026	.12	.0070	.0000	.29	0.3
27121	May 16	V. slight.	V. slight.	.14	2.50	1.05	.0012	.0122	.0116	.0006	.12	.0050	.0000	.29	0.3
27512	June 20	Slight.	Slight.	.15	2.35	1.10	.0006	.0174	.0150	.0024	.11	.0000	.0000	.32	0.3
27820	July 18	Slight.	Slight.	.13	2.35	0.95	.0012	.0168	.0156	.0012	.10	.0030	.0000	.36	0.3
28221	Aug. 15	V. slight.	V. slight.	.10	2.40	1.15	.0000	.0138	.0124	.0014	.11	.0020	.0000	.30	0.2
28677	Sept. 19	Slight.	Slight.	.17	2.30	1.15	.0002	.0190	.0158	.0032	.12	.0000	.0000	.29	0.5
29045	Oct. 17	V. slight.	V. slight.	.31	2.80	1.20	.0066	.0172	.0166	.0006	.12	.0010	.0000	.30	0.8
29395	Nov. 14	Decided.	Slight.	.40	3.56	1.40	.0078	.0200	.0176	.0024	.16	.0030	.0000	.43	0.6
29703	Dec. 19	V. slight.	Slight.	.39	3.70	1.30	.0080	.0180	.0162	.0018	.16	.0050	.0001	.41	1.1

WORCESTER.

Chemical Examination of Water from Lynde Brook Storage Reservoir — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1888	-	-	.24	2.64	0.85	.0037	.0151	-	-	.14	.0065	.0001	-	-
-	1889	-	-	.24	2.54	0.60	.0030	.0167	.0138	.0029	.15	.0053	.0001	-	-
-	1890	-	-	.21	3.07	1.15	.0026	.0132	.0107	.0025	.14	.0078	.0001	-	0.9
-	1891	-	-	.24	2.83	1.03	.0045	.0126	.0101	.0025	.12	.0074	.0001	-	0.7
-	1892	-	-	.25	2.99	1.15	.0038	.0139	.0113	.0026	.15	.0105	.0000	-	0.8
-	1893	-	-	.26	2.66	0.98	.0036	.0162	.0122	.0089	.15	.0066	.0001	.35	0.6
-	1894	-	-	.36	3.37	1.09	.0055	.0139	.0117	.0022	.18	.0103	.0000	.35	1.2
-	1895	-	-	.32	3.63	1.30	.0033	.0161	.0138	.0023	.20	.0116	.0000	.45	1.2
-	1896	-	-	.29	2.95	1.27	.0035	.0158	.0133	.0025	.18	.0054	.0000	.38	0.8
-	1897	-	-	.44	3.31	1.25	.0068	.0191	.0164	.0027	.18	.0087	.0001	.42	0.8
-	1898	-	-	.31	3.24	1.32	.0030	.0156	.0140	.0016	.20	.0059	.0001	.38	0.8
-	1899	-	-	.20	2.49	1.06	.0030	.0147	.0130	.0017	.12	.0031	.0000	.31	0.4

Note to analyses of 1899: Odor of the first two and last four samples, none, becoming faintly vegetable on heating; of the others, faintly vegetable, becoming stronger on heating.

Microscopical Examination of Water from Lynde Brook Storage Reservoir.

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	24	15	26	17	21	19	16	21	18	15	20
Number of sample,	25975	26328	26485	26929	27121	27512	27820	28221	28677	29045	29395	29708
PLANTS.												
Diatomaceæ,	5	1	1	40	33	110	6	3	70	2	73	20
Cyclotella,	0	0	0	5	2	66	4	0	8	0	0	1
Melosira,	0	0	0	20	22	20	0	0	16	0	54	0
Cyanophyceæ,	0	0	1	0	1	112	58	17	28	76	4	0
Anabæna,	0	0	0	0	1	0	43	14	26	0	2	0
Merismopœdia,	0	0	0	0	0	112	14	0	0	0	0	0
Microcystis,	0	0	0	0	0	0	0	3	0	76	2	0
Algæ,	0	0	2	0	21	86	8	34	19	58	15	0
Protococcus,	0	0	0	0	14	80	0	0	0	54	13	0

WORCESTER.

Microscopical Examination of Water from Lynde Brook Storage Reservoir — Concluded.

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS.												
Rhizopoda,	0	0	0	0	0	1	0	0	0	0	0	1
Infusoria,	11	2	55	29	8	24	10	21	2	4	4	114
Dinobryon,	11	0	52	25	0	0	0	18	0	2	0	113
Peridinium,	0	2	3	1	0	22	1	0	2	0	1	1
Uroglena,	0	0	0	1	4	0	0	0	0	0	0	0
Vermes,	0	0	0	0	1	2	2	0	1	2	0	1
Crustacea, Daphnia,	8	0	0	0	0	0	pr.	0	0	0	0	8
Miscellaneous, Zoöglœa,	0	0	5	10	7	0	50	5	10	3	3	8
TOTAL,	16	3	64	79	71	345	134	80	130	145	90	144

Chemical Examination of Water from Kent Reservoir on Kettle Brook, in Leicester.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25973	Jan. 17	Decided.	V. slight.	.34	2.85	1.25	.0018	.0258	.0214	.0044	.07	.0040	.0001	.56	0.8
26326	Feb. 23	Slight.	V. slight.	.30	3.10	1.50	.0100	.0234	.0196	.0038	.11	.0010	.0002	.55	0.6
26486	Mar. 14	Decided.	Slight.	.26	3.25	1.35	.0190	.0278	.0244	.0034	.15	.0060	.0001	.58	0.6
26926	Apr. 25	Slight.	V. slight.	.18	2.90	1.05	.0010	.0126	.0116	.0010	.11	.0070	.0001	.30	0.2
27119	May 16	Slight.	Slight.	.23	2.25	1.00	.0006	.0208	.0172	.0036	.11	.0000	.0000	.38	0.2
27509	June 20	Slight.	Slight.	.24	2.60	1.25	.0008	.0226	.0190	.0036	.08	.0010	.0000	.42	0.3
27818	July 18	Decided.	Cons.	.33	2.75	1.35	.0040	.0260	.0224	.0036	.09	.0020	.0000	.53	0.6
28263	Aug. 17	V. slight.	V. slight.	.24	3.50	1.55	.0002	.0230	.0200	.0030	.09	.0010	.0000	.47	0.5
28678	Sept. 19	Decided.	Cons.	.18	3.25	1.75	.0036	.0356	.0244	.0112	.08	.0000	.0001	.47	0.6
29048	Oct. 17	Decided.	Cons.	.21	4.10	1.35	.0020	.0268	.0178	.0090	.20	.0060	.0001	.36	1.6
29393	Nov. 14	Decided.	Cons.	.49	4.95	1.85	.0056	.0226	.0194	.0032	.23	.0070	.0000	.65	1.1
29704	Dec. 19	Decided.	V. slight.	.27	4.25	1.40	.0080	.0198	.0170	.0028	.19	.0100	.0001	.46	1.0
Av...	1899	....	....	.27	3.25	1.39	.0047	.0239	.0195	.0044	.13	.0037	.0001	.47	0.7
Av...	1898	....	....	.36	3.20	1.40	.0012	.0176	.0150	.0026	.16	.0042	.0001	.46	0.8

NOTE to analyses of 1899: Odor of the first and last two samples, none, becoming faintly vegetable on heating; of the third, none, becoming distinctly disagreeable on heating; of the others, vegetable, becoming stronger on heating.

WORCESTER.

Microscopical Examination of Water from Kent Reservoir on Kettle Brook in Leicester.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	24	15	26	17	21	19	18	21	18	15	20
Number of sample,	25973	26326	26486	26926	27119	27509	27818	28263	28678	29048	29393	29704
PLANTS.												
Diatomaceæ,	6	5	2	73	450	107	188	154	414	1,416	90	77
Asterionella,	0	0	0	3	42	8	44	50	32	26	12	19
Melosira,	0	0	0	38	332	71	104	46	314	1,028	40	49
Synedra,	6	5	0	22	56	14	14	38	36	304	20	6
Cyanophyceæ,	0	0	0	0	0	0	0	4	4	0	0	0
Algæ,	0	0	3	1	30	27	25	68	15	24	2	0
Raphidium,	0	0	0	0	10	16	0	50	6	0	0	0
ANIMALS.												
Rhizopoda, Difflugia,	0	0	0	0	0	0	0	1	0	0	0	0
Infusoria,	2	1	3	0	36	6	0	146	16	120	1	7
Dinobryon,	1	1	2	0	24	0	0	138	4	112	0	0
Peridinium,	0	0	1	0	2	3	0	6	12	0	0	0
Vermes,	0	0	0	0	6	1	1	0	1	16	0	0
Anuræa,	0	0	0	0	4	0	1	0	1	12	0	0
Miscellaneous, Zoöglœa,	5	3	7	8	60	15	20	15	8	10	60	25
TOTAL,	13	9	15	82	582	156	234	388	458	1,586	153	109

Chemical Examination of Water from Bottomly Pond, on Kettle Brook, Paxton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25976	Jan. 17	V. slight.	V. slight.	.01	0.80	0.45	.0088	.0078	.0064	.0014	.06	.0020	.0001	0.14	0.2
26329	Feb. 23	V. slight.	V. slight.	.18	1.50	0.50	.0052	.0070	.0064	.0006	.06	.0040	.0001	0.31	0.3
26487	Mar. 14	Slight.	Slight.	.25	2.40	0.95	.0038	.0136	.0100	.0036	.09	.0060	.0000	0.38	0.2
26930	Apr. 25	Slight.	Slight.	.22	2.00	1.10	.0006	.0130	.0110	.0020	.09	.0070	.0001	0.34	0.2
27122	May 16	V. slight.	Slight.	.24	2.40	1.15	.0014	.0196	.0148	.0048	.08	.0030	.0000	0.38	0.2
27511	June 20	Decided.	Cons.	.29	2.25	1.06	.0012	.0260	.0206	.0054	.10	.0020	.0000	0.51	0.2
27821	July 18	Decided.	Heavy.	.59	4.15	1.75	.0284	.0648	.0296	.0352	.14	.0040	.0001	0.68	1.8
28264	Aug. 17	Decided.	Heavy.	.39	4.80	1.50	.0156	.0384	.0264	.0120	.14	.0010	.0001	0.55	1.4
28679	Sept. 19	Decided.	Heavy.	.57	4.25	1.25	.0352	.0496	.0320	.0176	.12	.0060	.0003	0.50	1.4
29049	Oct. 17	Decided.	Cons.	.40	4.90	1.55	.0116	.0396	.0208	.0188	.19	.0080	.0001	0.53	1.7
29396	Nov. 14	Slight.	Slight.	.96	6.45	2.65	.0030	.0326	.0302	.0024	.23	.0010	.0000	1.27	1.7
29705	Dec. 19	V. slight.	Slight.	.50	4.50	1.65	.0040	.0182	.0170	.0012	.16	.0020	.0000	0.66	1.3

WORCESTER.

Chemical Examination of Water from Bottomly Pond, on Kettle Brook, Paxton — Concluded.

Averages by Years.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
-	1895	-	-	.46	3.51	1.84	.0056	.0259	.0223	.0036	.17	.0057	.0001	0.64	1.0
-	1896	-	-	.37	2.89	1.48	.0042	.0199	.0168	.0031	.14	.0070	.0000	0.50	0.7
-	1897	-	-	.41	3.20	1.37	.0018	.0239	.0179	.0060	.18	.0063	.0000	0.52	0.9
-	1898	-	-	.40	3.07	1.40	.0012	.0203	.0172	.0031	.14	.0115	.0001	0.51	0.8
-	1899	-	-	.38	3.37	1.30	.0099	.0275	.0188	.0067	.12	.0084	.0001	0.52	0.9

NOTE to analyses of 1899: Odor of the first three and last samples, none, becoming vegetable on heating; of the others, vegetable or unpleasant, becoming stronger on heating.

Microscopical Examination of Water from Bottomly Pond, on Kettle Brook, Paxton.

[Number of organisms per cubic centimeter.]

	1899. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	19	24	15	26	17	21	19	18	21	18	15	20
Number of sample,	25976	26329	26487	26930	27122	27511	27821	28264	28679	29049	29396	29705
PLANTS.												
Diatomaceæ,	24	0	9	16	138	344	2,380	2,558	7,578	2,276	46	25
Asterionella,	2	0	8	0	38	166	412	448	476	40	0	0
Cyclotella,	0	0	0	0	9	88	52	88	0	40	0	0
Melosira,	0	0	0	0	57	28	1,600	1,708	6,700	1,620	38	17
Navicula,	1	0	0	2	1	2	8	4	54	56	0	2
Synedra,	17	0	1	6	20	54	260	308	332	516	6	2
Cyanophyceæ,	0	0	1	0	1	46	0	4	0	0	0	0
Anabæna,	0	0	0	0	0	42	0	0	0	0	0	0
Algæ,	0	0	0	0	0	42	344	289	92	20	1	0
Raphidium,	0	0	0	0	0	8	52	0	2	0	0	0
Scenedesmus,	0	0	0	0	0	2	244	256	54	16	0	0
ANIMALS.												
Rhizopoda, Actinophrys,	0	0	0	0	0	0	8	0	0	0	0	0
Infusoria,	1	30	273	30	18	42	200	635	6	0	0	0
Ciliated infusorian,	0	0	0	0	0	0	0	20	0	0	0	0
Dinobryon,	1	22	169	22	0	0	56	600	0	0	0	0
Euglena,	0	0	94	2	0	0	4	0	0	0	0	0
Monas,	0	0	0	0	10	2	120	0	0	0	0	0
Peridinium,	0	5	9	6	2	32	4	8	0	0	0	0

WORCESTER.

Microscopical Examination of Water from Bottomly Pond, on Kettle Brook, Paxton — Concluded.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
ANIMALS — Concluded.												
Vermes,	0	1	3	1	6	5	2	26	18	0	0	0
Anurea,	0	0	1	0	1	1	0	0	16	0	0	0
Polyarthra,	0	1	1	1	2	2	0	20	0	0	0	0
Crustacea,	0	0	0	0	pr.	pr.	0	pr.	0	0	0	0
Bosmina,	0	0	0	0	0	0	0	pr.	0	0	0	0
Cyclops,	0	0	0	0	pr.	pr.	0	0	0	0	0	0
Miscellaneous, Zoöglœa,	3	3	12	7	12	40	200	200	30	16	3	5
TOTAL,	28	34	298	54	170	519	3,114	3,710	7,726	2,312	50	30

Chemical Examination of Water from Tatnuck Brook Storage Reservoir, at Inlet.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25971	Jan. 17	None.	V. slight.	.07	1.50	0.50	.0006	.0034	.0032	.0002	.12	.0040	.0000	.15	0.0
26324	Feb. 23	Slight.	V. slight.	.15	2.40	1.15	.0046	.0112	.0086	.0026	.12	.0060	.0001	.20	0.5
26482	Mar. 14	None.	V. slight.	.10	1.75	0.60	.0000	.0060	.0044	.0016	.12	.0010	.0000	.19	0.0
26924	Apr. 25	V. slight.	Slight.	.12	1.90	0.50	.0000	.0066	.0062	.0004	.13	.0010	.0000	.23	0.0
27117	May 16	V. slight.	Slight.	.41	2.35	1.10	.0020	.0194	.0174	.0020	.14	.0010	.0000	.54	0.2
27507	June 20	Slight.	Cons.	.19	2.75	1.35	.0020	.0220	.0184	.0036	.12	.0010	.0000	.35	0.0
27816	July 18	Slight.	Slight.	.35	2.80	1.20	.0140	.0260	.0212	.0048	.14	.0020	.0000	.44	0.2
28222	Aug. 15	V. slight.	V. slight.	.28	3.55	1.20	.0000	.0098	.0080	.0018	.20	.0010	.0000	.32	0.5
28674	Sept. 19	V. slight.	Slight.	.13	2.75	0.65	.0010	.0070	.0060	.0010	.14	.0040	.0001	.10	0.6
29046	Oct. 17	V. slight.	V. slight.	.27	3.50	1.20	.0008	.0156	.0116	.0040	.32	.0050	.0000	.37	0.3
29391	Nov. 14	V. slight.	V. slight.	.40	4.15	1.55	.0008	.0148	.0144	.0004	.27	.0040	.0000	.58	0.6
29700	Dec. 19	V. slight.	V. slight.	.33	3.25	1.15	.0006	.0124	.0118	.0006	.23	.0040	.0000	.36	0.5
Av.	....	....	....	.23	2.72	1.01	.0022	.0128	.0109	.0019	.17	.0028	.0000	.32	0.3

Odor of the first three and last samples, none; of the others, faintly vegetable, becoming occasionally unpleasant on heating.

WORCESTER.

Chemical Examination of Water from Tatnuck Brook Storage Reservoir.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25072	Jan. 17	V. slight.	V. slight.	.16	2.10	1.00	.0002	.0078	.0070	.0008	.15	.0030	.0000	.28	0.2
26325	Feb. 23	V. slight.	V. slight.	.12	2.15	0.80	.0024	.0072	.0064	.0008	.16	.0010	.0001	.25	0.3
26483	Mar. 14	V. slight.	None.	.15	2.25	0.75	.0026	.0078	.0068	.0010	.13	.0010	.0000	.23	0.0
26925	Apr. 25	Slight.	V. slight.	.13	1.85	0.85	.0028	.0076	.0060	.0016	.12	.0010	.0001	.20	0.0
27118	May 16	V. slight.	V. slight.	.11	1.75	0.55	.0004	.0128	.0094	.0034	.12	.0010	.0000	.22	0.0
27508	June 20	V. slight.	V. slight.	.12	1.50	0.35	.0010	.0146	.0126	.0020	.11	.0000	.0000	.23	0.0
27817	July 18	Slight.	Cons.	.06	2.65	0.95	.0032	.0188	.0120	.0068	.13	.0010	.0000	.23	0.2
28223	Aug. 15	V. slight.	V. slight.	.07	2.15	1.25	.0000	.0124	.0106	.0018	.12	.0030	.0000	.22	0.2
28675	Sept. 19	V. slight.	Slight.	.07	1.75	0.85	.0002	.0154	.0130	.0024	.10	.0010	.0000	.20	0.2
29047	Oct. 17	Slight.	Slight.	.08	1.70	0.70	.0004	.0172	.0130	.0042	.12	.0050	.0000	.18	0.3
29392	Nov. 14	Decided.	Cons.	.11	2.15	0.75	.0004	.0246	.0156	.0090	.14	.0010	.0000	.24	0.3
29701	Dec. 19	Slight.	Slight.	.10	2.00	0.85	.0024	.0168	.0146	.0022	.15	.0010	.0000	.23	0.3

Averages by Years.

-	1888	-	-	.17	2.23	0.75	.0012	.0157	-	-	.12	.0043	.0001	-	-
-	1889	-	-	.19	2.04	0.57	.0008	.0143	.0112	.0031	.12	.0031	.0001	-	-
-	1890	-	-	.17	2.68	1.24	.0007	.0141	.0102	.0039	.13	.0078	.0001	-	0.9
-	1891	-	-	.17	2.30	0.94	.0024	.0143	.0102	.0041	.11	.0077	.0001	-	0.4
-	1892	-	-	.20	2.52	1.03	.0012	.0142	.0113	.0029	.12	.0067	.0000	-	0.5
-	1893	-	-	.35	2.45	0.93	.0020	.0182	.0140	.0042	.14	.0049	.0000	.36	0.5
-	1894	-	-	.20	2.27	0.85	.0010	.0151	.0114	.0037	.16	.0032	.0000	.30	0.4
-	1895	-	-	.21	2.33	0.98	.0012	.0173	.0130	.0043	.18	.0068	.0000	.36	0.5
-	1896	-	-	.17	2.00	0.84	.0008	.0142	.0109	.0033	.15	.0034	.0000	.27	0.4
-	1897	-	-	.21	2.12	0.82	.0007	.0156	.0125	.0030	.16	.0054	.0000	.30	0.5
-	1898	-	-	.22	2.24	0.96	.0006	.0141	.0114	.0027	.16	.0020	.0000	.30	0.5
-	1899	-	-	.11	2.00	0.80	.0018	.0136	.0106	.0030	.13	.0016	.0000	.23	0.2

NOTE to analyses of 1899: Odor, faintly vegetable, becoming stronger and occasionally unpleasant on heating.

WORCESTER.

Microscopical Examination of Water from Tatnuck Brook Storage Reservoir.

[Number of organisms per cubic centimeter.]

	1899.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Day of examination,	18	24	15	26	17	21	19	16	21	18	15	20
Number of sample,	25972	26325	26483	26925	27118	27508	27817	28223	28675	29047	29392	29701
PLANTS.												
Diatomaceæ,	3	17	6	130	412	148	940	366	416	530	1,092	141
Asterionella,	0	5	0	12	12	21	756	222	40	142	48	110
Melosira,	0	7	3	64	342	36	112	30	296	204	1,004	6
Synedra,	2	4	3	10	6	4	2	38	38	84	22	0
Tabellaria,	1	0	0	30	42	86	68	70	34	100	18	25
Cyanophyceæ,	0	1	0	0	6	1	0	9	0	0	0	0
Algæ,	0	0	1	0	7	1	12	36	16	58	16	2
ANIMALS.												
Rhizopoda, Arcella,	0	0	0	0	0	0	0	0	1	0	0	0
Infusoria,	9	1	18	78	55	11	8	34	17	0	18	12
Chlamydomonas,	0	0	0	0	0	0	0	0	0	0	14	0
Dinobryon,	6	0	17	74	22	4	0	0	4	0	0	0
Peridinium,	1	1	1	4	28	4	6	32	12	0	2	12
Vermes,	1	1	0	0	3	3	2	6	1	2	2	1
Crustacea, Cyclops,	0	0	0	0	0	0	0	0	0	pr.	0	0
Miscellaneous, Zoöglœa,	0	3	3	8	12	5	15	10	8	5	5	10
TOTAL,	13	23	28	216	495	169	977	461	459	595	1,133	166

EXAMINATION OF RIVERS.

EXAMINATION OF RIVERS.

Regular monthly examinations have been made during the year 1899 of the waters of the Assabet, Blackstone, Charles, Hoosac, Housatonic, Merrimack, Nashua, Neponset, Saugus, Sudbury, Swift and Ware rivers, and examinations during the summer months of the waters of the Chicopee, Connecticut, French, Miller's, Nemasket, Quinebaug, Salisbury Plain, Taunton and Ten Mile rivers. Occasional examinations have also been made of other rivers in the State. Most of the results of these examinations will be found arranged alphabetically by rivers in the pages which follow, but some of them are given on the preceding pages in connection with the examinations of water supplies, as follows: —

	Page
Merrimack at Lowell,	231
Merrimack at Lawrence,	218
Nashua at Clinton,	130
Quinepoxet at Holden,	128
Saugus at Montrose,	245
Stillwater at Sterling,	129
Sudbury at Framingham,	143

The flow of the streams during the summer months was unusually low, making the effects of sewage pollution more noticeable than in years of ordinary flow.

ASSABET RIVER.

Assabet River.

Chemical Examination of Water from Assabet River, below the Sewage Filtration Area at Westborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25997	Jan. 19	V. slight.	V. slight.	0.60	3.65	1.65	.0042	.0174	.0160	.0014	.19	.0060	.0001	0.70	0.8
26248	Feb. 18	Slight.	V. slight.	0.51	5.15	2.15	.0168	.0204	.0174	.0030	.23	.0060	.0008	0.72	2.0
26573	Mar. 24	V. slight.	Slight.	0.34	2.95	1.25	.0002	.0166	.0136	.0030	.14	.0020	.0001	0.44	0.6
27010	May 2	Slight.	Cons.	1.14	5.55	2.65	.0052	.0476	.0404	.0072	.34	.0020	.0000	1.33	1.4
27129	May 16	V. slight.	V. slight.	1.00	4.75	2.25	.0028	.0392	.0382	.0010	.25	.0010	.0000	1.10	1.3
27555	June 22	V. slight.	Slight.	1.30	6.75	3.35	.0032	.0530	.0492	.0038	.29	.0030	.0000	1.58	1.0
27842	July 19	Slight.	Slight.	0.63	5.50	2.10	.0006	.0340	.0318	.0022	.27	.0040	.0000	0.81	1.8
28284	Aug. 19	V. slight.	Cons., iron.	0.38	6.05	2.15	.0036	.0356	.0276	.0080	.52	.0030	.0001	0.64	2.0
28857	Oct. 2	V. slight.	None.	0.29	6.25	1.75	.0302	.0288	.0276	.0012	.62	.0040	.0001	0.56	2.0
29081	Oct. 18	V. slight.	Slight.	0.55	6.00	2.30	.0168	.0368	.0338	.0028	.78	.0040	.0004	0.76	1.7
29462	Nov. 21	None.	V. slight.	0.63	8.05	2.55	.0014	.0306	.0292	.0014	.49	.0040	.0002	1.07	2.3
29748	Dec. 21	V. slight.	Slight.	0.56	7.10	2.25	.0054	.0296	.0276	.0020	.39	.0040	.0000	0.98	2.3
Av...	....	....	....	0.66	5.65	2.20	.0075	.0325	.0294	.0031	.38	.0036	.0001	0.89	1.6

Odor, generally faintly vegetable, sometimes unpleasant or musty, becoming stronger on heating. — The samples were collected from the river at the bridge on Belmont Street, about 1,000 feet below the filter-beds of the town of Westborough.

Chemical Examination of Water from Assabet River, below Hudson.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
27487	June 20	Slight.	Cons.	.60	5.05	2.00	.0034	.0366	.0320	.0046	0.41	.0040	.0004	.75	1.7
28224	Aug. 15	Slight.	Cons.	.52	8.15	2.90	.0010	.0452	.0412	.0040	0.60	.0000	.0000	.78	1.6
28663	Sept. 18	V. slight.	Slight.	.35	11.15	5.10	.0240	.0436	.0400	.0036	0.90	.0000	.0012	.56	2.0
29062	Oct. 17	Decided.	Cons., iron.	.52	10.40	3.00	.0604	.0608	.0460	.0148	1.41	.0010	.0001	.81	3.3
29398	Nov. 14	Decided.	Cons.	.50	6.75	2.05	.0136	.0424	.0324	.0100	0.69	.0050	.0003	.77	2.0
Av...	....	....	....	.50	8.30	3.01	.0206	.0457	.0383	.0074	0.80	.0020	.0004	.73	2.1

Odor, generally unpleasant, sometimes vegetable and musty, becoming stronger on heating. — The samples were collected from the river at the O'Neil bridge, so called, about a mile below the village of Hudson.

ASSABET RIVER.

Chemical Examination of Water from Assabet River, below Maynard.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
27489	June 20	Decided.	Cons.	.60	5.50	1.60	.0082	.0440	.0342	.0098	0.49	.0020	.0002	.65	2.0
27826	July 18	Decided.	Cons., floc.	.66	6.90	2.40	.0760	.0488	.0360	.0128	0.67	.0090	.0005	.69	1.8
28205	Aug. 14	Slight.	Cons.	.47	7.00	2.55	.0084	.0436	.0352	.0084	0.59	.0030	.0001	.57	1.1
28787	Sept. 26	Decided.	Cons.	.35	6.05	1.80	.0048	.0360	.0288	.0072	0.91	.0020	.0008	.51	1.7
29050	Oct. 17	Decided.	Cons.	.40	7.25	2.15	.0120	.0388	.0294	.0094	1.11	.0070	.0006	.58	1.8
29375	Nov. 14	Decided.	Slight.	.60	7.50	2.75	.0064	.0372	.0328	.0044	0.68	.0030	.0002	.74	2.0
Av...	....	....	....	.51	6.70	2.21	.0185	.0414	.0327	.0087	0.73	.0043	.0003	.62	1.7

Odor, generally distinctly unpleasant, sometimes musty.—The samples were collected from the river, near the works of the American Powder Company.

Blackstone River.

The regular monthly examinations of the water of the Blackstone River have been continued as in previous years and the results are given in the tables which follow. The first of the tables is taken from a report of the superintendent of sewers of the city of Worcester for the year ending Nov. 30, 1899, and contains the monthly averages of analyses made by the city of samples of sewage and effluent collected at the Worcester Precipitation Works, and the percentage of matters removed by treatment at these works. According to the above-mentioned report there were treated during the year ending Nov. 30, 1899, an average of about 17,100,000 gallons per day of mingled sewage and brook water taken from the Mill Brook Channel, and about 1,204 pounds of quick-lime were used for each million gallons of sewage treated. The effluent from the precipitation works and the excess of flow of Mill Brook over the amount treated were discharged into the Blackstone River. The second and third tables show the averages for each year and for the six dry months of each year of the chemical analyses of samples of water collected at various points along the river.

BLACKSTONE RIVER.

Worcester Sewage Purification Works.

Abstract of Analyses of Sewage and Effluent made by the City of Worcester.

[Taken from the annual report of the superintendent of sewers of the city of Worcester for the year ending Nov. 30, 1899.]

[Parts per 100,000.]

DATE OF COLLECTION.	Ammonia.				Oxygen Consumed.		
		Albuminoid.					
	Free.	Total.	Dissolved.	Suspended.	Unfiltered.	Filtered.	Chlorine.
Sewage, December, 1898,	.669	.314	.145	.169	3.61	2.02	3.48
Effluent, December, 1898,	.583	.172	.157	.015	1.86	1.86	3.58
Per cent. removed,	12.85	43.96	—7.65	91.11	48.48	8.00	—2.85
Sewage, January, 1899,	.583	.281	.158	.123	3.30	1.95	3.00
Effluent, January, 1899,	.530	.152	.143	.009	1.88	1.88	2.43
Per cent. removed,	9.10	45.91	9.49	92.68	43.03	3.59	6.28
Sewage, February, 1899,	.716	.353	.193	.160	4.18	2.51	4.41
Effluent, February, 1899,	.645	.190	.181	.009	2.26	2.26	4.38
Per cent. removed,	9.92	46.17	6.22	94.38	45.93	9.96	0.68
Sewage, March, 1899,	.450	.266	.141	.125	3.14	2.02	2.99
Effluent, March, 1899,	.405	.147	.138	.009	1.74	1.74	2.95
Per cent. removed,	10.00	44.73	2.13	92.81	44.59	13.87	1.33
Sewage, April, 1899,	.519	.266	.146	.120	3.33	1.60	3.28
Effluent, April, 1899,	.451	.139	.132	.007	1.55	1.55	3.20
Per cent. removed,	13.10	47.74	9.58	94.17	53.46	3.13	2.44
Sewage, May, 1899,	1.234	.577	.323	.254	6.09	3.22	6.36
Effluent, May, 1899,	1.106	.266	.255	.011	2.92	2.92	6.47
Per cent. removed,	10.37	53.91	21.05	95.65	52.06	9.32	—1.73
Sewage, June, 1899,	1.303	.616	.264	.352	6.53	3.37	7.60
Effluent, June, 1899,	1.145	.276	.260	.016	3.07	3.07	7.70
Per cent. removed,	12.14	55.20	1.53	95.45	52.99	8.90	—1.32
Sewage, July, 1899,	1.446	.609	.287	.353	6.47	3.29	8.05
Effluent, July, 1899,	1.336	.251	.269	.012	3.35	3.35	8.35
Per cent. removed,	7.60	58.10	6.27	96.62	48.22	—1.82	—3.37

BLACKSTONE RIVER.

WORCESTER SEWAGE PURIFICATION WORKS — *Concluded.*

[Parts per 100,000.]

DATE OF COLLECTION.	Ammonia.				Oxygen Consumed.		Chlorine.
		Albuminoid.					
	Free.	Total.	Dissolved.	Suspended.	Unfiltered.	Filtered.	
Sewage, August, 1899,	1.373	.612	.278	.334	6.76	3.71	7.91
Effluent, August, 1899,	1.231	.254	.240	.014	3.24	3.24	8.14
Per cent. removed,	10.31	58.82	13.68	95.81	52.08	12.67	—2.91
Sewage, September, 1899,	1.344	.584	.324	.260	7.31	4.27	7.10
Effluent, September, 1899,	1.240	.257	.244	.013	3.25	3.25	7.20
Per cent. removed,	7.74	60.00	24.69	94.99	55.54	23.89	—1.41
Sewage, October, 1899,	1.777	.652	.315	.337	8.23	4.96	8.01
Effluent, October, 1899,	1.589	.277	.269	.008	3.71	3.71	8.08
Per cent. removed,	10.45	57.51	14.61	97.63	54.92	25.20	—0.87
Sewage, November, 1899,	1.702	.593	.280	.313	8.29	5.49	7.52
Effluent, November, 1899,	1.547	.253	.246	.007	3.77	3.77	8.00
Per cent. removed,	9.11	57.33	12.14	97.77	54.51	31.25	—6.38
Sewage for year ending Dec. 1, 1899,	1.097	.480	.237	.243	5.63	3.24	5.87
Effluent for year ending Dec. 1, 1899,	.988	.222	.211	.011	2.71	2.71	6.00
Per cent. removed,	9.93	53.73	10.97	95.53	51.78	16.36	—2.23

NOTE. — Monthly averages are made from daily analyses of sewage and effluent. The daily sewage samples consist of forty-eight portions taken half hourly. Sewage samples are taken as nearly as possible in proportion to the amount of sewage being received at the time of the sampling. Effluent samples consist of twenty-four portions taken hourly.

BLACKSTONE RIVER.

AVERAGES OF CHEMICAL ANALYSES OF WATER FROM THE BLACKSTONE RIVER FOR THE YEARS 1888 TO 1899, INCLUSIVE.

Blackstone River between Mill Brook Channel and the Sewage Precipitation Works.

[Parts per 100,000.]

YEAR.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1888,	0.64	-	-	.2112	.1040	-	-	1.21	.0370	.0029	-
1889,	0.76	-	-	.2841	.1198	.0629	.0569	1.06	.0235	.0024	-
1890,	0.82	-	-	.1800	.1024	.0549	.0475	1.03	.0367	.0014	-
1891,	0.80	13.54	4.00	.3340	.1563	.0840	.0723	1.78	.0333	.0032	4.6
1892,	0.71	16.28	4.85	.2530	.1262	.0627	.0635	1.84	.0312	.0061	4.9
1893,	0.68	17.95	4.88	.1429	.0603	.0325	.0277	1.04	.0180	.0012	4.5
1894,	0.86	17.17	5.58	.0739	.0570	.0304	.0266	0.88	.0195	.0006	3.7
1895,	0.84	13.40	4.02	.0507	.0374	.0229	.0145	0.86	.0175	.0007	2.9
1896,	0.75	12.69	3.37	.0759	.0486	.0309	.0177	1.01	.0187	.0010	2.9
1897,	0.94	17.62	5.81	.0715	.0533	.0306	.0227	0.77	.0151	.0015	2.9
1898,	0.50	13.52	4.34	.0762	.0557	.0259	.0298	0.88	.0167	.0011	3.5
1899,	0.26	25.33	8.08	.1921	.0751	.0360	.0391	1.20	.0109	.0010	9.7

Blackstone River below Sewage Precipitation Works.

1888,	0.64	-	-	.2112	.1040	-	-	1.21	.0370	.0029	-
1889,	0.76	-	-	.2841	.1198	.0629	.0569	1.06	.0235	.0024	-
1890,	0.74	-	-	.2253	.1177	.0581	.0596	1.26	.0381	.0016	-
1891,	0.80	15.62	4.52	.4080	.1303	.0695	.0608	1.91	.0358	.0031	4.6
1892,	0.58	19.35	5.29	.3683	.1442	.0737	.0705	2.21	.0278	.0033	7.2
1893,	0.74	25.65	6.54	.3757	.1447	.0864	.0583	1.98	.0369	.0070	7.4
1894,	0.60	25.75	6.61	.4228	.1309	.0946	.0363	2.13	.0316	.0047	7.9
1895,	0.79	19.14	4.78	.2298	.0840	.0573	.0267	1.52	.0347	.0040	5.8
1896,	0.40	24.28	6.36	.2645	.0930	.0615	.0315	1.91	.0356	.0071	8.3
1897,	0.75	19.94	4.59	.2447	.0848	.0630	.0218	1.33	.0300	.0047	5.4
1898,	0.49	19.41	5.20	.2260	.0725	.0473	.0252	1.30	.0264	.0072	6.6
1899,	0.30	32.48	7.90	.3908	.1337	.0749	.0588	2.37	.0176	.0053	12.0

Blackstone River at Uxbridge.

1888,	0.45	-	-	.0979	.0284	-	-	0.61	.0322	.0008	-
1889,	0.28	-	-	.0992	.0300	.0191	.0109	0.60	.0258	.0009	-
1890,	0.25	-	-	.1168	.0214	.0152	.0062	0.66	.0272	.0006	-
1891,	0.27	8.32	1.94	.1647	.0272	.0197	.0075	0.77	.0396	.0008	2.8
1892,	0.21	8.59	1.90	.2118	.0222	.0153	.0069	0.82	.0326	.0007	2.8
1893,	0.40	9.45	1.91	.1603	.0256	.0167	.0089	1.00	.0424	.0029	3.2
1894,	0.51	10.80	1.97	.1372	.0242	.0187	.0055	1.22	.0460	.0032	4.0
1895,	0.64	10.56	2.44	.1081	.0315	.0243	.0072	1.05	.0439	.0037	3.9
1896,	0.42	10.77	2.50	.1209	.0308	.0249	.0059	1.09	.0405	.0054	4.2
1897,	0.59	10.31	2.50	.1126	.0298	.0248	.0050	1.04	.0481	.0035	3.8
1898,	0.58	8.72	2.30	.0818	.0305	.0232	.0073	0.84	.0360	.0046	3.2
1899,	0.26	14.06	2.51	.2298	.0374	.0297	.0077	1.59	.0381	.0078	5.6

Blackstone River at Millville.

1888,	0.47	-	-	.0444	.0253	-	-	0.44	.0242	.0005	-
1889,	0.38	-	-	.0450	.0277	.0206	.0071	0.43	.0160	.0004	-
1890,	0.34	-	-	.0587	.0211	.0162	.0049	0.46	.0240	.0004	-
1891,	0.32	6.05	1.88	.0807	.0293	.0194	.0099	0.55	.0275	.0005	1.9
1892,	0.35	6.03	1.62	.0896	.0249	.0180	.0069	0.54	.0218	.0004	1.8
1893,	0.40	6.23	1.53	.0899	.0288	.0225	.0063	0.66	.0289	.0008	2.0
1894,	0.49	6.37	1.90	.0528	.0219	.0173	.0046	0.78	.0232	.0008	2.5
1895,	0.58	7.47	2.27	.0501	.0253	.0189	.0064	0.74	.0278	.0016	2.7
1896,	0.40	7.34	1.64	.0549	.0248	.0185	.0063	0.76	.0347	.0018	2.8
1897,	0.53	7.07	2.14	.0528	.0262	.0219	.0043	0.73	.0332	.0014	2.6
1898,	0.55	6.43	1.95	.0456	.0256	.0201	.0055	0.61	.0222	.0016	2.3
1899,	0.28	8.95	2.04	.0985	.0267	.0221	.0046	0.88	.0220	.0029	3.2

BLACKSTONE RIVER.

Averages of Chemical Analyses of Water from the Blackstone River for Six Months, from June to November, 1887 to 1899, inclusive.

Blackstone River between Mill Brook Channel and the Sewage Precipitation Works.

[Parts per 100,000.]

Months.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.	
June-Nov., 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	3.08	.2107	.1246	.0678	.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	6.8
" " 1894,	0.66	16.93	4.76	.0548	.0380	.0236	.0144	0.74	.0115	.0005	4.4
" " 1895,	0.49	14.17	4.50	.0618	.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	.0369	0.96	.0053	.0010	4.6
" " 1899,	0.14*	34.88	10.60	.2583	.0788	.0390	.0398	1.55†	.0050†	.0004	14.8

Blackstone River below Sewage Precipitation Works.

June-Nov., 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,	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	3.18	.0187	.0050	10.8
" " 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	.1118	.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,	0.80	26.03	6.53	.2831	.0898	.0600	.0298	2.10	.0217	.0118	9.7
" " 1897,	0.78	25.98	4.97	.3650	.1122	.0782	.0340	1.61	.0207	.0063	6.9
" " 1898,	0.23	25.63	6.78	.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

Blackstone River at Uxbridge.

June-Nov., 1887,	0.39	-	-	.1129	.0271	-	-	0.79	.0360	-	-
" " 1888,	0.38	6.42	1.52	.1155	.0288	.0222	.0066	0.68	.0310	.0007	-
" " 1889,	0.32	-	-	.1133	.0296	.0192	.0104	0.66	.0333	.0009	-
" " 1890,	0.26	8.86	2.12	.1629	.0231	.0174	.0057	0.79	.0259	.0005	2.9
" " 1891,	0.20	10.16	2.61	.2280	.0175	.0117	.0058	1.04	.0425	.0007	3.6
" " 1892,	0.13	9.36	1.88	.2840	.0227	.0162	.0065	0.99	.0313	.0007	3.1
" " 1893,	0.24	11.74	2.37	.1965	.0207	.0140	.0067	1.20	.0623	.0050	4.2
" " 1894,	0.35	13.07	2.03	.1456	.0243	.0183	.0060	1.57	.0673	.0050	4.9
" " 1895,‡	0.56	12.95	2.69	.0906	.0258	.0182	.0076	1.34	.0631	.0065	4.7
" " 1896,	0.33	12.68	2.67	.1129	.0257	.0221	.0036	1.38	.0477	.0091	5.0
" " 1897,	0.48	11.60	2.47	.1029	.0280	.0215	.0065	1.32	.0652	.0051	4.3
" " 1898,	0.49	10.59	2.78	.0801	.0264	.0219	.0045	1.00	.0470	.0076	3.8
" " 1899,	0.18	18.34	3.11	.2490	.0359	.0310	.0049	2.17	.0510	.0141	7.4

Blackstone River at Millville.

June-Nov., 1887,	0.31	-	-	.0468	.0220	-	-	0.51	.0210	-	-
" " 1888,	0.41	5.22	1.40	.0467	.0296	.0233	.0063	0.50	.0278	.0004	-
" " 1889,	0.38	-	-	.0499	.0273	.0213	.0060	0.45	.0167	.0003	-
" " 1890,	0.26	6.71	2.24	.0736	.0196	.0152	.0044	0.53	.0229	.0003	2.3
" " 1891,	0.24	7.48	2.35	.1105	.0384	.0234	.0150	0.72	.0308	.0006	2.2
" " 1892,	0.37	6.70	1.62	.1143	.0294	.0210	.0084	0.63	.0217	.0002	2.0
" " 1893,	0.23	7.43	1.73	.0677	.0119	.0087	.0031	0.77	.0385	.0011	2.6
" " 1894,	0.47	8.42	2.16	.0510	.0172	.0139	.0033	0.89	.0273	.0012	2.8
" " 1895,	0.51	8.67	2.55	.0356	.0233	.0180	.0053	0.90	.0383	.0024	3.2
" " 1896,	0.35	8.53	1.69	.0484	.0237	.0180	.0057	0.97	.0413	.0027	3.3
" " 1897,	0.45	7.66	1.98	.0509	.0258	.0210	.0048	0.92	.0445	.0019	3.1
" " 1898,	0.51	7.12	2.17	.0325	.0240	.0193	.0047	0.63	.0240	.0023	2.5
" " 1899,	0.20	12.50	2.44	.1310	.0301	.0247	.0054	1.31	.0310	.0049	4.6

* Average of five months. † Average of two months.
‡ Average of five months. No sample was obtained in June.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River, between Mill

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1899.									
1	25938	Jan. 18	Decided.	Heavy.	–	8.20	8.00	0.20	3.20	3.10	0.10
2	26244	Feb. 17	Decided.	Heavy.	.50	24.00	14.00	10.00	10.20	3.80	6.40
3	26499	Mar. 15	Decided.	Cons.	.67	6.90	5.80	1.10	2.70	1.90	0.80
4	26937	Apr. 25	Decided, iron.	Heavy, iron.	.20	12.10	9.00	3.10	3.50	1.50	2.00
5	27153	May 17	Slight, milky.	Heavy, iron.	.03	21.40	17.00	4.40	6.70	5.00	1.70
6	27553	June 21	Decided.	Heavy, iron.	.11	46.10	39.30	6.80	7.60	5.30	2.30
7	27915	July 27	Decided.	Heavy, iron.	.14	22.20	17.20	5.00	6.30	4.10	2.20
8	28250	Aug. 16	Decided, iron.	Heavy, iron.	.13	27.70	17.95	9.75	9.50	7.00	2.50
9	28700	Sept. 21	Decided, iron.	Heavy, iron.	.29	34.50	32.70	1.80	11.40	11.00	0.40
10	29082	Oct. 18	Decided, iron.	Cons., iron.	–	17.60	15.30	2.30	4.00	2.70	1.30
11	29419	Nov. 15	Decided.	Heavy.	.04	58.20	53.20	5.00	24.80	22.10	2.70
12	29783	Dec. 20	Decided, iron.	Heavy, iron.	.50	25.00	20.60	4.40	7.00	5.30	1.70
13	Av....	....	....	....	.26	25.33	20.84	4.49	8.08	6.07	2.01

Odor, distinctly musty and disagreeable, sometimes unpleasant.—The samples were collected 28700 and 29082 on Thursday, No. 26244 on Friday, and the other samples on Wednesday. The samples

Chemical Examination of Water from Blackstone River,

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.					
						Total Residue.			Loss on Ignition.		
			Turbidity.	Sediment.	Color.	Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.
		1899.									
1	25989	Jan. 18	Decided.	Heavy.	–	8.00	7.30	0.70	3.40	3.30	0.10
2	26245	Feb. 17	Decided.	Heavy.	.30	41.20	33.50	7.70	15.60	10.50	5.10
3	26500	Mar. 15	Decided.	Cons.	.65	8.80	7.30	1.50	3.00	1.80	1.20
4	26938	Apr. 25	Decided, iron.	Cons., iron.	.68	13.60	12.00	1.60	4.00	2.50	1.50
5	27154	May 17	Decided, iron.	Heavy, iron.	.08	21.80	18.80	3.00	4.80	4.00	0.80
6	27554	June 21	Decided.	Cons.	.10	30.00	28.00	2.00	12.50	11.00	1.50
7	27916	July 27	Decided.	Heavy, iron.	.21	51.50	47.10	4.40	8.50	7.10	1.40
8	28251	Aug. 16	Decided, iron.	Heavy, iron.	.09	49.10	46.75	2.35	7.10	6.60	0.50
9	28701	Sept. 21	Decided, iron.	Heavy, iron.	–	39.50	37.00	2.50	6.50	6.30	0.20
10	29083	Oct. 18	Decided, iron.	Heavy, iron.	.25	60.00	31.60	28.40	17.60	5.30	12.30
11	29420	Nov. 15	Decided.	Heavy, iron.	.06	34.00	26.50	7.50	5.80	4.40	1.40
12	29734	Dec. 20	Decided, iron.	Heavy, iron.	.55	32.20	29.20	3.00	6.00	5.10	0.90
13	Av...	....	....	....	.30	32.48	27.09	5.39	7.90	5.66	2.24

Odor, distinctly musty and disagreeable, sometimes unpleasant.—The samples were collected cipitation Works enters the river. No. 26938 was collected on Tuesday, Nos. 27916, 28701 and 29083 on between the hours of 9.45 A.M. and 2.30 P.M.

BLACKSTONE RIVER.

Brook Channel and the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.		Hardness.	Iron.		
	Albuminoid.											
Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Un-filtered.	Filtered.		Unfiltered.	Filtered.	
.0944	.0612	.0456	.0156	0.48	.0130	.0013	1.04	0.84	2.1	0.2000	0.1800	1
.2920	.1610	.0540	.1070	2.09	.0180	.0027	2.21	0.91	4.2	1.1600	0.5600	2
.0672	.0404	.0256	.0148	0.38	.0240	.0005	0.61	0.49	1.4	0.2700	0.1800	3
.0820	.0630	.0268	.0362	1.16	.0080	.0012	1.22	0.51	8.1	1.3600	0.5690	4
.1440	.0550	.0265	.0285	-	.0030	.0024	1.16	0.75	8.1	2.4000	1.7200	5
.9120	.1480	.0640	.0840	-	.0030	.0000	1.80	1.29	16.5	0.7200	0.0080	6
.1260	.0820	.0430	.0390	1.75	.0070	.0002	1.47	0.95	8.9	1.5200	1.1720	7
.1600	.0540	.0230	.0310	-	-	.0005	1.32	0.90	11.1	2.4000	0.0800	8
.1520	.0500	.0320	.0180	-	-	.0014	1.62	1.44	11.5	4.8800	4.3600	9
.1360	.0860	.0460	.0400	1.35	-	.0000	1.32	0.72	6.6	2.0000	0.9200	10
.0640	.0530	.0260	.0270	-	-	.0005	2.96	1.47	31.5	5.1200	3.6800	11
.0760	.0480	.0200	.0280	-	-	.0010	1.26	0.83	11.0	3.5000	1.6800	12
.1921	.0751	.0360	.0391	1.20	.0109	.0010	1.50	0.92	9.7	2.1275	1.2549	13

from the river, about 200 feet below the iron bridge. No. 26937 was collected on Tuesday, Nos. 27915, were collected between 9.30 A.M. and 2.15 P.M.

below the Worcester Sewage Precipitation Works.

[Parts per 100,000.]

Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.		Hardness.	Iron.		
	Albuminoid.											
Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Un-filtered.	Filtered		Unfiltered.	Filtered.	
.0976	.0580	.0356	.0224	0.54	.0200	.0010	0.92	0.76	2.2	0.2120	0.1700	1
.3000	.1790	.0650	.1140	-	-	.0025	3.20	1.86	19.5	4.2640	3.8400	2
.0736	.0360	.0284	.0076	0.43	.0240	.0008	0.52	0.46	2.3	0.2900	0.1650	3
.1500	.0810	.0520	.0290	1.23	.0340	.0030	1.09	0.63	3.8	0.5000	0.2150	4
.3500	.1065	.0665	.0400	1.91	.0280	.0120	0.76	0.55	8.0	0.5200	0.0100	5
.0984	.0476	.0324	.0152	3.76	-	.0003	1.70	1.44	10.5	3.2000	2.7600	6
.9400	.1840	.1490	.0350	4.86	.0200	.0150	2.03	2.01	21.5	0.2200	0.0170	7
.6160	.0940	.0790	.0150	2.31	.0030	.0000	0.80	0.68	23.0	1.0000	0.0080	8
.4080	.1170	.1000	.0170	3.07	.0070	.0240	1.44	1.19	15.0	1.4400	0.6860	9
.6800	.4540	.1100	.3440	3.35	.0020	.0000	4.80	1.04	13.6	3.5000	0.0300	10
.4080	.1280	.0770	.0510	2.23	.0220	.0016	1.54	1.03	13.0	1.7200	0.4200	11
.5680	.1190	.1040	.0150	2.42	.0160	.0036	1.70	1.36	12.1	1.5500	0.3600	12
.3908	.1337	.0749	.0588	2.37	.0176	.0053	1.71	1.08	12.0	1.5347	0.7234	13

from the river, above Millbury and below the point where the effluent from the Worcester Sewage Pre-
Thursday, No. 26245 on Friday, and the other samples on Wednesday. The samples were collected

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River, at Uxbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25990	Jan. 19	Decided.	Heavy.	.60	5.75	1.65	.0656	.0528	.0272	.0256	0.44	.0160	.0010	.45	2.1
26241	Feb. 16	Decided.	Cons.	.22	10.25	2.25	.1920	.0424	.0320	.0104	1.08	.0180	.0014	.38	4.0
26501	Mar. 16	Decided.	V. slight.	.41	4.20	1.80	.0266	.0220	.0182	.0038	0.30	.0160	.0005	.36	1.4
26957	Apr. 26	Decided.	Cons.	.38	6.55	1.60	.1020	.0292	.0236	.0056	0.58	.0140	.0017	.36	2.2
27143	May 18	Decided.	Cons.	.26	10.10	1.75	.1488	.0360	.0236	.0124	0.96	.0160	.0024	.32	3.9
27539	June 21	Decided.	Slight.	.23	13.75	2.60	.2049	.0287	.0268	.0019	1.47	.0130	.0200	.39	5.9
27841	July 19	Slight.	V. slight.	.20	17.15	2.70	.0812	.0340	.0328	.0012	1.94	.0860	.0280	.42	7.0
28260	Aug. 17	Slight.	Slight.	.11	18.90	3.80	.0880	.0256	.0216	.0040	2.14	.0900	.0200	.36	7.7
28704	Sept. 21	Decided.	Cons.	.14	20.25	3.70	.2200	.0400	.0350	.0050	2.43	.0640	.0120	.37	8.6
29071	Oct. 19	Decided.	Slight.	.12	21.00	3.00	.4120	.0400	.0310	.0090	2.55	.0310	.0036	.33	8.6
29421	Nov. 16	Decided.	Cons.	.26	19.00	2.85	.4880	.0470	.0390	.0080	2.49	.0170	.0012	.36	6.9
29750	Dec. 22	Decided.	Slight.	.15	21.85	2.90	.7280	.0510	.0460	.0050	2.71	.0110	.0020	.43	8.4
Av...	....	....	....	.26	14.06	2.51	.2298	.0374	.0297	.0077	1.59	.0331	.0078	.38	5.6

Odor, generally faintly musty, occasionally unpleasant or vegetable, becoming stronger on heating. — The samples were collected from the canal leading from the upper dam of the Calumet Woolen Company to the mill, just before the water passed the screens.

Chemical Examination of Water from Blackstone River at Millville, Blackstone.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
25992	Jan. 19	Decided.	Slight.	.47	5.75	2.40	.0412	.0276	.0224	.0052	0.44	.0300	.0007	.42	1.7
26240	Feb. 16	Decided.	Slight.	.26	7.30	1.85	.0076	.0236	.0192	.0044	0.71	.0190	.0011	.31	3.3
26513	Mar. 16	Slight.	Slight.	.32	3.30	0.85	.0164	.0180	.0154	.0026	0.25	.0070	.0002	.32	0.8
26951	Apr. 26	Slight.	Slight.	.40	4.75	1.40	.0466	.0184	.0160	.0024	0.45	.0060	.0011	.36	1.4
27142	May 18	Decided.	Slight.	.28	5.65	1.50	.0640	.0232	.0172	.0060	0.54	.0030	.0010	.37	2.1
27551	June 22	Slight.	Slight.	.15	12.30	2.55	.1320	.0330	.0295	.0035	1.07	.0170	.0100	.42	4.2
27806	July 18	Slight.	Slight.	.16	12.05	2.15	.0306	.0232	.0192	.0040	1.25	.0700	.0090	.36	4.4
28259	Aug. 17	Slight.	V. slight.	.20	13.95	2.90	.0476	.0264	.0228	.0036	1.50	.0540	.0048	.35	4.9
28703	Sept. 21	Decided.	Cons.	.21	10.00	2.06	.0760	.0380	.0240	.0140	1.16	.0160	.0020	.39	3.9
29073	Oct. 19	Decided.	Slight.	.19	14.25	2.40	.2080	.0330	.0290	.0040	1.61	.0170	.0024	.35	5.4
29428	Nov. 17	Decided.	Slight.	.30	12.45	2.60	.2920	.0270	.0240	.0030	1.26	.0120	.0012	.45	4.6
29744	Dec. 21	Decided.	Slight.	.32	11.00	2.30	.2400	.0348	.0336	.0012	1.03	.0060	.0005	.56	3.6
Av...	....	....	....	.27	9.48	2.07	.1066	.0272	.0227	.0045	0.94	.0216	.0025	.39	3.4

Odor, generally musty or vegetable, occasionally unpleasant or disagreeable, becoming stronger on heating. — The samples were collected from the river, just above the dam in the village of Millville.

CHARLES RIVER.

Chemical Examination of Water from Charles River, below Milford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
27460	June 15	Decided.	Cons.	.75	15.95	3.25	.4380	.0920	.0670	.0250	4.68	.0010	.0000	1.12	3.0
27745	July 12	Slight.	Cons.	.51	4.45	2.15	.0140	.0560	.0416	.0144	0.46	.0040	.0003	0.94	0.5
28080	Aug. 7	Decided.	Cons.	.40	17.05	3.65	.4320	.1760	.1000	.0760	4.17	.0000	.0000	1.34	4.2
28673	Sept. 19	V. dec'd.	Heavy.	-	21.35	4.85	.9720	.3040	.1760	.1280	6.15	.0010	.0000	1.90	3.5
29014	Oct. 12	Decided.	Cons.	.50	9.50	2.70	.0920	.1070	.0580	.0490	1.76	.0130	.0030	0.79	2.9
29378	Nov. 13	Decided.	Cons.	.36	6.85	2.10	.0945	.0720	.0390	.0330	0.76	.0130	.0018	0.64	1.8
Av...	....	....	....	.50	12.52	3.12	.3487	.1345	.0803	.0542	3.00	.0053	.0008	1.12	2.6

Odor in September, offensive; at other times, musty and unpleasant or disagreeable.

Chemical Examination of Water from Charles River at Needham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25945	Jan. 15	V. slight.	V. slight.	.48	4.10	1.75	.0004	.0146	.0138	.0008	.32	.0130	.0001	.62	1.1
26237	Feb. 16	V. slight.	V. slight.	.39	4.70	1.80	.0044	.0146	.0130	.0016	.40	.0320	.0002	.52	1.8
26460	Mar. 13	V. slight.	V. slight.	.30	2.95	1.15	.0004	.0132	.0116	.0016	.25	.0030	.0001	.42	0.5
26688	Apr. 7	V. slight.	V. slight.	.35	2.85	1.50	.0004	.0156	.0150	.0006	.28	.0040	.0000	.45	0.5
27102	May 15	Slight.	Slight.	.75	4.20	2.25	.0004	.0296	.0268	.0028	.29	.0090	.0001	.82	1.0
27467	June 19	V. slight.	V. slight.	.50	4.55	2.10	.0006	.0252	.0234	.0018	.35	.0040	.0001	.61	1.6
27786	July 17	V. slight.	V. slight.	.40	4.45	1.60	.0008	.0232	.0218	.0014	.39	.0020	.0000	.59	1.3
28194	Aug. 14	V. slight.	V. slight.	.44	4.75	2.10	.0000	.0240	.0226	.0014	.38	.0020	.0000	.63	1.6
28638	Sept. 18	V. slight.	Slight.	.32	5.00	1.75	.0004	.0260	.0244	.0016	.47	.0010	.0001	.48	1.6
29055	Oct. 18	V. slight.	V. slight.	.48	6.50	1.90	.0010	.0268	.0238	.0030	.51	.0050	.0000	.63	2.0
29367	Nov. 13	Slight.	V. slight.	.70	6.50	2.40	.0010	.0292	.0272	.0020	.50	.0050	.0001	.90	1.7
29692	Dec. 19	Decided.	Cons.	.44	5.90	1.60	.0002	.0210	.0192	.0018	.47	.0120	.0001	.55	2.0
Av...	....	....	....	.46	4.70	1.82	.0008	.0219	.0202	.0017	.38	.0077	.0001	.60	1.3

Odor, generally vegetable or none, sometimes unpleasant and mouldy. —— The samples were collected from the river, at Dedham Avenue bridge.

CHARLES RIVER.

Chemical Examination of Water from Charles River, opposite the Filter-gallery of the Brookline Water Works at West Roxbury.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25968	Jan. 17	V. slight.	V. slight.	.47	4.10	1.75	.0006	.0142	.0134	.0008	.33	.0110	.0000	.54	1.1
26279	Feb. 20	Slight.	Slight.	.24	3.70	1.50	.0046	.0234	.0220	.0014	.33	.0170	.0004	.39	0.8
26469	Mar. 13	V. slight.	V. slight.	.32	2.85	1.35	.0008	.0154	.0140	.0014	.25	.0060	.0001	.42	0.6
26706	Apr. 10	V. slight.	V. slight.	.37	3.50	1.75	.0006	.0204	.0192	.0012	.26	.0030	.0000	.54	0.5
27124	May 16	V. slight.	V. slight.	.70	8.75	2.60	.0020	.0298	.0278	.0020	.29	.0090	.0001	.83	1.8
27519	June 20	V. slight.	V. slight.	.42	4.10	1.55	.0006	.0262	.0226	.0036	.32	.0080	.0001	.56	1.1
27796	July 17	V. slight.	V. slight.	.40	4.45	1.55	.0006	.0228	.0220	.0008	.41	.0020	.0000	.57	1.8
28211	Aug. 14	V. slight.	V. slight.	.51	4.85	1.90	.0006	.0280	.0212	.0068	.41	.0040	.0000	.65	1.1
28647	Sept. 18	V. slight.	Slight.	.82	4.65	2.00	.0004	.0240	.0222	.0018	.48	.0000	.0000	.39	1.4
29034	Oct. 17	V. slight.	Slight.	.48	5.65	2.15	.0024	.0284	.0244	.0040	.58	.0010	.0002	.64	1.7
29370	Nov. 13	Slight.	V. slight.	.71	6.50	2.40	.0022	.0280	.0256	.0024	.54	.0050	.0001	.90	1.7
Av.	....	....	....	.44	4.83	1.86	.0014	.0237	.0213	.0024	.38	.0055	.0001	.58	1.2

Odor, generally faintly vegetable.

Chemical Examination of Water from Charles River, opposite the Well of the Waltham Water Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25994	Jan. 20	Slight.	Slight.	.43	5.05	1.95	.0016	.0196	.0160	.0036	.37	.0230	.0001	.53	1.6
26229	Feb. 15	Slight.	Slight.	.39	5.25	2.00	.0088	.0264	.0262	.0002	.42	.0120	.0001	.50	1.7
26491	Mar. 15	Slight.	V. slight.	.38	3.15	1.50	.0012	.0140	.0132	.0008	.23	.0090	.0000	.41	0.8
26908	Apr. 25	Decided.	Cons.	.47	4.00	1.60	.0006	.0210	.0194	.0016	.29	.0060	.0001	.66	1.7
27126	May 17	V. slight.	Slight.	.71	4.80	1.95	.0034	.0332	.0314	.0018	.35	.0100	.0000	.76	1.8
27516	June 21	Slight.	V. slight.	.52	5.05	1.60	.0042	.0272	.0244	.0028	.41	.0025	.0002	.53	1.6
27829	July 19	V. slight.	V. slight.	.44	4.90	1.25	.0036	.0256	.0252	.0004	.49	.0030	.0000	.48	2.0
28229	Aug. 16	V. slight.	V. slight.	.38	5.75	2.50	.0088	.0246	.0238	.0008	.47	.0030	.0002	.45	1.6
28681	Sept. 20	Slight.	Slight.	.20	4.95	1.45	.0042	.0218	.0212	.0006	.56	.0070	.0001	.36	2.0
29057	Oct. 18	Slight.	V. slight.	.40	5.85	1.90	.0060	.0308	.0268	.0040	.58	.0060	.0002	.56	2.0
29413	Nov. 15	Slight.	Slight.	.55	6.50	2.15	.0064	.0282	.0274	.0008	.56	.0090	.0003	.75	2.0
29714	Dec. 20	Slight.	V. slight.	.53	6.40	1.80	.0046	.0254	.0242	.0012	.54	.0140	.0002	.59	2.1
Av.	....	....	....	.45	5.14	1.80	.0036	.0248	.0233	.0015	.44	.0087	.0001	.55	1.7

Odor, generally faintly vegetable, sometimes earthy or none. On heating, the odor of most of the samples became stronger.

Chicopee River.

Chemical Examination of Water from the Quaboag River, above Palmer.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
27634	1899. July 4	Slight.	Cons., earthy.	.45	3.90	1.75	.0040	.0258	.0226	.0032	.18	.0100	.0001	.51	1.3
28240	Aug. 16	Slight.	Cons.	.30	4.90	2.00	.0016	.0324	.0248	.0076	.27	.0040	.0001	.62	0.8
28707	Sept. 22	Decided.	Slight.	.44	4.50	2.00	.0026	.0230	.0218	.0012	.20	.0020	.0001	.60	1.4
29015	Oct. 13	Slight.	V. slight.	.33	4.80	1.75	.0004	.0190	.0172	.0018	.28	.0010	.0001	.35	1.4
29471	Nov. 22	Slight.	Slight.	.36	4.10	1.25	.0004	.0170	.0160	.0010	.25	.0100	.0001	.39	1.1
Av...	....	....	....	.38	4.44	1.75	.0018	.0234	.0205	.0029	.24	.0054	.0001	.49	1.2

Odor, distinctly vegetable.

Chemical Examination of Water from the Quaboag River, below Palmer.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
27635	1899. July 4	Slight.	Slight.	.40	4.15	1.65	.0046	.0238	.0186	.0052	.21	.0060	.0001	.45	1.0
28241	Aug. 16	Slight.	Cons.	.30	4.95	1.85	.0024	.0280	.0216	.0064	.27	.0040	.0002	.41	0.8
28708	Sept. 22	Decided.	Slight.	.39	4.50	1.75	.0056	.0292	.0242	.0050	.24	.0040	.0002	.55	1.3
29016	Oct. 13	V. slight.	V. slight.	.26	4.60	1.65	.0072	.0212	.0184	.0028	.31	.0060	.0004	.38	1.3
29472	Nov. 22	Decided.	Cons.	.40	4.50	1.50	.0044	.0238	.0212	.0026	.26	.0100	.0002	.41	1.3
Av...	....	....	....	.35	4.54	1.68	.0048	.0252	.0208	.0044	.26	.0060	.0002	.44	1.1

Odor, vegetable, becoming sometimes unpleasant on heating.

CHICOPEE RIVER.

Chemical Examination of Water from Swift River at Barrett's Junction.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27627	June 29	V. slight.	Slight.	.45	3.75	1.70	.0002	.0216	.0184	.0032	.09	.0000	.0000	.59	0.8
27848	July 20	V. slight.	V. slight.	.46	4.15	1.40	.0018	.0200	.0164	.0036	.14	.0030	.0000	.63	1.3
28255	Aug. 16	Slight.	Cons.	.34	4.50	1.55	.0006	.0164	.0146	.0018	.16	.0010	.0000	.43	1.6
28712	Sept. 22	V. slight.	Cons.	.49	4.50	1.80	.0004	.0212	.0174	.0038	.18	.0010	.0001	.55	1.8
29072	Oct. 18	Decided.	Cons.	.52	5.00	1.80	.0004	.0316	.0232	.0084	.19	.0010	.0000	.66	1.7
29618	Dec. 11	Slight.	V. slight.	.37	4.10	1.50	.0006	.0156	.0146	.0010	.16	.0060	.0003	.48	1.0
Av.	....	....	....	.44	4.33	1.62	.0007	.0211	.0174	.0037	.15	.0020	.0001	.56	1.3

Odor, generally faintly vegetable; in October, faintly unpleasant. —— The samples were collected from the river, near site of old bridge, back of pulp mill.

Chemical Examination of Water from Chicopee River, below Ludlow.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27556	June 23	Slight.	Slight.	.50	4.40	1.40	.0044	.0276	.0260	.0016	.17	.0050	.0002	.60	0.8
27805	July 18	Slight.	Slight.	.43	4.10	1.75	.0026	.0240	.0186	.0054	.17	.0080	.0002	.59	1.0
28206	Aug. 14	V. slight.	Slight.	.37	4.85	1.90	.0044	.0240	.0224	.0016	.22	.0040	.0002	.41	1.3
28657	Sept. 19	Slight.	Slight.	.33	4.95	1.70	.0040	.0246	.0216	.0030	.29	.0180	.0002	.36	1.8
29038	Oct. 17	Slight.	Cons.	.32	4.90	1.50	.0064	.0288	.0218	.0070	.35	.0120	.0002	.42	1.4
29381	Nov. 14	Decided.	Slight.	.38	4.55	1.65	.0064	.0240	.0220	.0020	.26	.0100	.0001	.56	1.3
Av.	....	....	....	.39	4.62	1.65	.0047	.0255	.0221	.0034	.24	.0095	.0002	.49	1.2

Odor, generally faintly unpleasant, occasionally vegetable or musty.

Connecticut River.

Chemical Examination of Water from the Connecticut River, at Northfield Farms.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27557	June 23	Slight.	Slight.	.27	6.85	1.75	.0012	.0228	.0180	.0048	.07	.0020	.0002	0.68	3.1
27857	July 22	V. slight.	Slight.	.20	7.00	1.90	.0006	.0164	.0150	.0014	.08	.0030	.0001	0.79	3.5
28281	Aug. 19	V. slight.	Slight.	.20	7.40	1.85	.0024	.0144	.0124	.0020	.11	.0010	.0001	0.58	3.9
28692	Sept. 20	Slight.	Slight.	.19	7.20	1.60	.0028	.0184	.0142	.0042	.14	.0010	.0001	0.52	4.2
29036	Oct. 16	Slight.	V. slight.	.28	8.75	3.10	.0020	.0172	.0146	.0026	.16	.0010	.0001	1.31	4.2
29357	Nov. 11	Decided.	Cons.	.64	6.75	2.85	.0006	.0242	.0208	.0034	.13	.0060	.0001	1.21	2.9
Av...	....	....	....	.30	7.32	2.17	.0016	.0189	.0158	.0031	.11	.0023	.0001	0.85	3.6

Odor in July, none; at other times, vegetable.

Chemical Examination of Water from the Connecticut River at Northampton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27744	July 12	V. slight.	V. slight.	.30	5.75	1.80	.0018	.0232	.0214	.0018	.09	.0030	.0001	.70	2.6

Odor, faintly vegetable, becoming distinctly vegetable on heating. —— The sample was collected from the river near the Hadley bridge.

Chemical Examination of Water from the Connecticut River, below Springfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27456	June 15	Slight.	Cons.	.22	5.35	1.00	.0066	.0250	.0192	.0058	.23	.0040	.0003	.49	3.3
27682	July 6	V. slight.	Slight.	.36	6.05	1.60	.0122	.0196	.0178	.0018	.16	.0040	.0003	.59	2.7
28075	Aug. 7	V. slight.	Slight.	.43	6.30	1.85	.0122	.0224	.0186	.0038	.20	.0040	.0001	.72	2.9
28551	Sept. 11	V. slight.	Cons.	.38	7.35	2.65	.0096	.0286	.0236	.0050	.29	.0060	.0004	.73	2.6
28965	Oct. 10	Slight.	Cons.	.28	7.75	2.75	.0110	.0222	.0188	.0034	.28	.0010	.0002	.77	4.0
29278	Nov. 7	Slight.	Cons.	.29	6.85	2.10	.0042	.0252	.0192	.0060	.20	.0060	.0003	.73	3.3
Av...	....	....	....	.33	6.61	1.99	.0093	.0238	.0195	.0043	.23	.0042	.0003	.67	3.1

Odor, faintly vegetable or unpleasant; in August, musty and disagreeable. —— The samples were collected from the river at the South End bridge. The samples were made up of portions taken at each pier of the bridge.

FRENCH RIVER.

French River.

Chemical Examination of Water from French River, below Webster.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
								Albuminoid.							
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27397	June 10	Decided.	Cons., floc.	.40	6.25	2.75	.0228	.0700	.0374	.0326	.37	.0020	.0018	.68	1.3
27708	July 10	Slight.	Cons.	.42	4.45	1.50	.0112	.0444	.0264	.0180	.25	.0060	.0002	.61	1.1
28056	Aug. 5	Slight.	Cons.	.43	5.85	1.95	.0208	.0500	.0312	.0188	.38	.0010	.0004	.66	2.0
28561	Sept. 11	Slight.	Cons.	.60	5.60	2.05	.0312	.0464	.0340	.0124	.43	.0020	.0004	.58	1.7
28906	Oct. 6	Decided.	Cons.	.37	6.20	2.10	.0332	.0952	.0632	.0320	.68	.0020	.0006	.75	2.0
Av.	....	....	....	.44	5.67	2.07	.0228	.0612	.0384	.0228	.42	.0024	.0007	.66	1.6

Odor, distinctly vegetable or musty and unpleasant. —— The samples were collected from the river below the village of Webster, near the boundary line between the states of Massachusetts and Connecticut.

Hoosac River.

Chemical Examination of Water from the South Branch of the Hoosac River, near its Confluence with the North Branch at North Adams.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
								Albuminoid.							
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27550	June 22	Slight.	Slight.	.15	11.85	2.25	.0124	.0308	.0198	.0110	.19	.0160	.0010	.33	8.6
27838	July 19	V. slight.	Cons., floc.	.14	11.75	2.20	.0096	.0328	.0212	.0116	.34	.0130	.0012	.31	8.7
28238	Aug. 16	Slight.	Cons.	.20	14.15	3.90	.0120	.0372	.0184	.0188	.39	.0160	.0012	.35	8.1
28688	Sept. 20	Slight.	Cons.	.18	13.80	2.55	.0076	.0380	.0260	.0120	.38	.0220	.0018	.27	10.0
29066	Oct. 18	Slight.	Cons.	.24	13.90	2.65	.0016	.0320	.0204	.0116	.39	.0210	.0010	.28	11.0
29411	Nov. 15	Decided.	Slight.	.15	12.25	2.35	.0040	.0286	.0214	.0072	.28	.0210	.0008	.31	9.3
Av.	....	....	....	.18	12.95	2.65	.0078	.0332	.0212	.0120	.33	.0182	.0012	.31	9.3

Odor, faintly musty or unpleasant, becoming stronger on heating —— The samples were collected from the river, about a quarter of a mile above its confluence with the North Branch.

HOOSAC RIVER.

Chemical Examination of Water from the North Branch of the Hoosac River, near its Confluence with the South Branch at North Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27549	June 22	Decided.	Heavy, earthy.	-	6.50	1.75	.0015	.0510	.0184	.0326	0.18	.0050	.0011	0.63	2.9
27837	July 19	Decided.	Heavy.	-	15.15	2.90	.0450	.0570	.0205	.0365	1.10	.0020	.0040	1.08	5.6
28237	Aug. 16	Great.	Heavy.	-	16.90	4.35	.0014	.0630	.0180	.0450	0.66	.0000	.0024	1.27	5.6
28687	Sept. 20	V. dec'd.	Heavy.	-	30.25	7.00	.0050	.0930	.0460	.0470	2.52	.0240	.0000	2.88	9.4
29065	Oct. 18	Great.	Heavy.	-	20.75	4.40	.0024	.0620	.0400	.0220	1.52	.0060	.0100	1.71	7.4
29410	Nov. 15	Decided.	Heavy.	-	14.70	4.35	.0088	.0500	.0320	.0180	0.62	.0180	.0052	1.32	3.9
Av...	....	....	....	-	17.37	4.12	.0107	.0627	.0292	.0335	1.10	.0092	.0038	1.48	5.8

Odor, distinctly musty and unpleasant or disagreeable. —— The samples were collected from the river, about a quarter of a mile above its confluence with the South Branch.

Chemical Examination of Water from the Hoosac River at North Adams.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27548	June 22	Decided.	Heavy, earthy.	-	7.85	2.40	0.0785	.1400	.0490	.0910	0.92	.0060	.0026	0.75	3.0
27839	July 19	Decided.	Heavy.	-	19.10	5.25	1.2320	.3080	.1780	.1300	1.78	.0020	.0000	0.76	7.0
28239	Aug. 16	Decided.	Heavy.	-	22.65	5.95	1.2000	.4580	.1900	.2680	2.23	.0020	.0000	1.62	8.1
28689	Sept. 20	V. dec'd.	Heavy.	-	24.85	5.55	0.4320	.3960	.1480	.2480	2.21	.0020	.0000	1.58	10.3
29067	Oct. 18	Decided.	Heavy.	-	29.30	9.00	0.8000	.3580	.1300	.2280	3.20	.0030	.0000	1.06	10.3
29412	Nov. 15	Decided.	Heavy.	-	18.50	5.55	1.4840	.6000	.1990	.4010	1.94	.0020	.0004	1.99	7.4
Av...	....	....	....	-	20.37	5.62	0.8711	.3767	.1490	.2277	2.05	.0028	.0005	1.29	7.7

Odor, generally distinctly musty and unpleasant or disagreeable, becoming offensive in most of the samples on heating. —— The samples were collected from the river, near the barn of the North Adams Manufacturing Company in Braytonville, about three-quarters of a mile below the confluence of the North and South branches and below the point of discharge of the principal sewer in North Adams.

HOOSAC RIVER.

Chemical Examination of Water from Hoosac River at Williamstown.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25067	Jan. 17	Decided.	Heavy, earthy.	.40	10.30	3.00	.0268	.0532	.0252	.0280	.71	.0220	.0004	.54	5.7
26211	Feb. 14	Decided.	Cons.	.21	14.00	4.20	.0582	.0846	.0528	.0318	.50	.0310	.0012	.40	8.6
26477	Mar. 14	Decided.	Slight.	.13	6.00	1.85	.0078	.0142	.0094	.0048	.15	.0150	.0002	.30	3.3
26922	Apr. 25	Decided.	Cons., clayey.	.14	4.70	1.15	.0002	.0100	.0072	.0028	.07	.0100	.0002	.24	2.9
27115	May 16	Decided.	Cons.	.35	11.45	2.90	.0042	.0434	.0300	.0134	.36	.0200	.0012	.64	6.4
27490	June 20	Slight.	Cons.	.25	14.75	3.00	.0128	.0576	.0352	.0224	.60	.0100	.0042	.52	7.6
27825	July 18	Slight.	Cons., floc.	.22	12.00	2.35	.0260	.0420	.0282	.0138	.34	.0080	.0014	.63	7.0
28214	Aug. 15	Decided.	Cons.	.24	16.05	4.85	.0224	.0540	.0352	.0188	.75	.0050	.0068	.50	8.1
28690	Sept. 20	Decided.	Cons.	.28	18.30	2.90	.0470	.0860	.0490	.0370	.84	.0010	.0004	.58	8.9
29064	Oct. 18	Decided.	Cons.	.42	17.85	3.60	.0148	.0828	.0484	.0344	.81	.0020	.0024	.68	11.0
29387	Nov. 14	Decided.	Cons.	.40	12.30	3.65	.0280	.0510	.0315	.0195	.48	.0160	.0020	.79	7.3
29707	Dec. 19	Decided.	Heavy.	–	10.75	2.40	.0190	.0270	.0170	.0100	.36	.0290	.0011	.53	6.4

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue Total.	Loss on Ignition.	Free.	Alb. Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
–	1888	–	–	.10	10.21	1.65	.0040	.0187	.0143	.0044	.24	.0206	.0010	–	–
–	1894	–	–	.23	10.77	2.13	.0111	.0265	.0169	.0096	.35	.0157	.0009	.34	7.3
–	1895	–	–	.28	12.41	2.95	.0146	.0334	.0207	.0127	.39	.0162	.0013	.46	8.1
–	1896	–	–	.21	11.83	2.91	.0261	.0326	.0217	.0109	.44	.0323	.0015	.44	8.1
–	1897	–	–	.23	9.92	2.16	.0125	.0273	.0169	.0104	.27	.0252	.0008	.31	6.4
–	1898	–	–	.24	9.13	2.20	.0152	.0286	.0180	.0106	.26	.0187	.0005	.32	5.8
–	1899	–	–	.28	12.37	2.95	.0223	.0505	.0308	.0197	.50	.0141	.0018	.53	6.9

NOTE to analyses of 1899: Odor, generally unpleasant, and sometimes vegetable or musty and disagreeable. —— The samples were collected from the river, at the bridge near the Williamstown station on the Fitchburg railroad.

HOUSATONIC RIVER.

Chemical Examination of Water from the East Branch of the Housatonic River, at Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27571	June 23	Slight.	Cons.	.30	11.65	1.75	.0156	.0312	.0208	.0104	.20	.0170	.0006	.33	8.0
28143	Aug. 10	V. slight	Cons.	.38	9.70	2.55	.0090	.0316	.0268	.0048	.20	.0020	.0003	.60	5.0
28700	Sept. 22	Decided.	Slight.	.42	10.00	2.80	.0056	.0356	.0292	.0064	.19	.0120	.0003	.81	6.0
29122	Oct. 24	Decided.	Cons.	.30	10.35	2.45	.0056	.0336	.0296	.0040	.23	.0150	.0001	.60	6.7
29479	Nov. 23	Decided.	Cons.	.28	10.15	2.45	.0056	.0330	.0292	.0038	.24	.0150	.0002	.67	7.0
Av.	....	....	....	.32	10.37	2.40	.0081	.0328	.0269	.0059	.21	.0122	.0003	.60	6.5

Odor, distinctly vegetable or unpleasant. —— The samples were collected from the river, at Hathaway bridge, above the thickly settled portion of the city.

HOUSATONIC RIVER.

Chemical Examination of Water from the West Branch of the Housatonic River, at Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27572	June 23	Decided.	Cons.	.09	9.25	1.50	.0040	.0368	.0244	.0124	.17	.0010	.0003	.23	6.0
28144	Aug. 10	Decided.	Cons.	.10	8.65	2.40	.0000	.0356	.0216	.0140	.27	.0010	.0001	.43	4.9
28711	Sept. 22	Decided.	Cons., floc.	.14	10.00	2.25	.0012	.0324	.0206	.0118	.38	.0030	.0002	.35	6.7
29121	Oct. 24	Decided.	Cons.	.30	13.25	3.10	.0100	.0580	.0470	.0110	.37	.0040	.0002	.58	7.4
29478	Nov. 23	Decided.	Cons.	-	11.95	2.50	.0116	.0340	.0284	.0056	.24	.0030	.0002	.48	8.3
Av...	....	....	....	.16	10.62	2.35	.0054	.0394	.0284	.0110	.29	.0024	.0002	.41	6.7

Odor of the first sample, faintly vegetable; of the others, distinctly unpleasant. —— The samples were collected from the river, a short distance below the junction of the brooks from Onota and Pontoosuc lakes.

Chemical Examination of Water from the South-west Branch of the Housatonic River, at Pittsfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27573	June 23	Decided.	Cons.	.15	14.25	2.50	.0020	.0480	.0316	.0164	.11	.0030	.0007	.40	8.6
28145	Aug. 10	Decided.	Cons.	.23	14.40	2.35	.0000	.0368	.0224	.0144	.17	.0040	.0005	.52	6.6
28710	Sept. 22	Decided.	Slight.	.16	16.75	3.00	.0072	.0260	.0198	.0062	.20	.0150	.0004	.32	10.5
29123	Oct. 24	Decided.	Slight.	.20	15.00	2.40	.0065	.0535	.0210	.0325	.17	.0120	.0001	.40	9.6
29511	Nov. 28	Decided.	Slight.	.12	14.20	2.65	.0042	.0124	.0106	.0018	.14	.0200	.0002	.22	10.8
Av...	....	....	....	.17	14.92	2.58	.0040	.0353	.0211	.0142	.16	.0108	.0004	.37	9.2

Odor, faintly unpleasant. —— The samples were collected from the river, at the first (Barkerville) road crossing above its confluence with the North Branch.

HOUSATONIC RIVER.

Chemical Examination of Water from the Housatonic River, at New Lenox.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25970	Jan. 17	Slight.	Slight.	.11	9.85	2.10	.0074	.0166	.0120	.0046	.17	.0170	.0006	.24	7.7
26234	Feb. 15	Slight.	Slight.	.12	10.25	2.10	.0084	.0154	.0104	.0050	.18	.0230	.0008	.28	8.7
26481	Mar. 14	Slight.	Slight.	.18	5.85	1.60	.0048	.0196	.0110	.0086	.06	.0100	.0002	.30	3.6
26906	Apr. 24	V. slight.	Cons., earthy.	.18	5.25	1.25	.0020	.0106	.0074	.0032	.06	.0080	.0001	.28	3.1
27116	May 16	Slight.	Slight.	.15	9.60	2.25	.0060	.0250	.0188	.0062	.14	.0080	.0010	.30	7.3
27506	June 20	Slight.	Cons.	.12	12.50	2.45	.0460	.0300	.0224	.0076	.25	.0100	.0024	.30	8.8
27823	July 18	Slight.	Cons., earthy.	.18	13.15	2.20	.0416	.0224	.0188	.0036	.36	.0130	.0045	.37	8.9
28219	Aug. 15	Decided.	Cons.	.20	12.90	3.35	.0312	.0264	.0220	.0044	.35	.0110	.0030	.39	6.7
28703	Sept. 21	Decided.	Cons.	.27	12.25	3.90	.0272	.0332	.0286	.0046	.38	.0090	.0040	.49	7.1
29108	Oct. 23	Slight.	Slight.	.31	12.60	2.10	.0202	.0236	.0200	.0036	.29	.0150	.0018	.39	9.3
29390	Nov. 14	Decided.	Cons.	.35	11.80	3.30	.0204	.0312	.0236	.0076	.28	.0120	.0010	.48	8.4
29699	Dec. 19	Decided.	Cons.	.23	13.15	2.55	.0214	.0252	.0196	.0056	.30	.0220	.0011	.37	9.6

Averages by Years.

-	1894	-	-	.27	11.37	2.13	.0131	.0183	.0144	.0039	.25	.0204	.0024	.35	8.5
-	1895	-	-	.26	11.73	2.50	.0183	.0238	.0183	.0055	.25	.0173	.0038	.43	8.4
-	1896	-	-	.26	11.18	1.97	.0169	.0192	.0152	.0040	.22	.0208	.0036	.36	8.6
-	1897	-	-	.32	10.79	2.47	.0159	.0240	.0170	.0070	.19	.0203	.0008	.40	7.5
-	1898	-	-	.27	9.40	2.17	.0106	.0223	.0141	.0082	.15	.0178	.0008	.37	6.4
-	1899	-	-	.20	10.76	2.43	.0197	.0233	.0179	.0054	.23	.0132	.0017	.35	7.4

NOTE to analyses of 1899: Odor, frequently faintly unpleasant or musty; sometimes vegetable or none.

Chemical Examination of Water from the Housatonic River, at Stockbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27464	June 16	V. slight.	Slight.	.12	11.75	2.20	.0184	.0234	.0182	.0052	.22	.0050	.0016	.31	8.6
27824	July 17	V. slight.	Slight.	.20	11.75	2.00	.0184	.0196	.0128	.0068	.20	.0100	.0009	.43	8.9
28405	Aug. 29	V. slight.	Slight.	.12	12.55	2.85	.0046	.0206	.0158	.0048	.29	.0110	.0000	.33	7.4
29019	Oct. 11	Slight.	Cons., iron.	.21	13.85	2.80	.0072	.0296	.0212	.0084	.36	.0120	.0015	.36	7.3
29565	Nov. 30	Decided.	Cons.	.28	13.15	2.65	.0160	.0300	.0220	.0080	.37	.0130	.0012	.35	9.3
Av...	....	....	....	.19	12.61	2.50	.0119	.0246	.0180	.0066	.29	.0102	.0010	.36	8.3

Odor, faintly vegetable and musty or unpleasant.

HOUSATONIC RIVER.

Chemical Examination of Water from the Housatonic River, at Sheffield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27628	June 29	V. slight.	Cons.	.16	12.25	2.70	.0080	.0208	.0166	.0042	.25	.0180	.0000	.32	9.4
27860	July 21	V. slight.	Slight.	.13	12.40	1.90	.0076	.0194	.0164	.0030	.26	.0100	.0005	.33	9.0
28560	Sept. 9	V. slight.	Slight.	.19	11.55	3.60	.0050	.0186	.0172	.0014	.28	.0160	.0007	.35	6.0
28702	Sept. 21	V. slight.	Slight.	.13	13.40	3.50	.0080	.0252	.0182	.0070	.36	.0100	.0004	.32	7.4
29043	Oct. 17	V. slight.	V. slight.	.13	14.20	3.15	.0060	.0252	.0226	.0026	.48	.0140	.0004	.36	10.0
29418	Nov. 15	Decided.	Slight.	.22	13.50	2.75	.0188	.0370	.0360	.0010	.33	.0130	.0004	.43	8.3
Av.*.	....	....	....	.16	12.96	2.81	.0094	.0249	.0219	.0030	.33	.0136	.0004	.35	8.7

Odor of the first four samples, vegetable; of the fifth, faintly musty, becoming stronger on heating; of the last, distinctly disagreeable.——The samples were collected from the river, near lower covered bridge.

* Where more than one sample was collected in a month, the mean analysis for that month was used in making the average.

Merrimack River.

The usual monthly examinations of the water of this river above Lowell and above Lawrence have been continued during the year 1899, the detailed results of which may be found on pages 231 and 218 of this volume. A comparison of the analyses made at these two places during the year is given in the following table: —

Table comparing the Analyses above Lowell with those above Lawrence, 1899.

[Parts per 100,000.]

	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.	
Number of determinations compared, ...	12	12	12	12	12	12	12	12	12	12	12
Mean of analyses above Lowell,	.27	3.60	1.42	.0050	.0187	.0152	.0035	.183	.0060	.0002	0.9
Mean of analyses above Lawrence, ...	.29	3.99	1.49	.0088	.0232	.0175	.0057	.242	.0056	.0003	1.0
Increase, ...	.02	0.39	0.07	.0038	.0045	.0023	.0022	.059	.0004*	.0001	0.1

* Decrease.

MERRIMACK RIVER.

In order to compare these results with similar ones obtained in previous years, another table is presented, which shows the increase in impurities as the water passes from a point above Lowell to Lawrence, as given in the last line of the above table, and the corresponding increase in previous years: —

Increase in the Amount of Impurities in the Merrimack River Water, from a Point above Lowell to Lawrence, as determined by the Regular Monthly Examinations of Different Years.

[Parts per 100,000.]

Date.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.	
					Total.	Dissolved.	Suspended.				
Increase, 1887-1889,	0.01	0.23	0.09	.0007	.0027	.0017	.0010	.026	.0003*	.0000	-
Increase, 1890,	0.05	0.62	0.22*	.0016	.0023	.0017	.0006	.023	.0020*	.0000	0.2
Increase, 1891,	0.02*	0.29	0.07	.0021	.0023	.0021	.0002	.035	.0030*	.0000	0.1
Increase, 1892,	0.06	0.48	0.12	.0019	.0037	.0037	.0000	.089	.0013*	.0000	0.0
Increase, 1893,	0.09	0.47	0.30	.0031	.0032	.0021	.0011	.035	.0002*	.0001	0.0
Increase, 1894,	0.02	0.15	0.04	.0028	.0032	.0032	.0000	.049	.0000	.0000	0.1
Increase, 1895,	0.11	0.52	0.33	.0022	.0063	.0046	.0017	.063	.0005	.0001	0.1
Increase, 1896,	0.02	0.51	0.24	.0034	.0053	.0047	.0006	.070	.0017	.0002	0.2
Increase, 1897,	0.06	0.30	0.08	.0019	.0051	.0033	.0018	.050	.0000	.0000	0.1
Increase, 1898,	0.03	0.37	0.07	.0024	.0039	.0019	.0020	.044	.0010	.0002	0.1
Increase, 1899,	0.02	0.39	0.07	.0038	.0045	.0023	.0022	.059	.0004*	.0001	0.1

The average flow of the river at Lawrence, for twenty-four hours, during the days on which samples were collected, was for the above periods, respectively, at the rate of 9,145, 9,948, 7,931, 5,434, 8,126, 5,459, 11,634, 5,886, 8,230, 9,402 and 7,406 cubic feet per second.

* Decrease.

Chemical Examination of Water from the Merrimack River, above Haverhill.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Suspended.					
	1899.														
27494	June 20	Slight.	Cons.	.25	4.65	1.50	.0020	.0312	.0188	.0124	.30	.0050	.0005	.62	1.6
27812	July 18	Slight.	Cons.	.23	4.80	1.55	.0204	.0332	.0238	.0094	.35	.0050	.0007	.48	1.6
28210	Aug. 14	Decided.	Cons.	.27	5.50	1.70	.0128	.0380	.0240	.0140	.32	.0030	.0004	.49	1.4
28659	Sept. 19	Decided.	Slight.	.21	7.05	2.20	.0140	.0392	.0260	.0132	.45	.0100	.0008	.47	1.7
29080	Oct. 19	Decided.	Cons.	.29	5.75	2.10	.0156	.0408	.0312	.0096	.49	.0050	.0008	.56	1.7
29389	Nov. 14	Slight.	Cons.	.49	5.60	2.20	.0240	.0384	.0324	.0060	.39	.0080	.0005	.86	1.6
Av.	....	....	....	.29	5.56	1.87	.0148	.0368	.0260	.0108	.38	.0060	.0006	.58	1.6

Odor, faintly vegetable or unpleasant, sometimes also musty. —— The samples were collected from the river, about a mile and a quarter above the Boston & Maine railroad bridge. The samples were made up of several equal portions collected at different points across the river.

MERRIMACK RIVER.

Chemical Examination of Water from the Merrimack River, below Haverhill.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27493	June 20	Slight.	Cons.	.21	4.25	1.55	.0056	.0300	.0180	.0120	.25	.0040	.0004	.45	1.6
27811	July 18	Slight.	Cons.	.21	4.70	1.50	.0120	.0296	.0202	.0094	.31	.0040	.0005	.53	1.1
28209	Aug. 14	Decided.	Cons.	.27	6.45	2.30	.0328	.0404	.0276	.0128	.38	.0040	.0006	.63	2.2
28660	Sept. 19	Decided.	Cons.	.33	7.40	2.50	.0256	.0436	.0296	.0140	.46	.0060	.0008	.52	1.7
29079	Oct. 19	Decided.	Cons.	.30	6.05	2.00	.0420	.0448	.0320	.0128	.55	.0070	.0010	.56	1.7
29388	Nov. 14	Slight.	Cons.	.47	5.30	2.05	.0180	.0400	.0304	.0096	.36	.0110	.0005	.82	1.3
Av...	....	....	....	.30	5.69	1.98	.0227	.0381	.0263	.0118	.38	.0060	.0006	.58	1.6

Odor, faintly vegetable or unpleasant, sometimes also musty.—— The samples were collected from the river, at the bridge between Haverhill and Groveland. The samples were made up of four equal portions, collected at different points across the river.

MILLER'S RIVER.

Chemical Examination of Water from the Miller's River, above Athol.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27491	June 20	Slight.	Slight.	0.97	4.00	2.00	.0020	.0252	.0208	.0044	.20	.0010	.0001	1.10	0.5
27840	July 19	V. slight.	V. slight.	0.98	3.90	2.20	.0036	.0274	.0250	.0024	.19	.0030	.0001	1.15	0.5
28204	Aug. 14	V. slight.	Cons.	0.95	3.80	2.35	.0010	.0284	.0272	.0012	.18	.0020	.0000	1.12	0.5
28656	Sept. 19	Slight.	Slight.	0.75	4.55	2.25	.0040	.0388	.0322	.0066	.29	.0000	.0000	0.89	1.0
29063	Oct. 17	Decided.	Cons.	1.60	6.85	1.90	.0164	.0292	.0224	.0068	.39	.0000	.0001	0.64	2.3
29416	Nov. 14	Slight.	Slight.	0.76	4.50	2.10	.0036	.0284	.0260	.0024	.22	.0020	.0001	1.04	1.0
Av...	....	....	....	1.00	4.60	2.13	.0051	.0296	.0256	.0040	.24	.0013	.0001	0.99	1.0

Odor, generally faintly vegetable; in October, faintly musty.—— The samples were collected from the river, at Starrett's mill pond.

Chemical Examination of Water from the Miller's River, below Orange.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27568	June 23	Decided.	Cons.	.75	3.50	2.00	.0104	.0356	.0244	.0112	.16	.0060	.0002	.95	0.5
28386	Aug. 24	V. slight.	Slight.	.68	4.25	2.30	.0096	.0294	.0272	.0022	.15	.0020	.0001	.82	0.5

Odor, distinctly vegetable or unpleasant.

NASHUA RIVER.

NASHUA RIVER.

Chemical Examination of Water from the North Branch of the Nashua River, above Fitchburg.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Sus-pended.					
	1899.														
27522	June 21	Slight.	Slight.	.75	3.55	1.90	.0015	.0250	.0205	.0045	.12	.0030	.0000	1.01	0.5
27855	July 21	V. slight.	Slight.	.60	3.35	1.60	.0008	.0196	.0166	.0030	.15	.0010	.0001	0.70	0.5
28235	Aug. 15	V. slight.	V. slight.	.58	3.60	1.75	.0016	.0170	.0152	.0018	.16	.0010	.0000	0.66	0.6
28668	Sept. 19	V. slight.	V. slight.	.57	2.90	1.50	.0006	.0216	.0208	.0008	.16	.0060	.0001	0.57	0.5
29051	Oct. 17	V. slight.	None.	.50	3.45	1.55	.0006	.0200	.0188	.0012	.18	.0030	.0000	0.60	0.5
29424	Nov. 16	V. slight.	V. slight.	.46	5.35	2.55	.0010	.0158	.0152	.0006	.22	.0040	.0000	0.68	1.0
Av...	....	....	....	.58	3.70	1.81	.0010	.0198	.0178	.0020	.16	.0030	.0000	0.70	0.6

Odor, faintly vegetable or unpleasant, becoming stronger on heating. —— The samples were collected from the river, a short distance above the Snow mill pond.

Chemical Examination of Water from the North Branch of the Nashua River, below Fitchburg.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
								Total.	Dissolved.	Sus-pended.					
	1899.														
25985	Jan. 17	Decided.	Cons.	.25	3.60	1.35	.0054	.0332	.0170	.0162	0.26	.0120	.0004	.43	0.8
26296	Feb. 21	Decided.	Cons.	.25	4.75	1.75	.0168	.0340	.0162	.0178	0.42	.0110	.0004	.46	1.3
26478	Mar. 14	Decided.	Cons.	.23	3.05	1.55	.0138	.0182	.0142	.0040	0.18	.0050	.0001	.42	0.6
26715	Apr. 11	Decided.	Cons.	.29	3.25	1.50	.0080	.0226	.0174	.0052	0.17	.0080	.0002	.47	0.6
27114	May 16	Decided.	Cons.	.49	6.80	2.30	.0448	.0628	.0452	.0176	0.56	.0050	.0008	.73	1.8
27523	June 21	Decided.	Heavy.	.90	8.60	3.10	.0820	.0830	.0425	.0405	0.80	.0080	.0020	.76	2.3
27856	July 21	Decided.	Cons.	.56	9.45	2.45	.1272	.0640	.0448	.0192	0.90	.0040	.0013	.84	2.1
28236	Aug. 15	Decided.	Cons.	.44	7.95	3.00	.1920	.0970	.0635	.0335	0.68	.0020	.0006	.78	1.7
28669	Sept. 19	Decided.	Cons.	.45	11.60	2.80	.1640	.0790	.0610	.0180	1.25	.0060	.0024	.74	2.5
29052	Oct. 17	Decided.	Cons.	.45	12.60	2.95	.2520	.0820	.0620	.0200	1.56	.0050	.0009	.86	3.0
29425	Nov. 16	Decided.	Heavy.	.40	10.55	3.40	.0870	.1040	.0485	.0555	1.00	.0080	.0008	.98	2.7
29725	Dec. 19	Decided.	Heavy.	.50	9.20	2.65	.1680	.1090	.0620	.0470	0.84	.0090	.0010	.71	2.6

Averages by Years.

-	1893	-	-	.57	7.46	2.16	.0461	.0360	.0257	.0103	0.69	.0118	.0018	.69	2.0
-	1894	-	-	.56	7.39	2.00	.0634	.0346	.0251	.0095	0.75	.0152	.0020	.58	1.9
-	1895	-	-	.59	8.10	2.58	.0832	.0423	.0319	.0104	0.75	.0134	.0010	.74	2.2
-	1896	-	-	.48	8.15	2.40	.0677	.0499	.0343	.0156	0.74	.0151	.0017	.69	2.0
-	1897	-	-	.61	6.82	2.37	.0370	.0420	.0317	.0103	0.61	.0120	.0007	.68	1.8
-	1898	-	-	.51	6.00	2.09	.0435	.0467	.0308	.0159	0.48	.0117	.0009	.64	1.6
-	1899	-	-	.43	7.62	2.40	.0967	.0657	.0412	.0245	0.72	.0069	.0009	.68	1.8

NOTE to analyses of 1899: Odor, generally distinctly unpleasant or disagreeable, occasionally distinctly musty. —— The samples were collected from the river, about half a mile below the point where water from the tail-race of the Falulah Paper Company enters the stream.

NASHUA RIVER.

Chemical Examination of Water from Monoosnock Brook in Leominster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
28228	Aug. 16	Decided.	Cons.	0.72	5.05	2.60	.0336	.0384	.0224	.0160	.50	.0060	.0007	0.59	1.1
28691	Sept. 20	Decided.	Slight.	0.60	5.15	2.65	.0008	.0356	.0332	.0024	.48	.0060	.0000	1.15	1.3
29069	Oct. 18	Decided.	Cons.	1.20	6.90	2.95	.1096	.0664	.0472	.0192	.75	.0070	.0028	0.81	2.8
29382	Nov. 14	Decided.	Cons.	1.00	5.55	2.10	.0192	.0400	.0296	.0104	.40	.0100	.0003	0.72	1.8
Av...	....	....	....	0.88	5.66	2.57	.0408	.0451	.0331	.0120	.53	.0072	.0009	0.82	1.6

Odor of the first two samples, faintly vegetable, becoming also musty in the second sample on heating; of the last two, distinctly unpleasant. —— The samples were collected from the brook, a short distance below the village of Leominster.

Chemical Examination of Water from the North Branch of the Nashua River, just above its Confluence with the South Branch at Lancaster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25941	Jan. 13	Decided.	Slight.	.32	4.60	1.75	.0136	.0214	.0188	.0026	0.33	.0200	.0004	.45	1.3
26221	Feb. 15	Decided.	Slight.	.29	6.00	2.05	.0398	.0294	.0226	.0068	0.51	.0110	.0004	.50	1.6
26497	Mar. 15	Decided.	Cons.	.23	3.00	1.25	.0058	.0166	.0136	.0030	0.12	.0080	.0001	.36	0.8
26914	Apr. 25	Slight.	Slight.	.29	3.20	1.20	.0048	.0184	.0140	.0044	0.21	.0040	.0004	.40	0.8
27140	May 17	Decided.	Cons.	.36	5.05	1.65	.0284	.0312	.0200	.0112	0.42	.0120	.0010	.47	1.1
27528	June 21	Decided.	Cons.	.47	6.00	2.00	.0508	.0404	.0308	.0096	0.48	.0020	.0030	.64	1.8
27798	July 17	Slight.	Slight.	.38	6.35	2.00	.0396	.0306	.0254	.0052	0.58	.0230	.0064	.58	1.6
28207	Aug. 14	Slight.	Cons	.28	8.45	2.65	.0832	.0368	.0332	.0036	0.81	.0230	.0025	.54	1.7
28754	Sept. 26	Decided.	Cons.	.33	8.50	2.70	.0844	.0396	.0304	.0092	0.92	.0190	.0024	.59	2.2
29076	Oct. 19	Decided.	Slight.	.42	8.25	2.25	.1040	.0340	.0305	.0035	1.00	.0140	.0015	.59	2.8
29422	Nov. 16	Decided.	Cons.	.47	8.05	2.40	.0815	.0375	.0325	.0050	0.74	.0110	.0008	.65	2.8
29737	Dec. 20	Decided.	Cons.	.43	9.10	2.20	.1120	.0436	.0328	.0108	1.08	.0110	.0007	.62	2.7

Averages by Years.

-	1895	-	-	.51	6.96	2.10	.0282	.0269	.0208	.0061	0.77	.0236	.0019	.59	1.9
-	1896	-	-	.47	6.16	1.95	.0217	.0293	.0224	.0069	0.55	.0155	.0019	.55	1.8
-	1897	-	-	.54	5.29	1.99	.0285	.0290	.0230	.0060	0.42	.0150	.0008	.59	1.5
-	1898	-	-	.45	5.07	1.74	.0222	.0268	.0200	.0068	0.44	.0168	.0013	.46	1.5
-	1899	-	-	.36	6.38	2.01	.0540	.0316	.0254	.0062	0.60	.0132	.0016	.53	1.6

NOTE to analyses of 1899: Odor, generally unpleasant and vegetable or musty. —— The samples were collected from the river, near the railroad bridge, a short distance above its mouth.

NASHUA RIVER.

Chemical Examination of Water from the South Branch of the Nashua River, just above its Confluence with the North Branch at Lancaster.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
25042	Jan. 13	Decided.	Slight.	.34	4.75	1.75	[illegible]	[illegible]	.0184	.0048	0.35	.0240	.0005	.50	1.8
26222	Feb. 15	Decided.	Slight.	.26	5.10	1.70	.0352	.0192	.0164	.0028	0.42	.0050	.0007	.41	1.3
26498	Mar. 15	Slight.	Slight.	.21	3.00	1.25	.0040	.0162	.0134	.0028	0.14	.0090	.0001	.35	0.3
26915	Apr. 25	Slight.	Slight.	.32	3.25	1.25	.0006	.0184	.0154	.0030	0.20	.0050	.0003	.42	0.5
27141	May 17	Decided.	Cons.	.41	7.25	2.50	.0644	.0688	.0456	.0232	0.60	.0080	.0030	.61	1.4
27529	June 21	Decided.	Heavy.	.85	8.65	2.75	.2050	.0545	.0485	.0060	0.72	.0020	.0024	.84	2.0
27799	July 17	Slight.	Cons.	.51	11.00	2.45	.3200	.0475	.0340	.0135	1.08	.0040	.0034	.63	2.2
28206	Aug. 14	Slight.	Cons.	.50	9.50	3.05	.2112	.0692	.0452	.0240	1.09	.0030	.0015	.55	2.2
28755	Sept. 26	Decided.	Cons.	.45	9.00	2.35	.0940	.0484	.0338	.0146	1.19	.0130	.0040	.46	2.6
29077	Oct. 19	Decided.	Heavy.	.70	8.85	2.00	.0740	.0595	.0410	.0185	1.13	.0080	.0030	.60	2.2
29423	Nov. 16	Decided.	Cons.	.40	8.75	2.50	.0806	.0355	.0275	.0080	0.97	.0180	.0015	.51	2.2
29738	Dec. 20	Decided.	Cons.	.46	9.00	1.95	.1200	.0380	.0328	.0052	1.16	.0110	.0008	.58	2.6

Averages by Years.

-	1895	-	-	.53	4.66	1.77	.0167	.0238	.0185	.0053	0.34	.0114	.0008	.61	1.4
-	1896	-	-	.45	4.72	1.69	.0094	.0216	.0180	.0036	0.35	.0134	.0006	.53	1.6
-	1897	-	-	.60	4.47	1.80	.0092	.0257	.0202	.0055	0.32	.0110	.0004	.56	1.8
-	1898	-	-	.50	4.77	1.81	.0327	.0269	.0206	.0063	0.33	.0098	.0010	.48	1.8
-	1899	-	-	.45	7.34	2.12	.1026	.0415	.0310	.0105	0.75	.0087	.0018	.54	1.7

Note to analyses of 1899: Odor, generally musty and unpleasant or disagreeable, sometimes vegetable.——The samples were collected from the river, at the Atherton bridge, a short distance above its mouth.

NASHUA RIVER.

Chemical Examination of Water from Nashua River, at Pepperell.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
28256	Aug. 16	Slight.	Cons.	.20	6.50	2.10	.0116	.0264	.0224	.0040	.70	.0230	.0014	.46	1.7
28699	Sept. 21	V. slight.	V. slight.	.27	6.75	2.25	.0054	.0230	.0206	.0024	.82	.0150	.0012	.42	2.0
29017	Oct. 14	V. slight.	V. slight.	.24	7.55	2.20	.0168	.0236	.0224	.0012	.97	.0060	.0004	.39	2.3
29417	Nov. 15	Decided.	Slight.	.42	6.85	2.20	.0332	.0264	.0232	.0032	.64	.0110	.0003	.58	2.3
Av...	....	....	....	.28	6.91	2.19	.0167	.0248	.0221	.0027	.78	.0137	.0008	.46	2.1

Odor of the last sample, faintly unpleasant, becoming stronger on heating; of the others, distinctly vegetable.

Nemasket River.

Chemical Examination of Water from the Nemasket River, below Middleborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27480	June 20	Slight.	Slight.	.44	3.85	1.50	.0024	.0242	.0204	.0038	.49	.0030	.0002	.63	0.5
27802	July 18	V. slight	V. slight.	.45	3.45	1.60	.0014	.0210	.0196	.0014	.50	.0040	.0000	.66	0.3
28272	Aug. 18	V. slight.	Slight.	.29	3.60	1.35	.0028	.0190	.0182	.0008	.52	.0020	.0000	.44	1.0
28656	Sept. 19	V. slight.	V. slight.	.17	3.65	1.25	.0080	.0224	.0200	.0024	.54	.0070	.0002	.35	0.5
29037	Oct. 17	V. slight.	V. slight.	.40	3.70	1.55	.0100	.0232	.0208	.0024	.51	.0010	.0002	.61	0.5
29380	Nov. 14	V. slight.	Slight.	.46	4.20	1.90	.0052	.0220	.0186	.0034	.53	.0050	.0001	.63	0.5
Av...	....	....	....	.37	3.74	1.52	.0050	.0220	.0196	.0024	.51	.0037	.0001	.55	0.5

Odor of the last sample, none; of the others, faintly vegetable, sometimes becoming stronger on heating. —— The samples were collected from the river, at Muttock dam.

Neponset River.

Special investigations of the condition of the Neponset River were made during the summers of 1891, 1895 and 1899. The results of the investigations made in 1891 were given on pages 319 to 336 of the annual report for that year, and the results of the investigations made in 1895 were given on pages 408 to 411 of the annual report for 1895. The results of the investigations made in the summer of 1899 are given in the following tables. All of these examinations were made at a time of low flow in the river.

NEPONSET RIVER.

Chemical Examination of Water

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.			
			Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.
		1899.									
1	28146	Aug. 10, 12.00 M.	V. slight.	Slight.	0.65	4.55	1.95	0.0000	0.0268	0.0252	0.0016
2	28968	Oct. 11, 9.45 A.M.	V. slight.	V. slight.	1.28	6.20	2.50	0.0044	0.0308	0.0280	0.0028
3	28147	Aug. 10, 11.45 A.M.	Decided.	Slight.	0.86	6.60	2.75	0.0000	0.0375	0.0315	0.0060
4	28969	Oct. 11, 9.30 A.M.	Slight.	Cons.	0.92	6.90	3.00	0.0048	0.0396	0.0348	0.0048
5	28148	Aug. 10, 12.30 P.M.	Slight.	Slight.	0.88	6.20	2.50	0.0000	0.0364	0.0320	0.0044
6	28970	Oct. 11, 10.15 A.M.	Slight.	Cons.	0.92	6.50	3.00	0.0052	0.0340	0.0288	0.0052
7	28149	Aug. 10, 12.45 P.M.	Decided.	Cons.	1.10	16.90	6.00	0.0015	0.1090	0.0820	0.0270
8	28971	Oct. 11, 10.40 A.M.	Decided.	Cons.	1.40	20.40	8.00	0.0080	0.0810	0.0690	0.0120
9	28150	Aug. 10, 12.55 P.M.	V. decided.	Cons.	1.50	52.10	20.00	0.0190	0.2500	0.2140	0.0360
10	28972	Oct. 11, 10.55 A.M.	Decided.	Heavy.	1.54	28.50	12.30	0.0190	0.1110	0.0825	0.0285
11	28151	Aug. 10, 1.15 P.M.	V. decided.	Cons.	1.65	47.15	16.75	0.0110	0.2100	0.1860	0.0240
12	28973	Oct. 11, 11.25 A.M.	Decided.	Heavy.	1.40	32.30	13.50	0.0280	0.1190	0.0910	0.0280
13	28152	Aug. 10, 1.10 P.M.	V. decided.	-	-	52.70	11.25	0.9200	2.1100	0.8040	1.3060
14	28974	Oct. 11, 11.15 A.M.	Decided.	Heavy, black.	-	133.60	34.60	0.4800	1.4500	0.7900	0.6600
15	28615	Sept. 13, 2.00 P.M.	Decided.	Heavy.	-	172.00	43.40	1.2400	0.7720	0.5400	0.2320
16	28153	Aug. 10, 1.25 P.M.	V. decided.	Cons., black.	-	41.90	10.70	0.0000	0.2480	0.1650	0.0830
17	28975	Oct. 11, 11.40 A.M.	Decided.	Heavy.	1.36	42.20	17.20	0.0200	0.2240	0.1120	0.1120
18	28154	Aug. 10, 1.40 P.M.	V. decided.	Heavy.	-	38.50	10.30	0.0020	0.2060	0.1460	0.0600
19	28976	Oct. 11, 12.20 P.M.	Decided.	Heavy.	1.32	40.30	16.60	0.0240	0.2000	0.1200	0.0800
20	28155	Aug. 10, 2.00 P.M.	V. decided.	Heavy.	-	241.35	24.35	4.4500	2.1400	0.7160	1.4240
21	28616	Sept. 13, 12.00 M.	Decided.	Heavy.	-	500.00	54.40	4.4700	2.0000	1.2000	0.8000
22	28977	Oct. 11, 1.15 P.M.	Decided.	V. heavy, black.	-	1170.40 1113.00	157.00 110.60	7.2000	4.3000	2.0400	2.2600
23	28978	Oct. 11, 12.25 P.M.	Decided.	Heavy.	1.30	57.00	20.00	0.1620	0.4600	0.2280	0.2320
24	28156	Aug. 10, 1.55 P.M.	V. decided.	Heavy.	-	42.00	10.20	0.0160	0.2500	0.1520	0.0980
25	28614	Sept. 13, 12.30 P.M.	Decided.	Heavy.	-	50.00	14.40	0.1800	0.2900	0.1640	0.1260
26	28979	Oct. 11, 12.35 P.M.	Decided.	Heavy.	1.30	39.00	15.10	0.0800	0.2360	0.1240	0.1120
27	28157	Aug. 10, 2.20 P.M.	Distinct.	Cons.	0.67	8.42	3.07	0.0040	0.0650	0.0425	0.0225
28	28980	Oct. 11, 12.50 P.M.	Slight.	Slight.	0.61	7.80	2.60	0.0028	0.0428	0.0320	0.0108
29	28158	Aug. 10, 11.45 A.M.	Decided.	Slight.	1.16	20.40	5.10	0.0265	0.1350	0.0925	0.0425
30	28981	Oct. 11, 12.55 P.M.	Decided.	Cons.	1.00	43.00	33.00	0.0150	0.0780	0.0570	0.0210
31	28159	Aug. 10, 1.00 P.M.	Decided.	Slight.	0.96	19.50	4.00	0.0140	0.1130	0.0960	0.0170
32	28982	Oct. 11, 10.45 A.M.	Decided.	Cons.	1.00	15.00	4.50	0.0120	0.0790	0.0510	0.0280
33	28160	Aug. 10, 1.25 P.M.	Decided.	Slight.	1.04	22.90	4.00	0.0485	0.1305	0.0960	0.0345

from the Neponset River.

[Parts per 100,000.]

Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Locality.	
0.33	.0020	.0000	0.73	0.3	Above Walpole.	1
0.36	.0060	.0000	1.56	-	Above Walpole.	2
0.55	.0020	.0000	1.07	1.4	Above Stetson's dam.	3
0.50	.0010	.0002	1.44	-	Above Stetson's dam.	4
0.50	.0000	.0000	0.89	1.1	Above paper mill of F. W. Bird & Son.	5
0.52	.0010	.0002	1.14	-	Above paper mill of F. W. Bird & Son.	6
1.38	.0000	.0003	2.92	5.0	Below paper mill of F. W. Bird & Son.	7
1.15	.0010	.0009	3.20	-	Above paper mill of Hollingsworth & Vose.	8
4.10	.0000	.0010	9.60	19.0	Next dam below paper mill of Hollingsworth & Vose.	9
1.90	.0010	.0080	5.10	-	Next dam below paper mill of Hollingsworth & Vose.	10
3.58	.0000	.0000	9.00	19.5	Above brook from Winslow's tannery.	11
2.05	.0010	.0070	5.50	-	Above brook from Winslow's tannery.	12
28.35	.0000	.0160	19.90	28.5	Brook from Winslow's tannery.	13
41.50	.0030	.0100	10.80	-	Brook from Winslow's tannery.	14
51.40	.0000	.0000	21.70	-	Brook from Winslow's tannery.	15
5.53	.0000	.0000	5.80	15.0	Above ink works.	16
4.10	.0020	.0130	6.50	-	Above ink works.	17
4.50	.0000	.0000	6.44	15.0	Below ink works.	18
3.75	.0020	.0008	6.40	-	Below ink works.	19
103.95	.0000	.0000	11.28	35.5	Sewer from Smith's tannery.	20
202.00	.0000	.0010	27.00	-	Sewer from Smith's tannery.	21
540.00	-	.0018	68.00 45.40	-	Sewer from Smith's tannery.	22
7.75	-	.0036	7.70	-	River in front of sewer from Smith's tannery.	23
6.75	.0000	.0000	6.12	16.5	Below sewer from Smith's tannery.	24
7.10	.0000	.0000	7.40	-	Below sewer from Smith's tannery.	25
4.05	.0010	.0036	6.40	-	Below sewer from Smith's tannery.	26
0.75	.0020	.0000	1.20	2.6	East Branch or Canton River.	27
0.63	.0020	.0002	1.04	-	East Branch or Canton River.	28
2.70	.0000	.0000	3.30	6.9	Bridge at Neponset Street.	29
1.73	.0040	.0000	2.40	-	Bridge at Neponset Street.	30
3.55	.0020	.0000	2.04	6.0	Bridge at Dedham Road.	31
2.70	.0010	.0020	2.00	-	Bridge at Dedham Road.	32
4.42	.0020	.0000	2.90	5.4	Bridge at Green Lodge Street.	33

NEPONSET RIVER.

Chemical Examination of Water

[Parts per 100,000.]

	Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.			
									Albuminoid.		
			Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dis-solved.	Sus-pended.
		1899.									
1	28983	Oct. 11, 10.00 P.M.	Slight.	Cons.	0.90	11.00	4.50	0.0040	0.0430	0.0340	0.0090
2	28161	Aug. 10, 2.15 P.M.	Decided.	Slight.	0.78	15.60	2.80	0.0415	0.0935	0.0585	0.0350
3	28984	Oct. 11, 9.20 A.M.	Decided.	Cons.	0.91	10.80	2.80	0.0140	0.0440	0.0350	0.0090
4	28985	Oct. 11, 12.10 P.M.	Decided.	Cons.	-	12.50	4.00	0.0150	0.0670	0.0450	0.0220
5	28986	Oct. 11, 12.00 M.	Decided.	Cons.	0.70	8.30	3.50	0.0120	0.0350	0.0260	0.0090
6	28162	Aug. 10, 6.55 P.M.	Distinct.	Slight.	0.55	9.30	1.80	0.0405	0.0465	0.0335	0.0130
7	28987	Oct. 11, 12.20 P.M.	Decided.	Cons.	0.60	11.60	4.50	0.0060	0.0635	0.0390	0.0245
8	28163	Aug. 10, 6.35 P.M.	Distinct.	Cons.	0.58	9.10	1.90	0.0280	0.0525	0.0390	0.0135
9	28989	Oct. 11, 1.45 P.M.	Decided.	Cons.	1.04	14.90	5.50	0.0210	0.0650	0.0500	0.0150
10	28988	Oct. 11, 1.30 P.M.	Decided.	Cons.	0.96	14.00	5.00	0.0140	0.0650	0.0500	0.0150
11	28164	Aug. 10, 7.15 P.M.	Decided.	Cons.	0.58	10.30	1.80	0.0625	0.0665	0.0430	0.0235
12	28990	Oct. 11, 2.00 P.M.	Decided.	Cons.	1.10	15.90	5.50	0.0310	0.0620	0.0440	0.0180
13	28991	Oct. 11, 2.30 P.M.	Slight.	Cons.	0.85	9.50	3.00	0.0210	0.0450	0.0360	0.0090
14	28165	Aug. 10, 7.25 P.M.	Slight.	Cons.	0.68	14.40	2.30	0.0665	0.0580	0.0430	0.0150
15	28992	Oct. 11, 3.00 P.M.	Decided.	Cons.	0.67	464.20	90.00	0.0190	0.0380	0.0320	0.0060

The samples were collected as follows: Nos. 28146 and 28968, from the Neponset River above Walpole; Nos. 28147 and 28969, at Stetson's dam, just below the village of Walpole; Nos. 28148 and 28970, from the millpond of the paper mill of F. W. Bird & Son, in East Walpole; No. 28149, from river, just below paper mill of F. W. Bird & Son; No. 28971, at the dam of the paper mill of Hollingsworth & Vose, which is the next below the paper mill of F. W. Bird & Son; Nos. 28150 and 28972, at the next dam below the mill of Hollingsworth & Vose, at Water Street; Nos. 28151 and 28973, at the Moore Street bridge, in Norwood, about 100 feet above the brook which conveys the drainage from Winslow's tannery to the river; Nos. 28152, 28974 and 28615, from the brook which conveys the drainage from Winslow's tannery to the Neponset River, about 100 feet above its junction with the river; Nos. 28153 and 28975, from Neponset River above printing-ink works of Geo. H. Morrill & Co., Pleasant Street, Norwood, and below the brook from Winslow's tannery; Nos. 28154 and 28976, from the Neponset River, below printing-ink works of Geo. H. Morrill & Co., and just above sewer from Smith's tannery; Nos. 28155, 28616 and 28977, from the sewer leading from Smith's tannery to the river; No. 28978, from the river directly in front of sewer from Smith's tannery; Nos. 28156, 28614 and 28979, from the river, 75 feet below the point where the sewer from Smith's tannery enters it; Nos. 28158 and 28981, from the river where it is crossed by the Neponset Street bridge; Nos. 28157 and 28980, from the Canton River; Nos. 28159 and 28982, from the Neponset River, where it is crossed by the Dedham road bridge; Nos.

from the Neponset River — Concluded.

[Parts per 100,000.]

Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Locality.	
1.12	.0020	.0007	1.52	-	Bridge at Green Lodge Street.	1
2.65	.0020	.0000	1.60	4.6	Bridge at Milton Street.	2
1.20	.0020	.0011	1.40	-	Bridge at Milton Street (Paul's Bridge).	3
1.40	.0000	.0022	1.72	-	Above Mother Brook (Paul's Bridge).	4
0.57	.0140	.0004	1.04	-	Mother Brook.	5
0.98	.0040	.0004	0.80	3.3	Below Mother Brook.	6
1.02	.0090	.0009	1.76	-	Below Mother Brook.	7
1.23	.0030	.0005	0.92	2.2	Opposite Gossamer Rubber Company, Hyde Park.	8
2.40	.0020	.0020	2.00	-	Opposite Gossamer Rubber Company, Hyde Park.	9
1.90	.0020	.0036	2.00	-	Above Mattapan paper mill.	10
1.10	.0030	.0007	1.00	3.4	Dam above Blue Hill Avenue.	11
2.53	.0060	.0018	2.08	-	Dam above Blue Hill Avenue.	12
1.18	.0110	.0010	1.32	-	Above Tileston & Hollingsworth paper mill.	13
2.15	.0030	.0008	1.20	5.0	At Central Avenue, Milton.	14
214.50	.0010	.0006	1.60	-	Tide water below Milton.	15

28160 and 28983, from the river at Green Lodge Street; Nos. 28161 and 28984, from the river, where it is crossed by Paul's bridge; No. 28985, from the river, about 200 feet above mouth of Mother Brook; No. 28986, from Mother Brook, 200 feet above mouth; Nos. 28162 and 28987, from the river, 200 feet below point where it is joined by Mother Brook; Nos. 28163 and 28989, from the river, near the factory of the Boston Gossamer Rubber Company; No. 28988, from the river above the Mattapan Paper Mill; No. 28164, below dam at Blue Hill Avenue; No. 28990, at dam, just above Blue Hill Avenue; No. 28165, from the river at Central Avenue, Milton; No. 28991, from the river, just above paper mill of Tileston & Hollingsworth; No. 28992, from the tide water at Godfrey's wharf, below Milton.

The odor of the samples from the river above the paper mill of Hollingsworth & Vose was faintly vegetable or unpleasant, generally becoming stronger on heating; between the paper mill of Hollingsworth & Vose and the brook from Winslow's tannery, distinctly disagreeable or unpleasant; from the brook from Winslow's tannery, offensive; between the brook from Winslow's tannery and the sewer from Smith's tannery, distinctly disagreeable and unpleasant; from the sewer from Smith's tannery and from the river between the sewer from Smith's tannery and the Canton River, very offensive; from Canton River, distinctly vegetable or faintly unpleasant; below Canton River, distinctly disagreeable or unpleasant.

NEPONSET RIVER.

Table Showing the Per Cent. of Dissolved Oxygen and the Number of Bacteria in the Water of the Neponset River.

Locality.	Bacteria per Cubic Centimeter.	Dissolved Oxygen (Per Cent. of Saturation).
Above Walpole,	350	90
Above Stetson's dam,	18,800	31
Above paper mill of F. W. Bird & Son,	141,000	57
Below paper mill of F. W. Bird & Son,	646,000	8
Below paper mill of Hollingsworth & Vose,	320,000	0
Above brook from Winslow's tannery,	620,000	15
Brook from Winslow's tannery,	621,000	0
Above ink works,	1,686,000	10
Below ink works,	1,320,000	9
Sewer from Smith's tannery,	1,650,000	0
Below sewer from Smith's tannery,	2,077,000	0
Above Canton River,	728,000	0
Canton River,	31,000	69
Bridge at Neponset Street,	774,000	0
Bridge at Dedham Road,	651,000	0
Bridge at Green Lodge Street,	823,000	0
Bridge at Milton Street,	469,000	4
Above Mother Brook,	501,000	1
Below Mother Brook,	109,000	-
Opposite Gossamer Rubber Company,	291,000	13
Above Mattapan paper mill,	600,000	14
Dam above Blue Hill Avenue,	80,000	9

Chemical Examination of Water from the Neponset River, at Hyde Park.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
25965	Jan. 17	Slight.	Slight.	0.56	5.55	2.20	.0004	.0210	.0182	.0028	0.57	.0110	.0002	0.74	1.7
26235	Feb. 16	Decided.	Slight.	0.73	6.75	2.75	.0040	.0260	.0236	.0024	0.66	.0120	.0004	0.87	2.3
26475	Mar. 14	V. slight.	V. slight.	0.40	3.50	1.35	.0010	.0152	.0142	.0010	0.42	.0020	.0000	0.56	1.0
26693	Apr. 10	V. slight.	V. slight.	0.50	4.55	1.80	.0010	.0224	.0210	.0014	0.44	.0020	.0001	0.66	1.1
27106	May 16	Slight.	Cons.	0.75	5.40	2.40	.0236	.0326	.0294	.0032	0.58	.0060	.0005	0.80	1.7
27504	June 20	Decided.	Cons.	0.78	13.65	3.50	.0032	.0760	.0448	.0312	1.41	.0000	.0003	1.34	5.9
27807	July 18	Decided.	Cons.	1.25	17.70	4.00	.0368	.1100	.0796	.0304	3.50	.0010	.0000	1.65	5.9
28196	Aug. 14	Decided.	Cons.	1.65	22.25	6.15	.0825	.1330	.1005	.0325	3.13	.0040	.0000	2.50	6.9
28671	Sept. 19	V. dec'd.	Cons.	1.00	24.55	6.10	.0030	.1475	.1102	.0373	3.32	.0030	.0000	2.37	8.9
29023	Oct. 16	Slight.	Slight.	1.02	11.10	4.05	.0212	.0460	.0428	.0032	1.08	.0030	.0004	1.45	4.2
29376	Nov. 14	Decided.	Cons.	1.15	8.20	3.25	.0120	.0492	.0380	.0112	0.78	.0080	.0004	1.28	2.2
29694	Dec. 19	Decided.	Cons.	1.00	7.75	2.80	.0024	.0380	.0332	.0048	0.74	.0100	.0006	1.11	2.0

Averages by Years.

-	1888	-	-	1.02	6.77	2.27	.0030	.0324	-	-	0.83	.0095	.0002	-	-
-	1893	-	-	1.16	7.70	2.49	.0151	.0320	.0254	.0066	1.19	.0154	.0005	0.95	2.4
-	1894	-	-	1.14	9.68	2.69	.0112	.0360	.0277	.0083	1.64	.0062	.0002	1.00	3.0
-	1895	-	-	1.04	8.40	2.81	.0182	.0365	.0312	.0053	1.18	.0064	.0001	1.05	3.0
-	1896	-	-	1.12	8.35	2.69	.0137	.0353	.0315	.0038	1.22	.0077	.0001	1.06	2.7
-	1897	-	-	1.19	8.79	2.84	.0193	.0385	.0333	.0052	1.28	.0067	.0001	1.07	2.9
-	1898	-	-	1.11	7.29	2.89	.0097	.0387	.0315	.0072	0.88	.0060	.0002	1.06	2.4
-	1899	-	-	0.90	10.91	3.36	.0159	.0597	.0463	.0134	1.39	.0052	.0002	1.28	3.6

NOTE to analyses of 1899: Odor, generally musty or disagreeable, occasionally vegetable. —— The samples were collected from the river, opposite the works of the Hyde Park Water Company, above the thickly settled portions of the town of Hyde Park.

Quinebaug River.

Chemical Examination of Water from the Quinebaug River, below Southbridge.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27424	June 13	Slight.	Cons.	.41	3.75	1.75	.0034	.0272	.0198	.0074	.21	.0040	.0001	.51	1.3
27779	July 15	Slight.	Cons.	.64	4.05	1.65	.0076	.0268	.0228	.0040	.16	.0050	.0003	.66	1.3
28352	Aug. 23	Slight.	Cons.	.44	4.75	1.70	.0152	.0316	.0228	.0088	.27	.0040	.0002	.44	1.3
28534	Sept. 9	Decided.	Cons.	.44	4.25	1.85	.0012	.0368	.0242	.0126	.26	.0020	.0001	.60	0.8
28945	Oct. 10	Decided.	Slight.	.30	4.30	1.55	.0100	.0292	.0248	.0044	.25	.0070	.0002	.48	1.0
29255	Nov. 6	Decided.	Slight.	.40	4.80	1.85	.0052	.0272	.0228	.0044	.25	.0070	.0001	.55	1.6
Av...	....	....	....	.44	4.32	1.72	.0071	.0298	.0229	.0069	.23	.0048	.0002	.54	1.2

Odor of the first and last samples, faintly unpleasant; of the others, vegetable, becoming sometimes also unpleasant on heating.—The samples were collected from the river, between the villages of Southbridge and Saundersdale.

Salisbury Plain River.

Chemical Examination of Water from Salisbury Plain River, below Brockton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27486	June 20	Decided.	Cons.	.26	12.40	3.15	.0748	.0264	.0228	.0036	1.79	.2080	.0160	.38	3.9
27803	July 17	Slight, milky.	V. slight.	.33	11.75	2.80	.0498	.0246	.0226	.0020	1.64	.1660	.0320	.44	3.4
28203	Aug. 14	Decided.	Cons.	.20	11.35	3.00	.0632	.0264	.0176	.0088	1.34	.0840	.0050	.27	3.0
28658	Sept. 19	Slight.	Slight.	.12	13.50	4.15	.0080	.0198	.0176	.0022	2.27	.2960	.0060	.24	3.8
29039	Oct. 17	Decided.	Cons.	.52	9.90	2.20	.0492	.0312	.0242	.0070	1.36	.0940	.0013	.61	3.0
29379	Nov. 14	Decided.	Cons.	.62	8.55	2.55	.0420	.0296	.0236	.0060	1.03	.0950	.0012	.62	2.9
Av...	....	....	....	.34	11.24	2.97	.0478	.0263	.0214	.0049	1.57	.1572	.0102	.43	3.3

Odor, generally distinctly unpleasant; in July, vegetable and musty.—The samples were collected from the river, at Plain Street bridge, above the sewage pumping station.

TAUNTON RIVER.

TAUNTON RIVER.

Chemical Examination of Water from the Taunton River, above Taunton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27794	July 17	Slight.	Cons.	0.53	5.05	2.10	.0016	.0326	.0274	.0052	.53	.0020	.0000	0.47	1.3
28267	Aug. 17	V. slight.	V. slight.	0.60	5.15	2.20	.0006	.0230	.0218	.0012	.60	.0030	.0000	0.66	1.1
28651	Sept. 18	V. slight.	Slight.	0.42	4.90	2.05	.0000	.0224	.0216	.0008	.65	.0010	.0002	0.38	1.1
29027	Oct. 16	V. slight.	Cons.	1.25	7.00	3.40	.0040	.0348	.0332	.0016	.61	.0050	.0002	1.55	1.3
29364	Nov. 13	Slight.	Cons.	1.56	6.70	3.55	.0032	.0388	.0364	.0024	.64	.0060	.0001	1.74	1.0
Av...	....	....	....	0.94	5.76	2.66	.0019	.0303	.0281	.0022	.61	.0034	.0001	0.96	1.2

Odor, vegetable, sometimes becoming unpleasant on heating. — The samples were collected from the river, opposite the pumping station of the Taunton Water Works.

Chemical Examination of Water from the Taunton River, below Taunton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27795	July 17	Decided.	Cons.	0.90	5.80	2.30	.0262	.0318	.0270	.0048	.60	.0060	.0003	0.94	1.3
28268	Aug. 17	Slight.	Slight.	0.59	5.70	1.60	.0172	.0252	.0234	.0018	.77	.0040	.0008	0.64	1.1
28652	Sept. 18	V. slight.	Slight.	0.55	6.15	2.00	.0180	.0264	.0234	.0030	.89	.0020	.0004	0.46	1.1
29028	Oct. 16	Decided.	Cons.	1.20	7.00	3.00	.0176	.0392	.0316	.0076	.66	.0120	.0005	1.52	1.4
29363	Nov. 13	Slight.	Cons.	1.42	6.90	3.50	.0068	.0360	.0344	.0016	.67	.0060	.0002	1.64	1.0
Av...	....	....	....	0.93	6.31	2.48	.0176	.0317	.0279	.0038	.72	.0060	.0004	1.04	1.2

Odor, faintly vegetable or unpleasant, sometimes becoming stronger on heating. — The samples were collected from the river, at the wharf of the Taunton Gas Works, below the bridge at Weir.

Ten Mile River.

Chemical Examination of Water from Ten Mile River, below Attleborough.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
27492	June 20	Decided.	Cons.	0.56	6.55	1.80	.0080	.0484	.0352	.0132	.72	.0080	.0002	0.54	1.8
27722	July 11	Decided.	Slight.	1.04	6.15	2.10	.0068	.0386	.0306	.0080	.46	.0170	.0001	1.01	1.6
28261	Aug. 17	Decided.	Cons.	0.33	6.00	1.75	.0008	.0384	.0208	.0176	.71	.0090	.0005	0.38	1.7
28575	Sept. 12	Decided.	Slight.	0.70	5.30	2.00	.0036	.0330	.0264	.0066	.48	.0170	.0001	0.66	1.0
28941	Oct. 10	Decided.	Slight.	0.65	7.20	2.50	.0120	.0320	.0270	.0050	.64	.0130	.0008	0.82	2.0
29275	Nov. 7	Decided.	Cons.	0.98	7.15	2.75	.0120	.0368	.0328	.0040	.71	.0160	.0006	1.05	2.0
Av...	....	....	....	0.71	6.39	2.15	.0072	.0379	.0288	.0091	.62	.0133	.0004	0.74	1.7

Odor, generally vegetable, and occasionally unpleasant or disagreeable. —— The samples were collected from the river, below Dodgeville.

Ware River.

Chemical Examination of Water from Ware River, at Cold Brook Station, Barre.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1899.														
25831	Jan. 2	V. slight.	V. slight.	.40	2.85	1.25	.0006	.0154	.0140	.0014	.15	.0040	.0000	.50	0.5
26089	Jan. 31	V. slight.	V. slight.	.40	3.25	1.35	.0000	.0114	.0106	.0008	.18	.0060	.0001	.52	0.3
26357	Feb. 28	V. slight.	V. slight.	.35	2.50	1.25	.0034	.0118	.0110	.0008	.11	.0050	.0000	.43	0.3
26646	Apr. 3	V. slight.	None.	.33	3.10	1.45	.0002	.0110	.0102	.0008	.11	.0050	.0000	.45	0.2
26969	May 2	V. slight.	V. slight.	.56	2.95	1.30	.0006	.0208	.0174	.0034	.12	.0040	.0000	.66	0.2
27285	May 31	Slight.	Slight.	.66	3.05	1.65	.0020	.0208	.0194	.0014	.13	.0010	.0000	.62	0.5
27678	July 6	V. slight.	V. slight.	.70	3.45	1.75	.0012	.0222	.0206	.0016	.11	.0020	.0000	.85	0.5
27927	July 31	V. slight.	V. slight.	.73	4.15	1.95	.0010	.0248	.0226	.0022	.10	.0020	.0000	.85	0.5
28416	Aug. 31	V. slight.	V. slight.	.40	3.85	1.70	.0010	.0232	.0214	.0018	.12	.0020	.0000	.54	0.6
28853	Oct. 2	Slight.	V. slight.	.38	4.00	1.65	.0008	.0220	.0198	.0022	.21	.0040	.0000	.60	0.6
29186	Oct. 31	V. slight.	V. slight.	.48	3.85	1.60	.0012	.0198	.0164	.0034	.24	.0020	.0001	.58	0.5
29512	Nov. 28	V. slight.	None.	.56	3.55	1.20	.0002	.0176	.0166	.0010	.17	.0010	.0001	.59	0.6

WARE RIVER.

Chemical Examination of Water from Ware River, at Cold Brook Station, Barre — Concluded.

Averages by Years.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
								Albuminoid.							
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
-	1894	-	-	.74	3.55	1.47	.0005	.0179	.0155	.0024	.14	.0023	.0000	.63	0.8
-	1895	-	-	.78	3.96	1.70	.0014	.0219	.0199	.0020	.17	.0051	.0000	.79	0.9
-	1896	-	-	.72	3.36	1.52	.0003	.0198	.0177	.0021	.11	.0038	.0000	.73	0.8
-	1897	-	-	.83	3.60	1.55	.0010	.0193	.0173	.0020	.14	.0032	.0000	.69	0.7
-	1898	-	-	.76	3.51	1.67	.0011	.0196	.0177	.0019	.14	.0027	.0000	.76	0.7
-	1899	-	-	.50	3.38	1.51	.0010	.0184	.0167	.0017	.14	.0032	.0000	.60	0.4

NOTE to analyses of 1899: Odor, generally faintly vegetable, sometimes none. On heating, the odor of some of the samples became stronger.—— The samples were collected from the river, at the railroad bridge, near Cold Brook station, in the south-easterly part of the town of Barre.

Chemical Examination of Water from Ware River, below Ware.

[Parts per 100,000.]

		Appearance.			Residue on Evaporation.		Ammonia.					Nitrogen as			
								Albuminoid.							
Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
	1899.														
27454	June 14	Slight.	Cons.	.44	3.75	1.25	.0024	.0404	.0272	.0132	.21	.0010	.0003	.59	0.8
27687	July 6	Slight.	Cons.	.60	4.20	1.75	.0066	.0384	.0280	.0104	.14	.0030	.0002	.74	0.6
28136	Aug. 9	Slight.	Slight.	.48	4.75	2.00	.0044	.0328	.0248	.0080	.25	.0020	.0003	.68	0.8
28617	Sept. 12	Decided.	Cons.	.46	5.40	1.90	.0032	.0396	.0284	.0112	.25	.0010	.0006	.68	1.0
28943	Oct. 10	Decided.	Cons.	.31	5.65	1.95	.0116	.0404	.0262	.0142	.38	.0010	.0006	.58	1.3
29281	Nov. 7	Decided.	Cons., floc.	.47	5.15	1.75	.0028	.0312	.0264	.0048	.26	.0010	.0002	.72	1.0
Av...	....	....	....	.46	4.82	1.77	.0052	.0371	.0268	.0103	.25	.0015	.0004	.66	0.9

Odor in September and November, faintly unpleasant; at other times, distinctly vegetable and sometimes mouldy.

Westfield River.

Chemical Examination of Water from Westfield River, above Westfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27477	June 19	V. slight.	V. slight.	.11	3.50	1.45	.0008	.0118	.0098	.0020	.11	.0020	.0001	.24	2.0
27804	July 18	V. slight.	V. slight.	.13	4.40	1.25	.0002	.0144	.0126	.0018	.11	.0020	.0000	.31	2.0
28269	Aug. 17	V. slight.	Slight.	.10	4.70	1.20	.0088	.0150	.0132	.0018	.17	.0040	.0000	.25	2.0
28910	Oct. 6	V. slight.	V. slight.	.22	4.45	1.40	.0006	.0172	.0132	.0040	.19	.0010	.0000	.40	2.2
29404	Nov. 14	V. slight.	V. slight.	.30	3.85	1.30	.0008	.0128	.0118	.0010	.11	.0030	.0001	.50	1.7
Av...	....	....	....	.17	4.18	1.32	.0012	.0142	.0121	.0021	.14	.0024	.0000	.34	2.0

Odor of the last sample, none; of the others, vegetable.——The samples were collected from the river, above the thickly settled portions of the town.

Chemical Examination of Water from Westfield River, below Westfield.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27832	July 19	V. slight.	Slight.	.14	4.70	1.10	.0120	.0216	.0164	.0052	.17	.0060	.0002	.33	2.0
28258	Aug. 17	Slight.	Slight.	.12	5.05	1.35	.0060	.0156	.0136	.0020	.16	.0050	.0002	.28	2.2
28696	Sept. 21	Slight.	Cons.	.16	5.50	2.10	.0116	.0304	.0234	.0070	.25	.0070	.0002	.28	2.3
29068	Oct. 18	Slight.	Cons.	.20	5.05	1.80	.0084	.0296	.0228	.0068	.33	.0060	.0002	.32	2.9
29407	Nov. 15	Slight.	V. slight.	.30	4.50	1.65	.0036	.0140	.0134	.0006	.14	.0020	.0001	.45	2.0
Av...	....	....	....	.18	4.96	1.60	.0083	.0222	.0179	.0043	.21	.0052	.0002	.33	2.3

Odor, generally faintly vegetable, sometimes unpleasant, becoming stronger on heating.—— The samples were collected from the river, at Mittineague.

SUMMARY

OF

WATER SUPPLY STATISTICS;

ALSO

RECORDS OF RAINFALL AND FLOW OF STREAMS.

SUMMARY OF WATER SUPPLY STATISTICS.

During the year 1899 a public water supply was introduced for the first time into the towns of Falmouth and Huntington, and important changes were made in the water supplies of other cities and towns. At the end of the year the State contained 32 cities and 321 towns, and of these all of the cities and 132 of the towns were provided with public water supplies.

The following table gives a classification by population of cities and towns having and not having a public water supply Dec. 31, 1899. The populations are taken from the census of 1895 : —

POPULATION (1895).	Number of Places of Given Population having a Public Water Supply.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having a Public Water Supply.	Total Population of Places in Preceding Column.
Under 500,	0	0	36	13,287
500-1,000,	4	3,301	55	42,508
1,000-1,500,	11	13,862	37	44,904
1,500-2,000,	9	15,722	30	51,754
2,000-2,500,	10	22,182	18	28,882
2,500-3,000,	9	25,099	9	24,392
3,000-3,500,	10	32,515	7	22,599
3,500-4,000,	6	21,788	0	0
4,000-4,500,	9	39,006	1	4,055
Above 4,500,	96	2,088,798	1	6,039
Totals,	164	2,261,768	189	238,415

From the totals given in the preceding table it will be seen that only 46.5 per cent. of the total number of cities and towns have public water supplies, but that 90.5 per cent. of the whole population of the State is contained within these cities and towns. The number of people to whom a public water supply is available is, of course, somewhat less than the total population of the municipalities supplied, but the difference is not large.

There are now 9 towns having, by the census of 1895, a population exceeding 3,000 which are not provided with a public water supply. These are given in the following table: —

Towns.	Population in 1895.	Towns.	Population in 1895.
Blackstone, ...	6,039	Dudley, ...	3,208
Barnstable, ...	4,055	Chelmsford, ...	3,162
Sutton, ...	3,420	Dartmouth, ...	3,107
Tewksbury, ...	3,379	Deerfield, ...	3,007
Pepperell, ...	3,321		

In the following table the various water supplies are classified according to the dates when a fairly complete system was first introduced into a city or town: —

Years.	Number of Places supplied.	Years.	Number of Places supplied.
Previous to 1850, ...	6	1893, ...	3
1850-1859, ...	4	1894, ...	3
1860-1869, ...	10	1895, ...	5
1870-1879, ...	44	1896, ...	5
1880-1889, ...	68	1897, ...	2
1890, ...	4	1898, ...	2
1891, ...	5	1899, ...	2
1892, ...	1	Total, ...	164

At the end of the year 1899 all of the 32 cities in the State, having by the census of 1895 an aggregate population of 1,640,503, owned their water works. Of the 132 towns having a public water supply, 83, with a population of 408,020, owned their works, while 49, having a population of 213,245, were supplied by private companies. The total population in both cities and towns owning their works was 2,048,523, against 213,245 in those supplied by private companies.

The following table gives statistics with regard to the consumption of water in the cities and towns in this State where such records are kept. The populations for 1899 as given in the table were obtained by adding four-fifths of the increase in population from 1890 to 1895 to the population as determined by the census taken in 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 1899. The amount obtained in this manner is somewhat less than the average amount used per consumer, because there are in all cities and towns a greater or less number of people who do not use the public water supply. The difference between the number of inhabitants and consumers would account to a large extent for the low rate per inhabitant in some of the towns where works have been in operation for a short time only, and where, in consequence, water has not been generally introduced. In some towns the population during the summer months is much greater than that which is shown by census returns, and in such cases the consumption per inhabitant as given in the table is somewhat higher than it would be if allowance were made for the increased population in the summer.

Statistics relating to the Consumption of Water in Various Cities and Towns.

City or Town.	Estimated Population in 1899.	Average Daily Consumption. Gallons. 1899.	Daily Consumption per Inhabitant. Gallons. 1899.	City or Town.	Estimated Population in 1899.	Average Daily Consumption. Gallons. 1899.	Daily Consumption per Inhabitant. Gallons. 1899.
Metropolitan Water District.	802,800	88,538,000	110	Easthampton, .	5,106	314,000	61
Abington and Rockland.	9,936	446,000	45	Easton, . . .	4,419	106,000	24
Amesbury,* . .	10,136	326,000	32	Fairhaven, . .	3,674	216,000	59
Andover, . .	6,147	392,000	64	Fall River, . .	101,047	3,581,000	35
Attleborough, .	8,856	365,000	41	Foxborough, . .	3,447	195,000	57
Avon, . . .	1,819	55,000	30	Framingham, . .	9,730	416,000	43
Ayer, . . .	2,063	94,000	46	Franklin, . .	5,380	167,000	31
Beverly, . . .	12,594	961,000	76	Gardner, . . .	9,788	698,000	71
Billerica,† . .	2,785	41,000	15	Gloucester, . .	31,059	968,000	31
Braintree, . .	5,683	452,000	80	Grafton, . . .	5,180	82,000	16
Bridgewater and E. Bridgewater.	7,916	213,000	27	Groton, . . .	2,300	106,000	46
Brockton, . .	37,861	1,137,000	30	Hopkinton, . .	2,100	32,000	15
Brookline, . .	19,415	1,772,000	91	Hyde Park, . .	13,132	701,000	53
Cambridge, . .	90,935	7,773,000	85	Ipswich, . . .	4,945	86,000	17
Canton, . . .	4,715	208,000	44	Lawrence, . .	58,172	3,205,000	55
Cohasset, . .	2,494	127,000	51	Lexington, . .	3,738	141,000	38
Danvers and Middleton.	9,582	674,000	71	Longmeadow, .	626	60,000	96
Dedham, . . .	7,281	600,000	82	Lowell, . . .	89,703	7,286,000	81

* Nine months. † Ten months.

Statistics relating to the Consumption of Water in Various Cities and Towns — Concluded.

City or Town.	Estimated Population in 1899.	Average Daily Consumption. Gallons. 1899.	Daily Consumption per Inhabitant Gallons. 1899.	City or Town.	Estimated Population in 1899.	Average Daily Consumption. Gallons. 1899.	Daily Consumption per Inhabitant. Gallons. 1899.
Lynn and Saugus, .	72,512	5,379,000	74	Peabody, . .	10,787	1,138,000	106
Manchester, . .	1,946	211,000	108	Provincetown, .	4,485	172,000	38
Mansfield, . .	3,954	139,000	35	Randolph and Holbrook.	5,648	292,000	52
Marblehead, . .	7,246	456,000	63	Reading, . . .	5,221	131,000	25
Marlborough, . .	15,915	525,000	33	Rockport, . .	6,251	191,000	31
Maynard, . .	3,402	116,000	34	Rutland, . . .	977	46,000	47
Methuen, . .	6,391	249,000	39	Salem, . . .	37,410	2,502,000	66
Middleborough, .	7,188	224,000	31	Sharon, . . .	1,784	64,000	36
Milford and Hopedale.	10,640	668,000	63	Stoughton, . .	5,608	252,000	45
Millbury, . .	5,868	117,000	20	Taunton, . . .	28,449	1,458,000	51
Milton, . . .	6,510	148,000	23	Tisbury, . . .	978	60,000	62
Montague, . .	5,868	430,000	73	Wakefield and Stoneham.	15,749	949,000	60
Nantucket, . .	2,814	121,000	43	Walpole, . . .	3,306	146,000	44
Natick, . . .	8,570	395,000	46	Waltham, . .	22,610	1,683,000	75
Needham, . .	3,892	225,000	58	Ware, . . .	7,907	282,000	36
New Bedford, .	66,564	6,743,000	101	Wareham, Onset Bay.	3,300	20,000	6
Newburyport, .	15,036	588,000	39	Webster, . .	8,413	299,000	36
Newton, . . .	30,159	2,038,000	68	Wellesley, . .	4,730	214,000	45
No. Andover,* .	3,431	53,000	15	Weston, . . .	1,746	55,000	32
No. Attleborough, .	6,456	243,000	37	Whitman, . .	6,786	162,000	24
No. Brookfield, .	5,246	185,000	35	Winchendon, . .	4,570	62,000	14
Norwood, . .	5,246	424,000	81	Woburn, . . .	14,721	1,110,000	75
Orange, . . .	5,996	160,000	27	Worcester, . .	110,055	7,682,000	69

* Eleven months.

RAINFALL.

The average rainfall in Massachusetts for the year 1899 was 39.48 inches, or 5.86 inches less than the normal. A considerable excess of rainfall occurred in the months of January, February, March and September and a slight excess in the month of June, but during the remainder of the year the rainfall for each month was below the normal for that month. The accumulated deficiency in the nine months from April to December inclusive was 9.91 inches. The greatest deficiency in any one month was 2.36 inches, which occurred in May.

The average rainfall in Massachusetts, as deduced from long-continued observations in various parts of the State, is given in the following table, together with the rainfall for each month in 1899 and the departures from the normal:*—

MONTH.	Normal Rainfall. Inches.	Rainfall. 1899. Inches.	Excess or Deficiency. 1899. Inches.	MONTH.	Normal Rainfall. Inches.	Rainfall. 1899. Inches.	Excess or Deficiency. 1899. Inches.
January,	3.97	4.20	+0.23	August,	4.35	2.04	—2.31
February,	3.70	4.64	+0.94	September,	3.34	5.07	+1.73
March,	4.02	6.90	+2.88	October,	4.08	2.55	—1.53
April,	3.39	1.74	—1.65	November,	4.18	2.24	—1.94
May,	3.69	1.33	—2.36	December,	3.54	1.78	—1.76
June,	3.23	3.30	+0.07	Total,	45.34	39.48	—5.86
July,	3.85	3.69	—0.16				

To show the condition of the streams or sources of water supply from which samples of water have been collected for analysis during 1899, the following tables are presented, which give the daily rainfall in inches at 9 stations scattered throughout the State:*—

* Prepared from the records of the New England section of the climate and crop service of the Weather Bureau.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected.

January, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.25	0.55	0.70	0.12	0.20	1.00	0.44	0.06	0.40
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	0.01	-	0.01	-	-	-	-	-
5, . .	-	-	0.07	-	-	-	-	-	-
6, . .	*	0.55	0.51	*	*	*	-	*	*
7, . .	0.94	0.40	0.40	1.04	1.06	0.72	0.91	1.48	1.20
8, . .	-	-	-	-	-	-	-	-	-
9, . .	-	-	-	0.02	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	-
13, . .	*	-	0.06	*	*	*	-	*	*
14, . .	0.38	0.60	0.49	0.50	0.45	0.57	-	0.40	0.56
15, . .	-	-	-	-	-	-	0.61	-	-
16, . .	*	-	0.62	-	*	-	-	*	*
17, . .	0.54	0.47	-	0.81	0.96	0.75	0.89	1.40	1.40
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	-	-	-	-	-	-
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	*	0.40	0.26	*	*	*	-	*	*
25, . .	1.09	0.43	0.36	1.49	1.85	0.84	1.69	1.97	1.64
26, . .	-	-	-	-	-	-	-	-	-
27, . .	-	-	-	-	-	-	-	-	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	-	-	-	-	-	-	-	-	-
30, . .	-	-	-	-	-	-	-	-	-
31, . .	-	-	-	0.20	0.08	-	-	0.14	0.10
Totals,	3.20	3.41	3.47	4.19	4.60	3.88	4.54	5.44	5.30

February, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	0.07	-	0.02	0.06	0.10	0.10	0.19
2, . .	-	-	-	-	-	-	-	-	-
3, . .	*	0.40	0.46	*	*	*	-	-	*
4, . .	0.08	0.40	0.29	0.72	0.78	0.56	0.83	0.50	0.56
5, . .	0.10	0.25	0.04	0.06	0.05	0.03	-	0.13	0.15
6, . .	-	-	-	-	-	-	-	-	-
7, . .	0.30	0.15	0.14	-	*	*	0.42	*	*
8, . .	0.90	0.37	0.25	0.97	1.21	0.69	0.26	1.00	0.90
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	0.50	0.11	0.18	*	*	*	0.30	*	0.56
13, . .	*	1.50	0.86	*	*	*	0.38	*	*
14, . .	1.10	-	0.38	1.96	1.89	0.89	0.56	2.10	1.35
15, . .	-	-	-	-	-	-	-	-	-
16, . .	*	-	-	-	-	-	-	*	*
17, . .	0.27	0.10	-	0.38	0.35	0.02	0.37	*	0.46
18, . .	*	0.37	0.11	*	0.50	*	0.06	*	0.02
19, . .	0.32	-	0.06	0.49	-	0.31	0.34	0.97	0.52
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	0.03	-	-	-	-	-	-	-
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	*	*	0.10	*	*	*	-	*	*
27, . .	0.55	0.57	0.23	0.21	0.23	0.17	-	0.69	0.02
28, . .	-	-	-	-	-	-	0.14	-	-
Totals,	4.42	4.25	3.19	4.79	5.03	2.14	3.75	5.49	5.31

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

March, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	*	*	0.38	*	*	*	-	*	*
3, . .	0.15	0.30	0.17	0.58	0.72	0.36	0.78	*	0.47
4, . .	*	0.15	0.13	*	0.68	*	-	*	*
5, . .	1.01	0.39	0.76	0.38	0.08	*	0.78	1.27	*
6, . .	-	-	-	-	-	0.90	-	-	1.20
7, . .	0.30	0.20	0.71	0.70	0.72	*	-	0.38	0.18
8, . .	-	-	-	-	-	0.78	0.55	-	-
9, . .	-	-	-	0.04	0.02	-	-	*	0.12
10, . .	-	-	-	-	-	-	-	0.03	0.10
11, . .	-	-	-	0.01	-	-	-	-	-
12, . .	0.16	0.18	0.27	0.09	0.08	0.24	0.13	0.07	*
13, . .	-	-	-	-	-	-	-	-	0.10
14, . .	-	-	-	*	-	*	-	*	*
15, . .	*	0.57	0.47	0.99	0.39	*	-	*	0.08
16, . .	1.08	0.45	0.62	-	-	0.95	0.84	0.75	0.64
17, . .	-	-	-	-	-	-	-	-	-
18, . .	1.52	0.50	0.48	*	*	*	-	*	*
19, . .	-	1.07	1.09	1.60	*	1.29	-	2.35	*
20, . .	-	0.04	-	-	1.74	-	1.55	-	2.10
21, . .	-	-	-	-	-	-	-	-	-
22, . .	*	0.48	0.44	*	*	*	0.69	*	*
23, . .	1.10	0.67	0.83	1.42	1.40	1.29	0.94	1.62	1.56
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	0.60	0.37	0.20	0.28	0.25	0.18	0.26	0.30	0.45
27, . .	-	-	-	-	-	-	-	-	-
28, . .	*	*	0.06	*	*	*	-	*	*
29, . .	0.88	1.05	0.65	0.26	0.39	0.30	0.38	0.31	0.40
30, . .	-	-	-	-	-	-	-	-	-
31, . .	-	0.09	0.10	0.11	0.10	0.12	0.13	0.04	-
Totals,	6.80	6.96	7.36	7.05	7.05	6.41	6.98	7.12	7.35

April, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	*	-	-	*	-	*	-	-	*
8, . .	1.04	0.66	0.92	0.84	0.78	0.76	0.77	0.78	0.48
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	0.10	0.11	0.10	0.13	0.10	0.16	-	0.12	0.15
13, . .	-	0.04	-	-	-	-	0.11	-	-
14, . .	0.07	-	-	0.01	0.03	0.18	0.10	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	*	0.80	0.62	0.63	*	*	-	*	*
17, . .	1.05	-	-	-	0.51	0.46	0.88	0.43	1.20
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	0.08	-	-	-	-
21, . .	0.07	0.04	-	0.07	-	-	-	0.26	0.24
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	0.02	-	-	0.15	-
25, . .	*	0.05	-	0.04	-	*	0.02	-	0.01
26, . .	0.04	0.03	-	0.01	-	0.44	-	-	-
27, . .	-	-	-	-	-	-	0.38	-	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	-	-	-	-	-	-	-	-	-
30, . .	-	-	-	-	-	-	-	-	-
Totals,	2.37	1.73	1.64	1.78	1.47	1.95	1.76	1.74	2.08

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

May, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	0.15	-	-	0.42	0.32	0.71	-	-	-
2, . .	-	-	0.45	0.23	-	-	0.86	0.72	0.18
3, . .	-	-	-	-	-	-	0.01	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	-	-	-	-	-	-	-	-
8, . .	-	-	-	-	0.08	-	-	-	-
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	0.65	-
11, . .	0.13	0.22	0.11	0.16	0.06	0.07	0.03	-	0.86
12, . .	-	-	-	-	-	-	-	0.25	-
13, . .	*	0.04	0.08	0.12	0.10	0.10	-	-	-
14, . .	0.13	-	-	-	-	-	0.09	0.05	0.05
15, . .	-	-	-	-	-	-	-	-	-
16, . .	*	0.25	0.02	0.11	-	0.01	-	-	-
17, . .	0.18	-	-	-	0.05	-	-	-	0.17
18, . .	0.03	0.06	-	0.02	0.06	0.02	-	0.18	-
19, . .	-	0.06	0.04	0.01	-	-	0.05	-	0.12
20, . .	-	-	0.05	*	-	-	-	-	0.01
21, . .	-	-	-	0.24	0.20	0.12	0.14	-	0.02
22, . .	0.05	-	-	-	-	-	0.05	0.14	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	-	-	-	-	-	-	-	-	-
27, . .	-	0.04	-	0.02	-	-	-	-	-
28, . .	*	0.32	-	-	0.08	0.11	-	-	-
29, . .	1.11	-	0.42	0.05	-	-	0.05	-	0.80
30, . .	-	-	-	-	-	0.48	0.05	0.18	-
31, . .	-	-	-	-	-	-	-	-	-
Totals,	1.78	0.99	1.12	1.38	0.91	1.62	1.33	2.17	1.21

June, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	0.02	0.02	-	-	0.06	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	0.14	-	-	-	-	-	-	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	-	0.10	0.09	0.48	*	-	0.49	-
8, . .	-	-	-	-	-	0.19	0.12	-	-
9, . .	-	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	-
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	0.07	0.05	-	0.01	-	0.15	-	-
15, . .	0.97	2.00	1.75	0.79	0.46	*	-	-	0.02
16, . .	-	-	-	-	-	0.40	0.47	0.10	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	0.15	0.17	0.64	-
20, . .	0.63	0.46	0.84	0.38	0.44	0.38	-	0.10	-
21, . .	-	-	-	-	-	-	0.78	-	-
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	*	0.60	0.16	0.18	*	*	-	-	1.56
25, . .	0.50	0.43	0.27	0.06	0.27	0.31	0.10	0.96	*
26, . .	-	-	-	-	-	-	0.22	-	0.74
27, . .	-	-	-	-	-	-	-	-	-
28, . .	*	0.34	0.54	*	*	*	0.58	-	0.16
29, . .	1.79	0.72	0.58	0.96	1.10	0.91	-	1.72	1.24
30, . .	-	-	-	-	-	-	-	-	-
Totals,	4.03	4.62	4.29	2.48	2.78	2.40	2.59	4.07	3.72

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

July, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	0.04	-
6, . .	*	0.20	-	0.09	0.11	-	-	-	-
7, . .	0.11	-	0.73	-	0.53	-	-	0.08	0.94
8, . .	*	1.90	0.60	1.23	0.59	-	-	-	0.16
9, . .	2.68	0.05	0.58	*	0.27	1.41	0.79	1.74	1.62
10, . .	-	-	0.20	0.08	-	-	-	0.05	-
11, . .	-	-	-	-	-	-	-	-	-
12, . .	0.34	0.91	0.11	0.02	-	0.29	-	-	-
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	0.53	0.20	0.47	0.07	0.10	0.25	0.10	1.10	0.48
17, . .	-	-	-	0.01	-	-	-	-	-
18, . .	-	-	-	-	-	0.01	0.02	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	-	-	-	-	-	-	-	-	-
22, . .	-	-	-	-	-	-	-	0.09	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	*	0.10	0.20	*	0.16	-	-	-	0.25
26, . .	0.84	0.99	1.23	1.11	1.59	1.24	0.96	1.29	0.38
27, . .	0.56	0.41	0.21	0.31	0.29	0.24	-	0.06	0.09
28, . .	-	-	-	-	-	-	-	-	-
29, . .	*	-	0.10	-	-	-	-	-	-
30, . .	0.31	0.26	-	0.12	0.06	1.02	0.10	0.04	0.10
31, . .	-	-	-	-	-	-	-	-	-
Totals,	5.87	5.02	4.43	3.10	3.70	4.46	1.97	4.44	3.97

August, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	0.52	0.02	-	-
3, . .	-	-	-	-	-	-	-	-	0.01
4, . .	-	-	-	-	0.04	-	-	-	-
5, . .	-	-	-	0.01	-	0.21	0.21	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	-	-	-	-	-	-	-	-
8, . .	-	-	-	-	-	-	-	-	-
9, . .	-	1.05	-	-	-	-	-	-	-
10, . .	0.70	0.02	1.08	*	*	*	-	-	*
11, . .	-	-	0.60	*	1.13	*	0.81	1.45	2.15
12, . .	-	-	-	0.96	-	1.21	0.08	-	-
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	-	-	-	-	-	-	-	-	-
20, . .	-	-	-	-	-	-	-	-	-
21, . .	0.25	0.16	-	0.06	-	-	-	-	-
22, . .	0.15	0.16	0.53	0.50	2.87	0.10	-	-	-
23, . .	-	-	0.05	-	0.04	-	1.12	-	-
24, . .	-	-	0.03	0.02	0.23	-	-	-	0.13
25, . .	0.20	-	-	0.02	-	-	-	0.84	-
26, . .	-	-	0.05	-	-	-	-	-	-
27, . .	-	-	-	-	-	-	-	-	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	-	-	-	-	-	-	-	-	-
30, . .	-	-	-	-	-	-	-	-	-
31, . .	-	-	-	-	-	-	-	-	-
Totals,	1.30	1.39	2.34	1.57	3.81	2.04	2.19	1.79	2.29

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Continued.

September, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	*	*	0.07	*	0.52	*	-	-	-
2, . .	0.84	2.98	2.19	0.73	0.04	0.68	0.26	0.24	0.02
3, . .	0.04	1.22	-	0.08	0.07	0.05	-	-	-
4, . .	-	-	-	-	-	-	0.03	0.54	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	-	-	-	-	-	-	-	-	-
7, . .	-	-	-	-	0.03	-	-	-	-
8, . .	0.03	0.04	0.02	0.01	-	0.04	0.05	0.17	0.08
9, . .	0.01	-	-	-	-	-	-	-	-
10, . .	-	-	-	-	-	-	-	-	-
11, . .	0.02	-	0.07	*	*	*	-	-	0.01
12, . .	0.05	-	0.11	0.14	0.24	0.04	0.32	0.97	1.27
13, . .	-	-	-	-	-	-	-	0.02	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	-	-	-	-	-	-
18, . .	-	-	-	-	-	-	-	-	-
19, . .	*	-	-	-	-	-	-	-	-
20, . .	1.66	1.18	1.22	1.84	3.34	2.00	2.86	4.41	2.62
21, . .	0.87	0.63	0.57	0.57	0.14	0.47	0.23	0.42	0.12
22, . .	-	-	-	-	-	-	-	-	-
23, . .	-	-	-	-	-	-	-	-	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	0.22	0.78	-	-	-	-	-	-	-
26, . .	0.02	-	-	-	0.17	0.17	0.12	0.83	1.30
27, . .	-	-	0.52	0.05	-	-	-	-	-
28, . .	-	-	-	-	-	-	-	-	-
29, . .	*	0.14	*	*	*	*	2.24	1.95	-
30, . .	0.08	-	0.05	0.30	0.83	0.53	-	-	1.10
Totals,	3.83	6.97	4.82	3.78	5.38	3.98	6.11	9.05	6.52

October, 1899.

Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, . .	-	-	-	-	-	-	-	-	-
2, . .	-	-	-	-	-	-	-	-	-
3, . .	-	-	-	-	-	-	-	-	-
4, . .	-	-	-	-	-	-	-	-	-
5, . .	-	-	-	-	-	-	-	-	-
6, . .	0.03	-	0.04	0.42	0.57	0.38	-	1.20	*
7, . .	-	-	-	-	-	-	0.64	-	1.17
8, . .	-	-	-	-	-	-	-	-	-
9, . .	0.17	0.17	0.12	0.31	0.31	0.15	-	0.40	0.64
10, . .	-	-	-	-	-	-	-	-	-
11, . .	0.01	-	-	-	-	-	-	-	-
12, . .	-	-	-	-	-	-	-	-	-
13, . .	-	-	-	-	-	-	-	-	-
14, . .	-	-	-	-	-	-	-	-	-
15, . .	-	-	-	-	-	-	-	-	-
16, . .	-	-	-	-	-	-	-	-	-
17, . .	-	-	-	0.05	-	-	-	-	-
18, . .	1.43	0.87	0.96	0.23	0.61	1.03	0.25	0.42	0.70
19, . .	-	-	-	-	-	-	-	-	-
20, . .	0.10	0.14	0.12	0.17	0.14	0.15	0.17	0.04	0.08
21, . .	-	-	-	-	-	-	-	-	-
22, . .	-	-	-	-	-	-	-	-	-
23, . .	0.13	0.19	0.04	0.12	0.04	0.05	0.04	0.08	-
24, . .	-	-	-	-	-	-	-	-	-
25, . .	-	-	-	-	-	-	-	-	-
26, . .	-	-	-	-	-	-	-	-	-
27, . .	-	-	-	-	-	*	-	-	-
28, . .	-	-	0.02	0.06	0.07	0.18	0.03	-	-
29, . .	0.36	0.20	0.07	0.16	0.22	0.05	0.03	0.15	0.07
30, . .	-	-	-	-	-	-	0.14	-	-
31, . .	0.70	0.35	0.25	1.10	0.85	-	1.11	1.21	0.85
Totals,	2.93	1.92	1.62	2.62	2.81	1.99	2.41	3.50	3.51

* Precipitation included in that of following day.

Daily Rainfall in Inches at Nine Places in Massachusetts, Geographically selected — Concluded.

November, 1899.										December, 1899.									
Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.	Day of Month.	Springfield.	Amherst.	Fitchburg.	Framingham.	Chestnut Hill.	Lawrence.	Salem.	Taunton.	New Bedford.
1, .	0.22	0.38	0.66	0.08	0.76	0.67	0.07	0.46	-	1, .	*	*	-	-	-	-	-	-	-
2, .	-	-	-	-	-	-	-	-	-	2, .	0.26	0.34	0.14	0.05	0.05	0.08	-	-	0.08
3, .	*	0.07	-	*	-	-	-	-	*	3, .	-	-	0.01	-	-	-	-	-	-
4, .	0.68	0.60	0.58	0.70	0.87	0.50	0.89	0.68	0.70	4, .	0.12	0.21	0.05	0.02	-	0.08	-	-	0.02
5, .	-	-	-	-	-	-	-	-	-	5, .	-	-	-	-	-	-	-	-	-
6, .	-	-	-	-	-	-	-	-	-	6, .	-	-	-	-	-	-	-	-	0.07
7, .	-	-	-	-	-	-	-	-	-	7, .	-	-	-	-	-	-	-	-	-
8, .	-	-	-	-	-	-	-	-	-	8, .	-	-	0.01	0.01	-	-	-	-	0.01
9, .	-	-	-	-	-	-	-	-	-	9, .	-	-	-	-	-	-	-	-	-
10, .	-	-	-	-	-	-	-	-	-	10, .	-	-	-	-	-	-	-	-	-
11, .	*	*	0.41	*	*	*	0.02	-	0.06	11, .	0.01	-	-	0.01	-	-	-	-	-
12, .	0.78	0.92	0.32	1.10	0.99	0.64	1.18	0.40	0.21	12, .	0.36	0.45	0.23	0.30	0.22	0.20	0.10	0.18	0.23
13, .	-	-	-	-	-	-	-	-	-	13, .	-	-	-	-	-	-	-	-	-
14, .	*	*	-	0.02	0.02	-	-	-	-	14, .	-	-	-	-	-	-	-	-	-
15, .	0.19	-	0.11	0.06	0.02	0.09	-	0.08	0.05	15, .	0.37	0.65	0.47	0.60	0.70	0.52	0.85	0.52	0.30
16, .	-	0.17	-	-	-	-	0.04	-	-	16, .	-	-	-	-	-	-	-	-	-
17, .	-	-	-	-	-	-	-	-	-	17, .	0.06	0.10	-	-	-	0.02	-	-	-
18, .	-	-	-	-	-	-	-	-	-	18, .	-	-	0.03	0.05	0.08	-	0.02	-	0.22
19, .	0.09	-	-	0.12	0.11	0.01	-	0.04	0.02	19, .	0.28	0.13	0.11	0.32	0.33	0.13	0.24	0.48	0.45
20, .	-	-	-	-	-	-	-	-	-	20, .	-	-	-	-	-	-	-	-	-
21, .	-	-	-	-	-	-	0.05	-	-	21, .	-	-	-	-	-	-	-	-	-
22, .	-	-	0.01	0.05	0.06	0.08	-	-	0.05	22, .	-	-	-	-	-	-	-	-	-
23, .	-	-	-	-	-	-	-	-	0.03	23, .	-	-	-	-	-	-	-	-	-
24, .	-	-	-	-	-	-	-	-	-	24, .	0.21	*	0.05	0.35	0.37	0.53	-	0.29	0.16
25, .	-	-	-	-	-	-	-	-	-	25, .	-	0.32	0.06	-	-	-	0.31	-	-
26, .	-	-	-	-	-	-	-	-	-	26, .	-	-	-	-	-	-	-	-	-
27, .	-	-	-	-	-	-	-	-	-	27, .	-	-	-	-	-	-	-	-	-
28, .	-	-	-	-	-	-	-	-	-	28, .	-	-	-	-	-	-	-	-	-
29, .	-	-	-	-	-	-	-	-	-	29, .	-	-	-	-	-	-	-	-	-
30, .	-	-	-	-	-	-	-	-	-	30, .	-	-	-	-	-	-	-	-	-
										31, .	-	-	-	-	-	-	-	-	-
Tot.,	1.96	2.14	2.09	2.12	2.83	1.99	2.25	1.66	1.11	Tot.,	1.67	2.20	1.70	1.71	1.75	1.51	1.52	1.47	1.99
Totals for the year, ...											39.16	41.60	38.07	36.52	42.06	34.87	37.40	47.94	44.36

* Precipitation included in that of following day.

Flow of Streams.

The flow of streams for the year 1899, as indicated by the records of the Sudbury River, was much less than the normal for the past twenty-five years. The flow during the months of January, March and April was in excess of the normal, but during the remainder of the year the flow during each month was considerably below the normal. The yield of the Sudbury River water-shed during the month of August was less than the evaporation from the water surfaces, so that the flow is represented by a minus quantity. The flow during the driest six months was less than during any similar period since measurements have been made.

In order to show the relation between the flow of the Sudbury River during each month of 1899 and the normal flow of the same river as deduced from twenty-five years' observations, from 1875 to 1899 inclusive, the following table has been prepared. The area of the water-shed of the Sudbury River above the point of measurement is 75.2 square miles.

Table showing the Average Monthly Flow of Sudbury River for the Year 1899 in Cubic Feet per Second per Square Mile of Drainage Area and in Gallons per Day per Square Mile of Drainage Area, also Departures from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1899.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Gallons per Day per Square Mile.
January,	1.937	1,252,000	3.540	2,288,000	+1.603	+1,036,000
February,	2.904	1,877,000	2.137	1,381,000	—0.767	—496,000
March,	4.489	2,901,000	6.506	4,205,000	+2.017	+1,304,000
April,	3.124	2,019,000	3.901	2,521,000	+0.777	+502,000
May,	1.680	1,086,000	0.791	511,000	—0.889	—575,000
June,	0.735	475,000	0.102	66,000	—0.633	—409,000
July,	0.305	197,000	0.029	19,000	—0.276	—178,000
August,	0.478	309,000	—0.054	—35,000	—0.532	—344,000
September,	0.376	243,000	0.145	94,000	—0.231	—149,000
October,	0.829	536,000	0.178	115,000	—0.651	—421,000
November,	1.475	953,000	0.470	304,000	—1.005	—649,000
December,	1.612	1,042,000	0.340	220,000	—1.272	—822,000
Average,	1.656	1,070,000	1.506	973,000	—0.150	—97,000

The next table shows the weekly fluctuations during 1899 in the flow of two of the streams which were carefully measured, namely, the Sudbury and the Merrimack. The flow of these streams, particularly the Sudbury, serves to indicate the flow of the other streams in eastern Massachusetts.

Week ending Sunday.	Sudbury River. — Cubic Feet per Second per Square Mile.	Merrimack River. — Cubic Feet per Second per Square Mile.	Week ending Sunday.	Sudbury River. — Cubic Feet per Second per Square Mile.	Merrimack River. — Cubic Feet per Second per Square Mile.
1899.			1899.		
Jan. 1,	2.119	1.597	July 9,	0.325	0.491
8,	4.593	1.874	16,	—0.117	0.602
15,	2.407	1.609	23,	—0.064	0.519
22,	3.772	2.005	30,	0.154	0.603
29,	4.374	1.590	Aug. 6,	—0.076	0.524
Feb. 5,	1.837	1.080	13,	—0.105	0.493
12,	1.370	0.910	20,	—0.100	0.467
19,	1.601	0.864	27,	—0.046	0.394
26,	2.941	1.394	Sept. 3,	0.123	0.406
Mar. 5,	3.988	1.569	10,	—0.065	0.494
12,	6.401	2.432	17,	—0.063	0.414
19,	8.233	3.493	24,	0.517	0.336
26,	7.126	2.531	Oct. 1,	0.101	0.461
Apr. 2,	5.621	3.014	8,	0.113	0.455
9,	5.398	3.747	15,	0.163	0.368
16,	4.191	6.363	22,	0.365	0.385
23,	3.643	7.361	29,	—0.029	0.359
30,	2.083	6.426	Nov. 5,	0.528	0.676
May 7,	1.369	4.377	12,	0.674	0.654
14,	0.856	2.014	19,	0.450	0.560
21,	0.549	1.384	26,	0.393	0.579
28,	0.622	1.119	Dec. 3,	0.228	0.488
June 4,	0.308	0.866	10,	0.207	0.535
11,	0.023	0.676	17,	0.484	0.716
18,	0.088	0.619	24,	0.680	0.695
25,	—0.029	0.607	31,	0.237	0.601
July 2,	0.168	0.585			

The following table gives the records of the rainfall upon the Sudbury River water-shed and its total yield expressed in inches in depth on the water-shed (inches of rainfall collected) for the year 1899, together with the average of the records of the twenty-five years from 1875 to 1899 inclusive: —

Rainfall, in Inches, received and collected on Sudbury Water-shed.

Month.	1899.			Mean for 25 Years, 1875-1899.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January,	4.18	4.062	97.08	4.33	2.233	51.57
February,	4.91	2.225	45.32	4.26	3.050	71.60
March,	7.01	7.501	107.00	4.41	5.175	117.35
April,	1.90	4.351	229.00	3.24	3.485	107.56
May,	1.45	0.911	62.83	3.33	1.936	58.14
June,	2.51	0.114	4.54	2.93	0.821	28.02
July,	3.22	0.035	1.09	3.77	0.352	9.34
August,	1.43	—0.063	—4.41	4.16	0.551	13.24
September,	3.96	0.162	4.10	3.23	0.419	12.97
October,	2.69	0.206	7.66	4.37	0.956	21.88
November,	2.18	0.525	24.08	4.22	1.645	38.98
December,	1.78	0.392	22.02	3.56	1.850	51.98
Totals and averages,	37.21	20.441	54.93	45.83	22.482	49.06

The Sudbury River records are particularly valuable as a basis for estimating the yield of other water-sheds in Massachusetts, both on account of the accuracy with which the measurements have been made and the absence of abnormal conditions which would unfavorably affect the results. The following table gives the records relating to the yield of this water-shed for each of the past twenty-five years, the flow from the water-shed being expressed in gallons per day per square mile, instead of inches in depth of rainfall collected, in order to render the table more convenient for use in estimating the probable yields of water-sheds used as sources of water supply: —

*Yield of the Sudbury River Water-shed in Gallons per Day per Square Mile.**

Month.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.
January,	103,000	643,000	658,000	1,810,000	700,000	1,121,000	415,000	1,241,000
February,	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000
March,	1,604,000	4,435,000	4,813,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000
April,	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,168,000	1,546,000	867,000
May,	1,188,000	1,139,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000
June,	870,000	222,000	597,000	506,000	413,000	176,000	1,338,000	529,000
July,	321,000	183,000	202,000	128,000	158,000	177,000	276,000	86,000
August,	396,000	405,000	121,000	475,000	395,000	119,000	148,000	55,000
September,	207,000	184,000	60,000	160,000	141,000	80,000	197,000	306,000
October,	646,000	234,000	632,000	516,000	71,000	101,000	186,000	299,000
November,	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	210,000
December,	584,000	454,000	1,289,000	3,177,000	462,000	175,000	775,000	314,000
Average for whole year,	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000
Av. for driest six months,	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000

Month.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
January,	335,000	995,000	1,235,000	1,461,000	2,589,000	1,053,000	2,782,000	1,254,000	3,018,000
February,	1,033,000	2,842,000	1,354,000	4,800,000	2,829,000	1,951,000	1,195,000	1,529,000	3,486,000
March,	1,611,000	3,785,000	1,572,000	2,059,000	2,868,000	3,237,000	1,339,000	3,643,000	4,453,000
April,	1,350,000	2,853,000	1,815,000	1,947,000	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000
May,	938,000	1,030,000	1,336,000	720,000	1,009,000	1,632,000	880,000	1,366,000	582,000
June,	300,000	417,000	426,000	203,000	414,000	422,000	653,000	568,000	414,000
July,	115,000	224,000	62,000	115,000	114,000	117,000	633,000	108,000	149,000
August,	78,000	257,000	240,000	94,000	214,000	380,000	1,432,000	132,000	163,000
September,	91,000	44,000	121,000	118,000	111,000	1,155,000	824,000	458,000	203,000
October,	186,000	83,000	336,000	146,000	190,000	1,999,000	1,230,000	2,272,000	210,000
November,	205,000	175,000	1,178,000	673,000	368,000	2,758,000	1,941,000	1,215,000	305,000
December,	193,000	925,000	1,174,000	1,020,000	643,000	3,043,000	2,241,000	997,000	544,000
Av. for whole year,	533,000	1,129,000	901,000	1,087,000	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000
Av. for driest six months.	145,000	200,000	391,000	223,000	234,000	953,000	944,000	747,000	239,000

Month.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	Mean for 25 Years, 1875-99, inclusive.
January,	1,870,000	433,000	693,000	1,034,000	1,084,000	845,000	1,638,000	2,288,000	1,252,000
February,	943,000	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000	1,381,000	1,877,000
March,	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000	4,205,000	2,901,000
April,	871,000	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000	2,521,000	2,019,000
May,	1,259,000	2,883,000	840,000	636,000	360,000	915,000	1,246,000	511,000	1,086,000
June,	428,000	440,000	419,000	174,000	399,000	962,000	530,000	66,000	475,000
July,	214,000	158,000	161,000	231,000	95,000	658,000	231,000	19,000	197,000
August,	280,000	181,000	209,000	229,000	57,000	591,000	1,107,000	—35,000	309,000
September,	229,000	108,000	150,000	89,000	388,000	182,000	369,000	94,000	243,000
October,	126,000	221,000	374,000	1,379,000	592,000	94,000	1,160,000	115,000	536,000
November,	697,000	319,000	836,000	2,777,000	659,000	909,000	1,986,000	304,000	953,000
December,	485,000	797,000	716,000	1,782,000	657,000	1,584,000	1,799,000	220,000	1,042,000
Av. for whole year,	781,000	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000	973,000	1,070,000
Av. for driest six months.	327,000	237,000	356,000	460,000	314,000	564,000	777,000	93,000	450,000

* The area of the Sudbury River water-shed used in making up these records included water surfaces amounting to about 1 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 1886, to 3.5 per cent. in 1894 and to about 6 per cent. in 1898. The water-shed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

EXPERIMENTS

UPON THE

PURIFICATION OF SEWAGE AND WATER

AT THE

LAWRENCE EXPERIMENT STATION,

DURING THE YEAR 1899.

EXPERIMENTS UPON THE PURIFICATION OF SEWAGE AND WATER AT THE LAWRENCE EXPERIMENT STATION.*

By HARRY W. CLARK, *Chemist of the Board.*

The year 1899 is the twelfth that the investigations of the Lawrence Experiment Station have been continued. 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 the writer in direct charge. The following report presents a summary of the investigations and results obtained. Besides the chemical and bacterial analyses necessary in these investigations, many samples of sand, gravel and soil have been examined from proposed sewage filtration areas in the State, and areas that have been in use for a number of years by different towns and cities.

PURIFICATION OF SEWAGE.

During 1898 many new investigations were started at the station upon methods of purifying sewage at high rates of filtration, and during 1899 some of these investigations have been continued and additional experiments upon the subject have been started, when our studies have brought new points of practical interest before us or have seemed to show that new work could be inaugurated with valuable results.

Besides continuing investigations and studies upon the results obtained with septic tanks and bacterial or contact filters, the qualitative and quantitative efficiency of filters of coarse material, — broken stone, etc., — when receiving a continuous stream of sew-

* A full account of the work done at the Lawrence Experiment Station for 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 twenty-third annual report of the Board for the year 1891. Since 1891 the results have been published yearly in the annual reports.

age, has been studied, with encouraging results. Many other interesting investigations have been made and are summarized in the pages beyond, and the more important of the older intermittent sand filters have been continued in operation, as the results from them become more valuable each year.

The following tables show the general character and composition of the Lawrence sewage, as it flows in the sewer from which it is obtained and as it arrives at the station after passing slowly through a 2½-inch pipe, 4,300 feet long. The sewage from the sewer has not, however, borne the same relation to the station sewage as in previous years, for two reasons: first, the low rainfall during the year caused the sewage in the sewer to be of such a strength that more frequent flushing of the pipe to the station was necessary than during previous years; and, second, our sewage pumps at the station became so worn that they ceased to work well, this also necessitating flushing of the pipe frequently during the first eight months of the year. It will be noticed that during the last four months of the year, after the installation of a new pump, a sewage was obtained at the station more nearly resembling that in the sewer than during the previous portion of the year.

Monthly Averages of Analyses of Sewage from the Lawrence Street Sewer.

[Parts per 100,000.]

1900.	Temperature, Deg. F.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. In Solution.	Albuminoid Ammonia. In Suspension	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	50	2.20	0.81	.54	.27	11.96	.241	.0165	7.65	1,823,000
February,	50	2.40	0.81	.52	.29	9.65	.191	.0145	9.15	1,500,000
March,	40	1.76	0.69	.47	.22	10.13	.296	.0120	7.45	1,462,000
April,	54	2.76	0.86	.58	.28	8.40	.258	.0200	7.96	1,543,000
May,	60	3.73	1.00	.57	.43	7.40	.185	.0255	9.32	2,363,000
June,	67	3.64	0.86	.45	.41	10.48	.122	.0200	7.50	2,356,000
July,	72	3.96	1.12	.68	.44	13.45	.084	.0130	7.96	2,453,000
August,	71	3.34	0.91	.59	.32	14.28	.123	.0126	8.56	2,242,000
September,	69	4.96	1.16	.64	.52	11.37	.122	.0240	9.18	2,755,000
October,	64	4.43	1.56	.62	.96	10.17	.086	.0195	10.35	2,565,000
November,	62	4.13	1.10	.65	.44	14.12	.094	.0120	10.45	3,480,000
December,	56	4.20	1.32	.65	.65	7.08	.123	.0160	12.85	3,155,000
Average,	60	3.47	1.02	.58	.44	11.90	.156	.0186	9.02	2,484,000

Monthly Averages of Regular Sewage Samples.

[Parts per 100,000.]

1899.	Temperature, Deg. F.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. In Solution.	Albuminoid Ammonia. In Suspension.	Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	45	2.05	0.45	.26	.19	4.50	3.08	1,531,000
February,	46	2.11	0.50	.25	.25	4.36	3.19	1,847,000
March,	45	1.70	0.43	.23	.20	4.08	3.17	1,091,000
April,	47	2.72	0.82	.23	.59	5.42	5.43	2,077,000
May,	57	2.81	0.48	.22	.26	6.75	3.50	3,472,000
June,	60	2.86	0.45	.18	.27	8.13	3.44	1,518,000
July,	74	2.58	0.41	.15	.26	6.58	2.61	805,000
August,	71	2.99	0.36	.17	.19	6.97	2.15	805,000
September,	66	4.23	0.75	.34	.41	10.49	4.51	3,026,000
October,	58	3.55	0.58	.27	.31	6.89	4.10	2,006,000
November,	47	4.32	0.83	.33	.50	7.32	5.75	2,715,000
December,	47	5.14	1.03	.43	.60	7.71	7.19	3,711,000
Average,	56	3.08	0.59	.26	.33	6.60	4.01	2,050,000

Monthly Averages of Mixed Samples representing all of the Sewage applied to Filters Nos. 1, 6 and 9A.

[Parts per 100,000.]

1899.	Free Ammonia. Filter No. 1.	Free Ammonia. Filter No. 6.	Free Ammonia. Filter No. 9A.	Albuminoid Ammonia. Filter No. 1.	Albuminoid Ammonia. Filter No. 6.	Albuminoid Ammonia. Filter No. 9A.	Chlorine. Filter No. 1.	Chlorine. Filter No. 6.	Chlorine. Filter No. 9A.	Oxygen Consumed. Filter No. 1.	Oxygen Consumed. Filter No. 6.	Oxygen Consumed. Filter No. 9A.
January,	3.50	1.84	1.91	0.82	0.47	0.47	8.58	5.87	4.84	4.98	3.23	3.45
February,	4.03	2.10	2.11	0.82	0.55	0.57	8.70	5.58	6.13	4.96	2.98	3.18
March,	3.18	1.68	1.63	0.69	0.45	0.51	8.03	4.19	4.78	4.58	2.78	3.15
April,	2.85	2.52	2.17	0.84	0.71	0.66	5.12	7.05	5.79	5.18	4.33	4.33
May,	3.11	2.86	2.54	0.69	0.72	0.65	8.23	6.98	6.42	3.91	3.68	3.47
June,	3.05	2.58	1.94	0.69	0.60	0.52	8.40	11.03	6.49	4.45	3.53	3.23
July,	1.31	2.25	2.13	0.36	0.57	0.48	4.22	6.56	6.37	2.54	4.02	3.04
August,	4.15	3.90	3.50	0.23	0.63	1.24	11.76	13.69	11.51	5.00	5.00	4.80
September,	4.75	4.43	3.78	1.01	0.92	0.71	11.35	11.86	10.60	5.33	5.98	4.63
October,	3.15	3.49	3.26	0.53	0.66	0.52	7.28	7.10	7.98	3.65	4.43	3.45
November,	4.13	4.13	4.00	0.79	0.74	0.69	8.84	7.82	8.51	4.97	4.67	4.30
December,	5.00	5.58	5.60	0.95	1.14	1.07	9.37	9.76	9.91	6.61	7.36	7.42
Average,	3.52	3.11	2.88	0.70	0.68	0.67	8.32	8.12	7.44	4.68	4.33	4.04

Septic Sewage.

In the report for 1898 a detailed statement was made of the varying composition of sewage (1) from the time it is introduced into the sewer from the streets, houses, etc., (2) until it reaches the experiment station, or a filtration area under ordinary conditions, and (3) its character when issuing from a tank through which it is passed slowly and when it is known as septic sewage. These three grades of sewage we now call *fresh*, *stale* and *septic* sewage.

Septic Tank A was first put in operation at the station during the latter part of 1897, and the results obtained from it up to Jan. 1, 1899, were given in the previous report. The two following tables show the average analyses for 1899 of samples of the station sewage collected as it enters the tank and of the septic sewage as it is drawn from the tank: —

Sewage as it enters Septic Tank A.

[Parts per 100,000.]

1899.	Temperature, Deg. F.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Total.	In Solution.	In Suspension.			
March,	48	2.59	0.52	.30	0.22	5.81	3.61	1,272,000
April,	47	4.03	0.46	.26	0.20	6.81	2.80	1,018,000
May,	56	3.64	0.40	.24	0.16	7.26	2.40	1,736,000
June,	68	3.16	0.57	.15	0.42	8.03	4.86	682,000
July,	74	0.56	0.83	.07	0.76	1.09	6.10	279,000
August,	70	1.73	0.61	.10	0.51	5.36	4.11	410,000
September,	65	4.83	1.19	.37	0.82	11.23	6.67	2,896,000
October,	57	3.56	0.89	.26	0.63	6.79	5.75	1,596,250
November,	47	5.14	1.42	.39	1.03	9.11	8.89	3,742,000
December,	46	5.67	1.96	.49	1.47	9.47	12.26	5,591,000
Average,	58	3.49	0.89	.26	0.63	7.10	5.75	1,922,000

Effluent of Septic Tank A.

[Parts per 100,000.]

1899.	Temperature, Deg. F.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Total.	In Solution.	In Suspension.			
January,	50	4.40	.43	.32	.11	7.33	2.76	546,000
February,	48	4.35	.39	.33	.06	7.30	2.89	616,000
March,	48	3.93	.41	.32	.09	7.21	2.92	451,000
April,	52	4.37	.30	.27	.03	6.13	2.03	296,000
May,	58	4.56	.33	.26	.07	7.95	1.98	577,000
June,	69	3.81	.19	.16	.03	7.75	1.56	240,800
July,	75	1.07	.08	.06	.02	1.50	0.65	50,300
August,	71	2.31	.12	.10	.02	3.56	1.12	157,400
September,	65	4.83	.39	.29	.10	11.06	3.21	720,800
October,	56	3.49	.31	.11	.20	6.92	2.47	386,800
November,	48	5.04	.49	.37	.12	7.41	3.85	1,205,000
December,	48	6.24	.65	.40	.25	9.36	4.83	1,679,000
Average,	57	4.03	.34	.25	.09	7.00	2.52	577,100

Septic Tank A is an air-tight wooden tank, divided by a partition midway into two equal compartments. The sewage flows into one compartment and over the partition into the other compartment, from which it is drawn by means of a faucet halfway between the top and bottom on the side of the tank; the general custom at the experiment station being to allow the faucets by which the sewage enters and flows from the tank to remain open during a large portion of the day, and the sewage slowly passes through. The time of passage has varied during the year from twenty to thirty-six hours, the tank always being kept full of sewage. It was stated in the last report that, after more than a year's operation, there was very little sediment upon the bottom of the tank, and a scum of bacterial growths and fatty matters about ½ inch in thickness upon the surface of the sewage in the tank and adhering to the under side of the cover of the tank. At the end of 1899 there was about 3 inches in depth of sediment in the first compartment of the tank and about 1 inch in depth in the second compartment. It will be seen from the tables of analyses, when compared with the tables given in the report of the Board for 1898, that a considerably stronger sewage has entered the tank during 1899 than during 1898. It will also be seen that a greater percentage of the organic matter in the sewage has been removed from the sewage by the tank during 1899 than during 1898, the results being as follows: —

The total organic matter of the sewage entering, as shown by the albuminoid ammonia, was decreased 48 per cent. in 1898 and 65 per cent. in 1899; the carbonaceous organic matters, indicated by the determination of oxygen consumed from permanganate, were decreased 43 per cent. in 1898 and 54 per cent. in 1899. In short, the results obtained during 1899 have strongly indicated that the greater the amount of organic matter in the sewage entering a septic tank the greater will be the percentage reduction of organic matter by the tank treatment.

An analysis* of the gas from this tank gave the following result: carbonic acid 3.4 per cent., "heavy hydrocarbons" 0.3 per cent., oxygen 0.5 per cent., carbonic oxide 0.6 per cent., methane 78.9 per cent., nitrogen 16.3 per cent.

Treatment of the Sludge only in a Septic Tank.

The observation that the stronger the sewage entering a septic tank the greater is the percentage removal of organic matter suggests the idea that, where exceedingly large volumes of sewage are to be purified, as in the case of the sewage of a large city, this sewage could be passed through ordinary settling tanks, so constructed that the sludge settling to the bottom of these tanks could be flushed into a septic tank and this sludge alone be treated by septic tank action, instead of attempting to treat the whole of a city's sewage. Following up this idea, a septic tank was put in operation during September, 1899, to receive the strong sludge from settled sewage. The results of this experiment during the period of operation in 1899 were that 75 per cent. of the organic nitrogen in the sewage entering the tank and 73 per cent. of the carbonaceous matters, as shown by the determination of oxygen consumed, did not appear in the effluent from it, the time of passage of the sewage through the tank being forty-eight hours. It is apparent, however, at the time of writing this report, that the tank is slowly filling with undissolved organic matter.

* Made by Dr. A. H. Gill of the Massachusetts Institute of Technology.

Septic Tanks need not be Air-tight, neither need Light be excluded.

It was stated in the last report that it appeared to be doubtful if it was necessary to have a septic tank air-tight, and also doubtful if it was necessary to exclude light. During the year two small septic tanks were operated for several months, one being open to the air and light, and the other air-tight and covered. The results obtained, as shown by the average analyses of the sewage entering and the effluents from these two tanks, are as follows:—

Average Analyses of Sewage entering and Effluents from Open and Closed Septic Tanks.

[Parts per 100,000.]

	Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.				
		Total.	In Solution.			
Sewage entering the tanks,	3.26	.62	-	7.32	4.32	-
Effluent of open tank,	3.92	.35	.28	7.68	2.54	424,000
Effluent of closed tank,	3.88	.34	.25	7.46	2.42	443,000

In the case of the open tank, it can be said that a phenomenon took place that prevented the access of air to the sewage in the tank, and excluded the light almost as thoroughly as if care had been taken in the first place to make the tank air-tight and to exclude the light; that is, a thick scum of fats and bacterial growths formed over the surface of the sewage. This same result has been obtained upon a large scale more recently at Manchester, Eng., where it is proposed to utilize hereafter as septic tanks the already constructed open chemical precipitation tanks in the new scheme of treatment of the sewage of that city. The experiment herein given was carried on during the months of January, February and March, 1899, and the average temperature of the effluent of these septic tanks was 56 degrees F.

Gas formed in the Septic Tank.

At this temperature, — 56 degrees F., — and with the sewage passing through these septic tanks at a rate equal to an entire change of sewage once in thirty hours, a rapid evolution of gas began towards the end of the second month of operation, and from that time until the end of the experiment the gas evolved averaged about 1 gallon in volume for every 22½ gallons of sewage passing through the closed septic tank. It was evident from this experiment and from observations of the work of other septic tanks at the station that, to obtain the best results, sufficient time for the installation of the desired bacterial life is necessary, and that this time varies with different kinds of sewage and at different seasons. It is evidently not giving the septic tank process a fair trial to undertake to operate as a septic tank a tank constructed simply for a settling tank and of insufficient capacity and hence be obliged to pump from it every week or two the accumulated sludge. By this procedure the ripening of the effective bacterial growth within the tank is constantly interrupted, just as it is beginning to be effective.

Discussion of Septic Tank Results.

From the results obtained in England and at the Lawrence Experiment Station during 1898 and 1899 it has been fully demonstrated that the addition of a septic tank to a sewage purification plant may be made of great value in many instances. It has been stated many times in the reports of this Board that the matter in suspension in sewage is the chief factor in clogging the surfaces of intermittent sand filters. By the action of the tank a very large proportion of these matters in suspension is eliminated from the sewage when it flows from the tank. A certain portion changes its form and goes into solution in the sewage, while another portion is changed to the gaseous form and escapes; while undoubtedly at times, as has been repeatedly noticed at Lawrence, considerable very finely divided solid matter comes from the tank. This occurs at times when the movement of the gas in the tank disturbs the sludge, and, while only lasting for a few minutes at a time, causes considerable solid matter to flow out in suspension. The solid matter removed in this way is of such a nature, however, that it is rapidly oxidized when reaching the filter. It is shown by the results obtained at Lawrence that a greater percentage of change occurs with the carbonaceous matters entering the tank than with the nitrogenous matters. It is also evident, from observation, that the clogging of the surfaces of intermittent sand filters is due largely to carbonaceous matters — cellulose, paper, etc. — rather than to nitrogenous matters. For example, the analysis of a typical sludge, which had covered in the form of a scum the surface of one of the beds at a filtration area of the State, showed that only 2.5 per cent. of it was organic nitrogen, while it lost 63 per cent. upon ignition, due to the large amount of carbonaceous matter present. Careful inspection has shown that, when these carbonaceous matters are exposed in comparatively thin layers upon the surfaces or near the surfaces of filters, and their destruction depends entirely upon oxidation, they will remain for a very long period without much change. In the septic tank, however, where the oxidizing actions are eliminated, and only the putrefactive bacteria live and work, this carbonaceous matter is more quickly attacked by them, with the evolution of carbonic acid gas and marsh gas.

Changes taking Place in the Septic Tank, as affected by the Composition of the Sewage entering the Tank.

The statement has already been made of the percentage removal of organic matter obtained by the septic tank at Lawrence, receiving ordinary sewage, and the practical non-accumulation of matter within a tank receiving sewage of ordinary strength. At Exeter, Eng., where the first septic tank of any considerable size was constructed, there was an accumulation during the first twenty-six months of its operation of about 1½ inches in depth of sediment per month,* and at the end of this period there had been a diminution in the capacity of the tank of 40 per cent. by this accumulation and surface scum. From the published analyses which we have been able to obtain of sewage entering the Exeter tank, it is probable that this sewage is fully as stale when entering as the sewage reaching Tank A at the Lawrence Experiment Station, where we had no accumulation worth mentioning during the first year of its operation, and the amount accumulated during the second year was slight and may largely disappear during the coming summer.

At both Exeter and Lawrence the amount of sediment that has accumulated within the tank is a very small percentage of the amount that has entered the tanks and been destroyed therein. It is also a very small percentage of what would have been sent to the filters if these tanks had been simply used as settling tanks, and the sludge pumped from them every few days. At Worcester,

* Second report Sewerage Commission, City of Baltimore.

Mass., where are large chemical precipitation works for treating the sewage of the city, the wet sludge from chemical precipitation is stated to be from 1 to 3 per cent. of the sewage treated. At Lawrence the percentage of sludge obtained, when experimenting with chemical precipitation, has been larger, owing to the smaller volumes of sewage treated, but, assuming that the suspended organic matter in the sewage which has entered septic tank A and has not flowed from it in the effluent had been concentrated in 1½ per cent. of the volume of sewage that has entered the tank, and had not been destroyed by bacterial actions within the tank, the accumulation during the twenty-six months of operation up to Jan. 1, 1900, would have amounted to enough to fill the tank five times. Instead of this result, however, we have in the tank the small amount noted.

At Yeovil, Eng., results similar to those at Lawrence have been obtained with a tank equal in capacity to that at Exeter, Eng., that is, no serious accumulation of matter within the tank. At Exeter, all the sewage is domestic sewage, while at Yeovil there is a large admixture of liquid refuse from breweries and other industrial works. Judging from analyses published, the sewage entering the Yeovil tank is staler than the sewage entering the Exeter tank, and, from statements made of the capacity of the two tanks and the volume of sewage passing through them, it would seem probable that the Yeovil sewage is longer within the tank than the Exeter sewage. It is probable that the fresher the sewage entering a septic tank — that is, the less the bacterial and mechanical action that it has undergone — the greater might be the accumulation of matters within the tank. The percentage reduction of organic matter in the tank might also vary not only as the freshness or staleness of the sewage entering varied, but as the character of the sewage varied. Some manufactural wastes probably would aid hydrolysis in the tank, and others probably would impede hydrolysis.

Bacteria in the Septic Tank, and Increasing the Surface for their Growth.

The theory of the septic tank is that the bacteria living in it are those which thrive without the presence of air, and hence cause putrefaction. It is evident, from our experiments, that the bacteria in the tank that do the larger proportion of the work live on the sides, bottom and top of the tank, where organic matter accumulates, and where they are found in enormous numbers compared with the numbers found in the liquid that is passing through the tank; hence a recent experiment has been inaugurated, in which sewage is passed upward through a tank filled with broken stone, the idea being that this broken stone, filling approximately 40 per cent. of the space of this tank, will afford a very extensive foothold and breeding-place for the necessary classes of bacteria. As the sewage enters at the bottom of the tank, the sludge accumulates there, if it accumulates at all, there is practically an upward filtration carried on, and the sewage passing upward meets and is acted upon by the bacteria growing upon the surfaces of the broken stone. The sewage is twenty-four hours passing through. The average analyses of the sewage entering this septic upward filtration tank — No. 133 — and the effluent from the tank are here presented.

Sewage applied to and Effluent from Filter No. 133.

[Parts per 100,000.]

	Ammonia.			Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.			Nitrates.	Nitrites.		
		Total.	In Solution.					
Sewage, . . .	5.19	.65	.33	7.83	.00	.00	4.96	2,556,000
Effluent, . . .	5.30	.29	.23	8.56	.00	.00	3.11	704,000

Application of Septic Sewage from Tank A to Filters.

Filters Nos. 100, 103, 116 and 118, the operation of which was described in the last report, have been continued during 1899. Each of these filters is $1/20,000$ of an acre in area. Filters Nos. 100 and 118 contain 5 feet in depth of sand of an effective size of 0.23 millimeter; Filter No. 116 contains 5 feet in depth of sand of an effective size of 0.17 millimeter; and Filter No. 103 contains 5 feet in depth of small pieces of coke of such a size that all will pass through a sieve with a quarter-inch mesh and but few through a sieve with an eighth-inch mesh. Filters Nos. 100, 116 and 118 are intermittent sand filters, and each of them has been operated during a large portion of the year at a rate of 300,000 gallons per acre daily; while Filter No. 103 is a contact filter, and has been operated during the year at the average rate of 666,000 gallons per acre daily. The sewage applied to these filters has been the effluent of Septic Tank A (see table, page 421), and the results obtained from them during the year are presented in the following tables: —

Effluent of Filter No. 100.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	200,000	50	43	2m.	Decided.	.39	0.6067	.0880	7.68	2.82	.0028	0.80	47,200
February,	200,000	48	41	3m.	Decided.	.29	0.4340	.0668	7.92	3.08	.0064	0.67	45,800
March,	300,000	48	43	2m.	Decided.	.31	0.3850	.0720	6.77	2.62	.0032	0.63	44,300
April,	300,000	52	49	2m.	Decided.	.23	0.4233	.0733	5.70	3.11	.0030	0.53	28,900
May,	300,000	58	57	2m.	Slight.	.23	0.7067	.0687	7.77	3.66	.0042	0.71	26,400
June,	300,000	69	70	2m.	V. slight.	.21	0.3800	.0482	6.78	2.82	.0035	0.48	31,900
July,	300,000	75	76	2m.	V. slight.	.18	0.1190	.0430	2.25	1.28	.0006	0.36	200,000
August,	222,200	71	69	2m.	Decided.	.11	0.1290	.0270	2.70	1.65	.0012	0.26	4,600
September,	242,300	65	68	2m.	Decided.	.40	1.2567	.1267	10.47	2.12	.0041	1.08	17,900
October,	300,000	56	53	3m.	Decided.	.35	0.8733	.0913	9.49	2.52	.0020	0.79	14,500
November,	230,800	48	43	3m.	Decided.	.36	0.9000	.0640	7.28	3.87	.0020	0.73	7,500
December,	300,000	48	49	20m.	Decided.	.46	1.3000	.1190	9.09	3.50	.0175	1.03	28,200
Average,	265,400	57	55	4m.	-	.29	0.6262	.0757	6.99	2.75	.0041	0.67	41,700

Sewage applied, 5 gallons septic sewage twelve times a week, January 1 to February 28; 5 gallons septic sewage eighteen times a week, March 1 to December 31. Filter not operated August 16 to August 21, August 30 to September 5, November 20 to November 25. Filter not scraped or raked.

Effluent of Filter No. 103.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	773,000	50	44	Decided.	.40	0.5800	.0860	7.40	1.74	.0011	0.69	72,800
February,	700,000	48	44	Decided.	.34	0.3668	.0696	7.95	1.96	.0021	0.65	93,400
March,	700,000	48	42	Decided.	.33	0.2833	.0693	6.63	1.88	.0022	0.60	96,000
April,	700,000	52	51	Decided.	.29	0.3000	.0653	5.41	2.13	.0016	0.46	30,600
May,	700,000	58	58	Decided.	.31	0.7167	.0673	8.00	2.58	.0031	0.54	51,900
June,	700,000	69	71	Slight.	.25	0.5025	.0895	9.02	2.62	.0034	0.64	12,300
July,	700,000	75	75	Slight.	.17	0.2605	.1620	1.62	1.26	.0006	1.26	33,600
August,	518,500	71	70	Decided.	.29	0.3500	.1250	2.32	2.43	.0008	1.06	33,400
September,	565,400	65	66	Decided.	.39	0.8267	.1033	9.75	2.15	.0070	0.89	99,500
October,	700,000	56	56	Decided.	.43	0.5800	.0650	9.76	2.34	.0025	0.84	42,900
November,	538,500	48	44	Decided.	.43	0.9600	.1060	7.35	2.99	.0030	0.82	44,600
December,	700,000	48	50	Decided.	.52	1.3400	.1280	9.01	3.50	.0175	1.03	109,400
Average,	666,300	57	56	....	.35	0.6139	.0964	7.02	2.30	.0040	0.79	60,200

Sewage applied, 5 gallons septic sewage forty-eight times a week, January 1 to January 23; 5 gallons septic sewage forty-two times a week, January 24 to December 31. Filter allowed to rest August 6 to August 21, August 30 to September 5, November 20 to November 25.

Effluent of Filter No. 116.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January,	200,000	50	47	41m.	None.	.12	.0760	.0252	7.31	3.39	.0083	.26	51
February,	200,000	48	47	17m.	None.	.12	.2514	.0554	7.99	3.66	.0090	.28	189
March,	300,000	48	48	36m.	None.	.11	.1890	.0293	7.03	3.05	.0094	.31	303
April,	156,000	52	51	38m.	None.	.10	.0923	.0206	5.01	2.22	.0100	.23	66
May,	267,000	58	59	21m.	None.	.13	.7650	.0440	7.24	3.79	.0210	.37	534
June,	300,000	69	69	12m.	None.	.11	.1685	.0441	8.29	3.83	.0120	.26	57
July,	292,000	75	76	1h. 5m.	V. slight.	.09	.0346	.0134	1.05	0.89	.0040	.17	981
August,	222,000	71	71	20m.	V. slight.	.08	.0284	.0111	2.79	1.98	.0091	.15	251
September,	242,000	65	65	41m.	V. slight.	.09	.0391	.0235	13.76	3.32	.0026	.28	1,487
October,	292,000	56	61	58m.	V. slight.	.14	.0372	.0230	9.85	4.86	.0034	.28	53
November,	222,300	48	47	45m.	V. slight.	.17	.4700	.0310	7.45	3.63	.0016	.40	830
December,	300,000	48	49	38m.	V. slight.	.25	.3156	.0330	9.82	4.31	.0026	.48	188
Average,	249,400	57	58	36m.	-	.13	.2056	.0295	7.30	3.20	.0078	.29	412

Sewage applied, 5 gallons septic sewage twelve times a week, January 1 to February 28; 5 gallons septic sewage eighteen times a week, March 1 to December 31. Surface raked 3 inches deep February 1, March 22, July 24, October 9. Beginning November 9, surface raked 3 inches deep weekly to December 31. Filter not operated August 17 to August 22, August 30 to September 5, November 20 to November 25. April 16 to May 3, experiment interrupted by freshet.

Effluent of Filter No. 118.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January,	188,000	50	44	1h. 37m.	V. slight.	0.20	2.1200	.0507	7.31	1.70	.0418	0.43	25,500
February,	192,000	48	43	40m.	V. slight.	0.27	1.1100	.0550	8.19	2.27	.2300	0.70	25,300
March,	300,000	48	44	15m.	Slight.	0.28	0.4100	.0628	6.96	2.35	.2980	0.82	68,200
April,	156,000	52	45	10m.	Slight.	0.28	0.0778	.0666	5.19	1.95	.2600	0.69	14,900
May,	267,000	58	57	10m.	Slight.	0.39	0.5675	.0745	7.14	2.20	.3300	0.98	15,200
June,	300,000	69	69	10m.	V. slight.	0.22	0.1288	.0334	8.69	3.54	.1485	0.49	2,100
July,	300,000	75	75	11m.	V. slight	0.11	0.0107	.0194	1.72	1.08	.0015	0.21	800
August,	222,000	71	69	10m.	V. slight.	0.14	0.0165	.0138	3.02	1.78	.0012	0.17	1,100
September,	242,000	65	65	14m.	Slight.	0.13	0.0976	.0289	13.58	3.43	.0150	0.35	6,100
October,	300,000	56	55	9m.	V. slight.	0.14	0.1287	.0241	10.21	3.18	.0020	0.29	840
November,	230,800	48	42	5m.	Slight.	0.26	0.4550	.0450	7.44	2.81	.0074	0.52	1,789
December,	296,000	48	47	54m.	Decided.	1.10	2.0090	.1620	9.10	2.03	.0450	1.80	18,970
Average,	249,500	57	55	24m.	-	0.29	0.5943	.0530	7.38	2.35	.1150	0.62	14,650

Sewage applied, 5 gallons septic sewage twelve times a week, January 1 to February 28; 5 gallons septic sewage eighteen times a week, March 1 to December 31. Surface raked 3 inches deep on following dates: January 25, February 11, December 16. Beginning February 21 and ending November 14, surface of filter was raked 3 inches deep each week. Filter not operated August 17 to August 22, August 30 to September 5, November 20 to November 25. Experiment interrupted by freshet April 16 to May 3.

Discussion of the Results of Filtration of Septic Sewage from Tank A.

Examining the results here tabulated, it will be noticed that a considerably purer effluent and one with less turbidity and odor was obtained from Filter No. 118 than from its duplicate, Filter No. 100; this being probably due to the fact, as explained in the previous report, that the septic sewage applied to Filter No. 118 is aerated before application, thus perhaps freeing it from certain bodies inimical to bacterial life, which enter Filter No. 100, receiving unaerated septic sewage, and also supplying a certain amount of oxygen to the sewage. The average rate of filtration of these two filters has approximated 250,000 gallons per acre daily, yet, after more than two years' operation, the sewage generally passed below the surface of Filter No. 100 within two minutes after application each day. On Filter No. 118 it remained somewhat longer, owing to the fact that by the method of applying the sewage the surface is compacted rather than disturbed; the freedom from surface clogging in both instances, however, being largely due to the small amount of matter in suspension in the septic sewage applied. It will be noticed that Contact Filter No. 103, operating at a rate two and one-half times as great as these intermittent sand filters, has produced nearly as good an effluent as Filters Nos. 100 and 118 but considerably less pure than the effluent of Filter No. 116. During a portion of the year — namely, from June 12 to September 5 — this filter was operated differently — that is, flooded more quickly — than during the rest of the year, and with somewhat poorer results.

Prolongation of the Anaerobic Action may impede Subsequent Purification of Sewage.

During the year 1898 a system of sewers and a filtration area was constructed in Andover, Mass. As the conditions seemed to afford an opportunity to study the septic process upon a somewhat larger scale than had been carried on at the experiment station, a septic tank of a capacity of about 9,000 gallons and two experimental filters 1/200 of an acre were constructed at the area. One of these filters was filled with 5 feet in depth of fairly coarse sand of an effective size of 0.23 millimeter, while the other filter contains 5½ feet in depth of coke, most of which would pass through a sieve with a half-inch mesh. There is a considerable proportion of large pieces of coke, however, but the material is free from coke dust. These filters were put in operation the first week in July, 1899, the sand filter being started as an intermittent filter at the rate of 40,000 gallons per acre daily, and the coke filter as a contact filter at the rate of 860,000 gallons per acre daily. The rate of the sand filter was increased in October to approximately 110,000 gallons per acre daily, and in November to 220,000 gallons per acre daily.

The amount of sewage reaching the town filtration area has averaged about 70,000 gallons per day during the year, and it is a very strong sewage, as shown by the table of analyses given beyond. The volume of the sewage is slowly increasing at the present time, as more connections are made with the sewers; but, with the comparatively small volume now flowing, the sewage is practically twenty-four hours in reaching the area, and is stale when arriving at and entering the septic tank. The sewage, in the condition in which it reaches the area and flows upon the town beds, not operated at a high rate, is fairly well purified by these beds. When flowing to the experimental filters, however, after having been practically twenty-four hours in the septic tank, it is in a condition very difficult to purify. When operating the experimental sand filter at a low rate, fairly good results were obtained in warm weather, although the amount of free ammonia in the effluent was larger than would be expected, even though the sewage applied was very strong. When the rate of operation of this filter was increased, nitrification became much less active and had practically ceased by the end of November.

During this period we had been unable to obtain any nitrification whatever in the coke contact filter, although this filter was not operated at a rate greater than filters had been operated at the station with strong station sewage with satisfactory results; and various efforts were made, by aerating the sewage before passing it to the filter and by slow filtration for several days at a time, etc., to encourage nitrification. The sewage applied to the filters has not averaged stronger in albuminoid ammonia or oxygen consumed from permanganate than has the sewage at the experiment station during some years, but the amount of free ammonia present is more than twice as great as the average amount in the experiment station sewage. The amount of chlorine, while greater than that in the Lawrence sewage at the experiment station, is not enough in quantity to impede nitrification, as various investigations with tannery sewage, etc., previously reported, have illustrated.

It seems probable — although this is not yet proved — that the anaerobic action has been carried so far before the sewage reaches the filters that various bodies have been generated in the sewage which prevent the development of the nitrifying bacteria in the filters. The sewage has an odor more nearly resembling that of the wastes from a cesspool than that of ordinary fresh, stale or septic sewage. It is certain that, if the anaerobic process is carried too far, there may be a formation of distinctly poisonous bodies, which might prevent nitrification. It is possible, however, that the coke in this particular instance is of such a nature that it does not, when used as a filtering medium, furnish the proper conditions for the promotion of nitrification and the formation of sodium and potassium nitrate. This will receive further study during 1900. Whatever may be the cause, it must be stated that this septic tank experiment is not, so far, satisfactory, neither the tank nor the filters producing favorable results. The following tables present the results of analyses of the sewage as it reaches the area and enters the septic tank, the tank effluent and the effluents of the two filters: —

Monthly Averages of Analyses of Andover Sewage.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Total.	In Solution.	In Suspension.			
July,	-	8.77	0.68	0.60	.08	19.79	4.84	3,000,000
August,	64	9.00	1.02	0.59	.43	14.60	6.25	1,683,000
September,	62	9.20	1.12	0.81	.31	11.90	6.87	3,470,000
October,	55	9.40	1.60	1.30	.30	10.92	7.73	2,350,000
November,	50	13.05	2.05	1.58	.47	15.74	11.35	5,335,000
December,	44	9.10	1.27	0.98	.29	20.79	7.50	6,793,000
Average,	55	9.75	1.29	0.98	.31	15.62	7.42	3,772,000

Monthly Average of Analyses of Sewage from the Experimental Septic Tank in Andover, Mass.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Free Ammonia.	Albuminoid Ammonia. Total.	Albuminoid Ammonia. In Solution.	Albuminoid Ammonia. In Suspension.	Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
July,	-	8.03	0.51	.46	.05	22.93	4.57	653,000
August,	64	9.49	0.73	.54	.19	22.74	5.48	840,000
September,	62	9.70	0.74	.65	.09	17.58	5.45	1,450,000
October,	56	10.20	0.81	.73	.08	15.30	5.80	1,373,000
November,	50	8.70	0.93	.78	.15	11.55	6.80	5,950,000
December,	44	9.67	1.09	.89	.20	11.68	6.77	6,480,000
Average,	55	9.30	0.80	.68	.12	16.97	5.81	2,791,000

Effluent of the Andover Experimental Sand Filter.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Seven Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
July,	40,000	-	-	None.	0.07	0.6667	.0160	20.23	1.23	.0626	0.22	4,500
August,	40,000	64	75	None.	0.05	0.6850	.0160	21.94	5.47	.0098	0.22	400
September,	40,000	62	64	None.	0.07	0.2727	.0212	18.61	4.87	.0007	0.25	4,898
October,	111,300	56	55	Slight.	0.26	3.9250	.0670	18.01	1.54	.0583	0.92	30,950
November,	220,800	50	47	Slight.	0.44	5.7000	.1380	10.89	0.46	.0095	1.21	176,600
December,	220,800	44	41	Decided.	1.47	8.5100	.2707	14.28	0.03	.0017	2.09	466,000
Average,	112,150	55	56	-	0.39	3.2932	.0682	17.33	2.27	.0238	0.82	113,900

October 18 surface of the filter was badly clogged, and after 3 days rest it was raked to the depth of 3 inches. From this date the surface was raked 1 inch deep each week.

Effluent of the Andover Experimental Coke Contact Filter.

[Parts per 100,000.]

1899.	Quantity Applied.	Temperature. Deg. F.		Appearance.		Ammonia.			Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Gallons per Acre Daily for Seven Days in a Week.	Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.			Nitrates.	Nitrites.		
							Total.	Soluble.					
July, . .	860,000	-	-	Great.	*	6.9500	.4500	.3000	24.71	.019	.0030	3.20	681,200
August, .	860,000	64	65	Great.	*	7.3500	.5000	.4100	24.31	.032	.0000	4.15	812,900
September, .	860,000	62	63	Great.	*	7.2700	.5300	.4500	18.11	.014	.0003	4.27	661,700
October, .	500,000	56	55	Great.	.72	7.8500	.6300	.5100	15.46	.020	.0000	4.27	903,400
November,	1,036,000	50	50	Great.	.73	6.8000	.6700	.6500	11.07	.027	.0015	5.06	270,000
December,	1,036,000	44	44	Great.	.87	9.4700	.8000	.6900	11.75	.016	.0000	4.90	4,027,000
Average,	873,700	55	55	-	-	7.6200	.6100	.5100	17.57	.021	.0008	4.31	1,226,000

July 10 to August 19 sewage was applied until surface of the filter was covered, filter stood full four hours and then drained slowly; August 20 to October 9 sewage was applied in two equal volumes; October 10 to November 17 volume applied reduced; November 18 to December 31 a continuous stream of sewage passed through the filter, at rate of 6.1 gallons per minute. September 8 to 12 filter not operated.

* Black.

Bacterial or Contact Filters.

The so-called bacterial filters are always constructed of coarse material, and the entire depth of the filter is brought into contact with the sewage applied each day; that is to say, the entire open space of the filter is filled with sewage daily or even several times daily. The name "bacterial filter" is misleading, as an intermittent sand filter is as truly a bacterial filter as these filters of coarse material; "contact filter" is a more suitable term, although it is not entirely satisfactory.

During the year 1899 there have been four coke or cinder contact filters in operation at the station; namely, Filters Nos. 82, 103, 107 and 108. The construction of, and the results obtained from Filter No. 103 have been described in connection with the discussion upon septic sewage. The general construction, methods of operation and rates of filtration of contact filters, and the degree of purification obtained by them at the experiment station, have been described in previous reports. It is here intended to discuss a few points in connection with them, upon which our investigations have given us interesting results.

Permanency of Bacterial or Contact Filters.

The question of the permanency of contact filters is one of great importance; that is to say, the question whether the open space in the filter will ultimately become filled with mineral and organic matter, but especially mineral matter, so that the entire filtering material will have to be removed and washed if the filter is to be continued in operation, is one of practical moment. The results at the experiment station upon this point are as follows: —

The sewage at the station, consisting of house sewage and street washings, comes through a 2½ inch pipe, 4,300 feet long, reaching from a point in one of the city sewers to the station; and it was stated in the first extended report of the Board upon filtration of sewage — the report of 1890 — that the sewage reaching the station must of necessity contain less mineral matter in suspension than the sewage in the sewer, because some of the matter in suspension in the sewage as it enters the pipe is gradually deposited, and for this reason the pipe has to be flushed out by a stream from a city hydrant about once a month. On this account the filters do not receive quite as much sand with the sewage with which we flood them as they would if they received sewage directly from the sewer outlet, but they undoubtedly receive as much mineral matter, sand, etc., in suspension as they would from sewers conveying sewage of a separate system, — that is, sewage without the street washings. They probably also receive as much sand as would be the case with filters before reaching which the sewage was first passed through settling tanks or grit chambers. Analyses of the sewage as it reaches the experiment station, compared with analyses of sewage going upon filtration areas in the State, show that there is little difference in the average amount of mineral matter in these different sewages, and the proportion of the fixed solids to the total residue upon evaporation is fully as great with the Lawrence sewage as with most of the sewages of the cities and towns of the State which have filtration areas in use.

We have had in operation at the station contact filters of gravel, coke, cinders, cinders and ashes, broken stone, metallic iron, hematite, etc. The first of our contact filters were constructed of gravel stones, and operated in a manner different from that now followed and different from the English method, — Filters Nos. 15 and 16 (see report of the Board for 1895). Coke and cinder filters have been experimented with extensively for several years.

A contact filter containing $4\frac{1}{2}$ feet in depth of ashes and cinders, put in use in November, 1896, had become so badly clogged by the end of 1898, both by organic and mineral matter, but principally by organic matter, that we ceased to operate it (see report of the Board for 1898, page 452). In this case the material placed within the filter was (intentionally) not prepared as carefully as the material placed in a contact filter should be,—that is, there was a mixture of much fine material with the coarse material.

Another contact filter, Filter No. 82, was put in operation in September, 1897, and contained 5 feet in depth of cinders freed from fine material, such as ashes, small pieces of cinder, etc. This filter is in good working condition at the present time, is operating at the rate of approximately 560,000 gallons per acre daily, and is producing what must be considered a satisfactory effluent for a contact filter. At the end of two months' operation the interspace capacity of this filter had decreased about 12 per cent.,—that is, from about 55 per cent. open space to 43 per cent. open space; but since then to the present time there has been little or no decrease in this interspace that a short resting does not remove, showing that this clogging and decrease is caused largely at least by the accumulation of organic matter and not by mineral matter, and the filter is taking the same volume of sewage daily at the present time that it did at the beginning of December, 1897, three months after it was first put in operation. With the cinder in this filter, however, there is a tendency towards disintegration. This quality would vary undoubtedly with cinder from different kinds and grades of coal; and hard clinkers, free from easily disintegrated pieces, would certainly be a more satisfactory material.

Filter No. 103, the construction of which has been previously described (see page 427), and which has been in operation for two years, receiving septic sewage containing less mineral matter than the untreated station sewage, has shown a somewhat similar result; that is, a somewhat rapid decrease in the percentage of open space for the first two or three months, when a fairly permanent condition was reached, and the volume of sewage necessary to fill the filter to its surface remains practically the same. There is no tendency to disintegration observable in the coke in this filter, the particles being firm and clean at the present time. Similar results have been obtained with Filter No. 107 (cinder) and Filter No. 108 (coke).

In conclusion, it can be said that, judging from the operation of the contact filters at the station and for the period in which they have been in operation, beyond the first rapid decrease of 12 to 15 per cent. in open space, there is little change for a number of years, if sufficient resting is given from time to time; but the indications are that the coke used at Lawrence is from its nature a more permanent material than the cinders used at Lawrence. We must conclude therefore that much of the finely divided mineral matter, that enters with the sewage at the top of these filters with a large percentage of open space and large voids between the particles of material of which the filters are constructed, must to a very large extent pass away with the effluent from the filters.

Method of Operation of Contact Filters.

In England it is customary, where experimental contact filters have been operated or contact filters of a considerable size have been constructed, to have these filters in series of two, the depth of each filter being generally not more than 3 to 4 feet; the first filters in the series being filled in one flow of sewage, the sewage allowed to remain for a certain period in the filters, and then the effluent from these filters allowed to flow upon the second filters, which are also filled to the surface with one flow of sewage; that is to say, the sewage passes through 8 feet in depth of material if each of these filters is 4 feet in depth, and each filter is filled with sewage quite quickly.

At the experiment station at Lawrence the general method of operating the contact filters has been somewhat different; that is to say, instead of filling them with one flow of sewage, they are filled with successive applications of sewage, and by this means more air is introduced into the filter. It is also customary, with most of our filters, to fill each one but once daily.

Having the filters arranged as double contact filters increases the area of land required, compared with the area required for single contact filters; and if, with greater depth and more careful methods of flooding, the single contact filter can produce as good or nearly as good results, the cost of land and construction can certainly be minimized. It must be understood, however, that the effluents of contact filters do not approach the same degree of purity as the effluents of the best intermittent sand filters.

Limit of Period of Time that Sewage should remain within a Contact Filter to give the Best Purification.

By the method of flooding a contact filter followed in England and at Lawrence, air is introduced with the sewage. The Lawrence method of intermittent flooding introduces more air than the English method, as experiments at the station have proved and, as the sewage which enters the filter first is withdrawn first, all the sewage applied remains for approximately an equal period of time within the filter. It is evident that, if the action upon the sewage in the filter is to be that of oxidation entirely, the sewage should be withdrawn somewhat before the exhaustion of the oxygen occurs. Determinations of the *dissolved* oxygen in the effluents of contact filters made during the past year have shown that this exhaustion takes place usually within two or three hours from the completion of flooding, depending of course more or less upon the amount of air introduced at the time of flooding and the strength and state of the sewage applied. If the effluent is then withdrawn, it is of a slight earthy odor; and many tests have shown that secondary decomposition seldom occurs in it, even when held in bottles in a warm laboratory for several days, this fact being determined by the amount of oxygen *consumed* from permanganate at different periods after withdrawal from the filter. If it does not occur in the laboratory, it certainly ought not take place if this effluent flowed into a stream the water of which contained considerable dissolved oxygen to aid and continue the oxidation begun in the effluent as it leaves the filter.

Determinations of dissolved oxygen in the effluent of Filter No. 82, as it flows from the filter, have shown a variation during the first eleven months of the year from 3 per cent. of saturation to 23 per cent. saturation, with an average of 7 per cent. During December, when the surface of the filter had become somewhat clogged, no free oxygen was found in the effluent. The following table shows the average amount of free oxygen present in the effluents of many of the sewage filters during the year: —

Average Amount of Dissolved Oxygen in Effluents of Sewage Filters.

[Per cent. of saturation.]

1899.	Number of Filter.																				
	1	2	4	5	6	9	10	82	88	95	96	100	103	107	108	116	117	118	121	123	125
January,	24	68	84	65	63	50	50	6	80	80	2	56	21	2	5	75	-	105	-	-	-
February,	47	35	82	82	49	46	31	23	78	68	-	57	9	0	10	68	-	102	-	-	-
April,	69	43	62	78	6	67	46	0	78	66	3	51	2	0	6	78	-	92	0	-	-
June.	70	72	76	85	69	81	77	5	67	77	-	52	33	0	16	58	51	51	7	1	90
July,	80	86	91	92	82	84	82	9	79	92	-	82	78	0	76	80	77	79	-	-	97
August,	-	-	-	-	-	-	-	-	-	-	-	-	46	0	27	76	35	66	-	0	-
September,	56	80	-	40	63	63	70	4	72	40	-	48	27	1	11	42	21	21	8	1	2
October,	63	52	56	66	45	72	53	3	41	66	-	48	2	-	8	16	4	47	-	2	2
December,	52	75	75	87	46	35	57	0	27	64	-	21	1	-	10	38	-	18	-	-	3
Average,	58	64	75	74	53	62	58	6	65	69	3	52	24	-	19	59	38	66	5	1	39

Filters Nos. 82, 103, 107, 108, 117, 121 and 123 are contact filters; the remainder are intermittent filters, with the exception of Filter No. 125, which was an intermittent filter during June and July, and a contact filter during the remainder of the year.

Theory of the Action within a Contact Filter.

The effluents of properly constructed and operated contact filters contain very little organic matter in suspension. When the effluent flows from a filter, air is drawn into the filter again and fills the open space. Consequently a partial oxidation of the organic matter left within the filtering material proceeds until this oxygen is exhausted, when the open space is completely filled with the chief products of this oxidation, — namely, carbonic acid gas, marsh gas, nitrogen of the air primarily present and nitrogen liberated during decomposition, — and the filter will remain with its open space filled with these gases until they are removed by the introduction of sewage or air. This condition reached, the activity of the oxidizing and nitrifying bacteria within the filter ceases and anaerobic actions begin, which change a considerable portion of the organic matter adhering to the filtering material into forms easily soluble and oxidized by the air introduced when the filter is again flooded. On page 430 of the report of the Board for 1897 is given the result of a series of examinations of the atmosphere from the interior of a filter of coarse material, showing the almost complete exhaustion of oxygen in the course of a few hours and a large volume of carbonic acid gas present. Examinations made during 1899, of air from the interior of contact filters, have shown similar results.

With the double contact system and frequent and quick floodings daily the anaerobic and aerobic actions are more completely separated than is the case in the single contact filter; that is, the action taking place in the first filter is largely anaerobic and its effluent rarely contains dissolved oxygen, while in the second filter, receiving partially purified sewage, the action is largely aerobic, as shown by the presence of dissolved oxygen in the effluent. If the first filter was filled from below, however, and in this manner the access of air prevented, the separation would be more complete. For partial illustration of this, Filters Nos. 133 and 134, discussed on pages 426 and 450, are examples, and also Filters Nos. 107 and 108 (see page 444).

Comparison of Aerated Filters Nos. 15 B and 16 B with Bacterial or Contact Filters.

That the cycle of anaerobic and aerobic actions upon the sewage in the filters is of advantage, not only in obtaining good purification but in preventing the accumulation of organic matter in the interspace of filters and the consequent clogging, is well proved by a comparison of the action of the aerated Filters Nos. 15 B and 16 B (formerly in operation at the station) with the results obtained from contact filters in more recent years.

Filters Nos. 15 B and 16 B were put in operation in 1892, and contained 5 feet in depth of coarse gravel stones of an effective size of 5.10 millimeters, and were operated at a rate of approximately 500,000 gallons per acre daily. Through these filters currents of air were drawn almost continuously. This experiment was carefully conducted, and we know that, while occasionally perfect aeration was not obtained, generally it was accomplished, and immense volumes of air, as compared with the volume of sewage purified, were forced through every part of these filters. As a result, fair purification was obtained. In the report of the Board for 1895, page 469, the following statement was made: "It is noticeable that the organic matter in the liquids after rapid filtration combined with aeration is of a different character from the organic matter in the sewage resulting from other sludge-removing processes. That is to say, even when the organic matter, as shown by the albuminoid ammonia, is present in quantities as great as in the other partially purified sewages, it has passed through such chemical and biological changes that it develops offensive odors very slowly on standing." These aerated filters became so clogged with organic matter from time to time, however, that in order to continue them in operation all the filtering material had to be removed and washed, aeration failing completely to destroy or oxidize this organic matter; and determinations of the amount of organic matter in this wash water showed that a very large percentage of that applied with the sewage was stored in the filters and removed by the washing. This organic matter was of a granular character, not at all offensive, but rather of an earthy odor.

In these filters we were depending entirely upon oxidation, allowing no opportunity for anaerobic action within the filter, as in the present contact filters, and hence the organic matter applied in the sewage was not given an opportunity to become putrefied — that is, broken down by the rapid anaerobic actions — and thus changed into bodies easily oxidized. Even when resting the aerated filters at times of clogging, we drew air through them, still depending upon oxidation, while recent experiments have demonstrated that we could have more quickly removed the stored organic matter in them if we had kept them full of sewage and depended entirely upon anaerobic action. We have operated the contact filters for longer periods, at higher rates and without causing clogging, and obtained more satisfactory effluents. In fact, the results of the operation at the station of aerated filters, of the class of which Nos. 15 B and 16 B are a type, compared with the results obtained with contact filters, have apparently demonstrated the superiority of the latter method, the better results obtained being due undoubtedly to causes already explained.

Results obtained from Contact Filters — 1899.

A description of three of the contact filters in operation during 1899 is here given; a description of Filter No. 103 having been given on page 427, and a description of Filters Nos. 121, 123 and 125 on page 474.

Double Contact Filters Nos. 107, $\frac{1}{20000}$ of an Acre in Area, and 108, $\frac{1}{18000}$ of an Acre in Area.

Filters Nos. 107 and 108 were put in operation during 1898, and the results during that year have been given in the report of the Board. They were continued in operation during 1899. Filter No. 107 contains 2 feet in depth of cinders freed from ashes, and Filter No. 108 contains the same depth of pieces of fine coke free from dust; at the beginning of the year Filter No. 107 was operating at the rate of 726,000 gallons per acre daily and Filter No. 108 at the rate of 600,000 gallons per acre daily. The method of operation was as follows: —

To Filter No. 107 sewage was applied once daily until the interspace of the filter was full. After remaining within the filter two hours, this sewage was run to the surface of Filter No. 108, somewhat larger in area, which explains the somewhat lower rate of filtration. They were operated for periods of six weeks and then allowed to rest for one week. By this method of treatment a degree of purification has been obtained, shown by the following tables of average analyses of the effluents during the year: —

Effluent of Filter No. 107.

[Parts per 100,000.]

1899.	Quantity Applied — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January,	726,100	49	45	Great.	0.68	2.2800	.3770	10.50	0.50	.0080	2.82	764,000
February,	600,000	49	47	Great.	0.55	2.0200	.3120	7.45	0.52	.0150	2.47	864,000
March,	500,000	48	49	Great.	0.50	1.0800	.2710	5.93	0.64	.0140	2.50	965,000
April,	432,000	47	49	Great.	0.53	1.8000	.2500	5.98	0.56	.0180	1.88	186,000
May,	720,000	56	57	Great.	0.57	1.5400	.2000	5.17	1.40	.0407	1.72	435,000
June,	526,000	68	70	Decided.	0.49	0.5187	.1273	3.17	0.78	.0253	0.96	122,500
July,	564,000	74	73	Slight.	0.36	0.0064	.0842	0.47	0.49	.0003	0.35	7,500
August,	533,000	70	70	Decided.	1.05	2.1750	.1120	8.38	0.62	.0400	1.17	144,000
September,	600,000	65	65	Great.	0.50	2.0000	.3700	11.82	0.47	.0006	2.50	1,050,700
Average,	584,500	56	58	–	0.58	1.6200	.2302	6.55	0.66	.0188	1.83	503,300

Sewage applied, 20 gallons sewage twelve times a week, January 1 to January 24; 18 gallons sewage twelve times a week, January 25 to September 30. Filter was operated in periods of five weeks each, and allowed to rest one week between each period. April 18 to April 30, experiment interrupted by freshet.

Effluent of Filter No. 108.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, . .	599,000	45	46	Great.	.61	.8600	.1680	8.90	1.53	.0060	1.86	323,000
February, . .	495,000	47	47	Great.	.45	.6200	.1467	7.42	1.42	.0067	1.29	396,000
March, . . .	462,000	49	47	Great.	.41	.6500	.1500	5.69	1.46	.0040	1.87	265,000
April, . . .	356,000	49	49	Decided.	.40	.4500	.1200	5.12	1.41	.0082	0.94	175,000
May, . . .	594,000	57	58	Great.	.53	.4900	.1067	4.90	2.22	.0057	0.85	177,000
June, . . .	434,000	70	72	Decided.	.40	.1113	.0747	3.86	1.51	.0070	0.60	226,400
July, . . .	457,000	73	72	Slight.	.26	.0046	.0527	0.60	0.70	.0001	0.37	66,000
August, . . .	440,000	70	70	Decided.	.64	.6500	.0680	7.25	1.61	.0035	0.74	49,000
September, . .	503,000	65	65	Great.	.48	.8600	.1840	11.78	1.99	.0150	1.56	382,000
Average, . .	482,200	58	58	-	.46	.5218	.1190	6.17	1.54	.0057	1.01	228,800

Sewage applied, 20 gallons of effluent of Filter No. 107 twelve times a week, January 1 to January 20; 18 gallons of effluent of Filter No. 107 twelve times a week, January 25 to September 30. Filter was operated in periods of five weeks each, and allowed to rest one week between each period. April 18 to April 30, experiment interrupted by freshet.

Filter No. 82.

Filter No. 82 contains 5 feet in depth of cinders freed from fine material, and was first put in operation in September, 1897. The results obtained by it during 1899 are shown by the following table: —

Effluent of Filter No. 82.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, . .	623,000	49	45	Great.	.39	0.7000	.1687	7.39	0.99	.0027	1.19	425,000
February, . .	623,000	49	48	Great.	.42	0.5900	.1530	7.18	1.22	.0088	1.13	405,100
March, . . .	471,400	48	46	Great.	.50	0.9200	.1520	7.16	0.93	.0012	1.21	258,000
April, . . .	623,000	47	53	Decided.	.41	0.7800	.1160	6.50	1.28	.0018	0.82	239,000
May, . . .	623,000	56	60	Decided.	.42	0.9300	.1453	8.21	0.88	.0060	0.93	385,000
June, . . .	599,000	68	71	Great.	.42	0.9300	.1193	8.33	0.91	.0153	0.96	434,000
July, . . .	623,000	74	74	Slight.	.39	0.0900	.0520	0.93	0.47	.0053	0.36	143,000
August, . . .	138,400	70	-	-	-	-	-	-	-	-	-	-
September, . .	503,200	65	72	Great.	.45	1.6000	.2280	11.68	0.08	.0140	2.16	253,000
October, . .	558,000	57	56	Great.	.35	0.4800	.1030	5.47	0.76	.0290	0.96	252,900
November, . .	480,000	47	47	Great.	.40	0.5800	.1100	6.40	0.76	.0070	0.99	434,000
December, . .	455,300	46	45	Great.	.65	1.7500	.1770	6.64	0.25	.0030	1.58	417,800
Average, .	526,700	56	56	-	.44	0.8500	.1270	6.32	0.78	.0081	1.12	331,500

Sewage applied, 10 gallons forty-two times a week, January 1 to May 28; 70 gallons six times a week, May 29 to September 27; 70 gallons six times a week, September 28 to October 9; 10 gallons forty-two times a week, October 10 to December 31. January 1 to February 28 surface remained covered three hours daily; March 1 to December 31, surface remained covered five hours daily. Filter not operated, March 20 to March 26, August 2 to August 23, August 30 to September 5, November 21 to November 25, December 4 to December 9. Surface dug over to a depth of 3 inches, March 20; 6 inches, October 18; 8 to 10 inches, December 8.

Comparison of the Result of Double Contact Filters (Nos. 107 and 108) with the Result from Filter No. 82.

While a direct comparison of the results obtained from this double contact filtration with shallow filters with those obtained from single contact filtration in a deeper filter cannot be made, owing to the fact that Filter No. 82 contained cinders throughout its entire depth, while Filter No. 108 was constructed of coke, still, it is interesting to observe that the average rate, considering the depth of material employed and estimating Filters Nos. 107 and 108 as one filter, was practically the same; but the result in percentage of organic matter removed was slightly greater with the double contact filters than with the single Filter No. 82, and nitrification was considerably greater, this undoubtedly being due partly to the better work performed by a coke filter than by our cinder filters, partly to the separation of aerobic and anaerobic actions and partly to the thorough aeration obtained when passing the effluent from Filter No. 107 to Filter No. 108. The dissolved oxygen in the effluent of Filter No. 108 for the year averaged 19 per cent. of saturation, while the dissolved oxygen in the effluent of Filter No. 82 during the year averaged 6 per cent. of saturation; and occasionally the effluent of Filter No. 82 contained no free oxygen, while it was never absent from the effluent of Filter No. 108. The effluent of Filter No. 107 seldom contained even a trace of dissolved oxygen.

Sand Filtration of the Effluent of Contact Filters.

Filter No. 124, $\frac{1}{20000}$ of an Acre in Area.

Beginning in May and continuing throughout the year, the effluent of Contact Filter No. 82 was applied to a filter containing 5 feet in depth of sand of an effective size of 0.19 millimeter. This filter purified this effluent efficiently at an average rate of 712,400 gallons per acre per day. The following table shows the quality of the effluent: —

Effluent of Filter No. 124.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
May, . .	679,000	60	54	-	V. slight.	.06	.7800	.0840	12.62	0.22	.0880	.29	25,800
June, . .	971,000	71	70	29m.	None.	.10	.3062	.0153	7.87	1.42	.0244	.16	1,420
July, . .	1,000,000	74	75	18m.	None.	.11	.0019	.0165	1.04	0.54	.0008	.28	2,270
August, .	218,000	75	68	-	V. slight.	.06	.0098	.0222	4.15	4.39	.0010	.16	-
September,	769,000	72	67	32m.	None.	.18	.0172	.0281	12.44	1.23	.0082	.34	1,568
October, .	846,000	56	57	30m.	None.	.16	.0090	.0232	6.77	1.77	.0059	.28	1,682
November, .	730,800	47	50	1h.17m.	None.	.15	.0287	.0234	7.62	1.50	.0023	.30	3,474
December, .	490,000	45	45	16h.	V. slight.	.31	.2204	.0436	7.67	1.22	.0070	.47	2,285
Average,	712,400	63	61	3h.11m.	-	.14	.1717	.0260	7.46	1.54	.0165	.28	5,500

Sewage applied, 5 gallons of effluent of Filter No. 82 six times a week, from May 16 to May 21; 12½ gallons of effluent of Filter No. 82 twelve times a week, from May 21 to May 28; 12½ gallons of effluent of Filter No. 82 twenty-four times a week, from May 29 to December 31. Surface raked 3 inches once each week. Surface dug over to a depth of 6 inches December 27. Filter not operated October 12 to October 16, November 20 to November 27, December 4 to December 11, December 23 to December 27.

Operation of Contact Filters in Winter Weather in New England.

All grades of sand, no matter how fine, can be used in intermittent sewage filtration. During summer weather the finer grades of sand produce the purest effluent, as can be seen from the results obtained with Filters Nos. 2 and 4 (see page 477); but in winter these fine sand beds are operated with more difficulty than beds of coarser sand, and especially is this the case with experimental filters. The difficulty is less apparent with the larger filters in operation at various towns and cities in the State. The coarser the sand in the filter and the greater the volume of each void between the sand grains, the more easily does the sewage enter the bed in the winter temperature of Massachusetts and the less danger is there of a bed becoming seriously affected by frost. A difference of a few degrees in the temperature of the sewage entering the sand causes a considerable difference in the degree of nitrification taking place within the filter in winter. The temperature of the sewage flowing in the Lawrence Street sewer (see table, page 418) averages about 50 degrees F. in the coldest months of the year, and the winter temperature of sewage reaching various filtration areas in the State averages during the winter months from 34 to 50 degrees F. The coarser the filter and the greater the readiness with which the sewage enters it, the less will be the heat lost from the sewage during its exposure upon the filter's surface; but with a filter of fine sand covered with sewage for many hours during a cold winter day, owing to the slowness with which the sewage can enter the pores of the filter, a considerable portion of the sewage entering will be at a temperature only slightly above the freezing point, as many observations at the experiment station during the past year or two have determined.

Filter No. 5 B, constructed of ashes and cinders, and the coarsest of the out-door filters, maintains better nitrification during the winter than any of the other out-door filters, and is operated more easily, as the sewage enters the filter readily as a general rule, is less chilled by exposure to the air on this account, and the temperature within the filter is, as a consequence, higher than is the temperature in the other out-door filters, this being shown by the slightly higher temperature of the effluent of this filter. The effluent of Filter No. 4 is apparently an exception to this; but the effluent flowing from this filter during the cold winter months represents sewage applied to the surface many weeks before, owing to the slow rate of filtration and the water capacity of this filter.

Owing to the coarse material used in contact filters and the rapid entrance of sewage at a temperature necessarily approximating that which it has when flowing from the sewer, there should be no difficulty in operating these filters and keeping them free from ice and frost, even in Massachusetts winter weather; especially as the sewage remains in the filter only a portion of the day, not longer than it often remains upon the surface of fine sand filters exposed to the cold winter air; and sewage near the upper portion of the filter only is exposed to the outside air, and very little ice would probably be formed. It also seems probable in this connection that filters of the construction of Filter No. 117 (see page 448) could be operated in winter weather, as the warm sewage from the sewers applied, passing through the filter in a period of time not greater than 1½ hours and often much less, depending upon the depth of filtering material and the rapidity of flow, would probably not lose so large a percentage of its heat as does the sewage when passing slowly, in the course of days, through an intermittent sand filter. The experimental coke contact filter at the Andover filtration area, described on page 430, was operated without difficulty and with very little formation of ice during the winter of 1899–1900, during a portion of this winter being operated as a contact filter and during a portion in the manner followed with Filter No. 117.

Septic Sewage and Winter Weather.

A filter of coarse sand can be operated with less accumulation of nitrogen, etc., in its upper layers than a filter of fine sand; and the more even distribution of the organic matter through the filter as occurs when the filter is of coarse sand allows greater facility of operation than a more dense accumulation in the surface sand, as occurs with filters of fine sand, and a smaller accumulation deeper in the filter. Filters Nos. 12 A, 13 A, 19 and 14 A could undoubtedly have been operated at as high rates as they were operated and have produced nearly as pure effluents if they had been constructed of coarser sand, and the upper few inches of filtering material would have been in better condition at the end of the period of operation of each filter than they were. This is well shown by a comparison of the nitrogen stored in the upper inch of Filter No. 116 and Filter No. 118. These two filters were operated at high rates and had received the same volume of septic sewage for the same length of time, but Filter No. 116 was constructed of fine sand of an effective size of 0.17 millimeter (the same grade as in the filters named above), while Filter No. 118 contained sand of an effective size of 0.26 millimeter. At the end of 1899 the upper inch of sand from Filter No. 116 contained 75 parts per 100,000 of nitrogen by weight, and that from Filter No. 118 43 parts per 100,000.

With intermittent filters constructed of either fine or coarse sand, considerable benefit might be derived in winter weather, as far as ease of operation is concerned, from the large volume of septic sewage that could be applied without surface clogging; that is, this sewage is generally quite free from matters in suspension, and hence enters the filter more quickly than when these matters settle out upon the surface of the filter, as occurs when untreated sewage is applied. It is true that large volumes of sewage are now applied in winter on various areas in the State, and insure freedom from frost; but this sewage, owing to the suspended matters present, passes below the surface very slowly, exposure of the surface of the finer filters to air is infrequent in cold weather and nitrification is comparatively poor, and the sewage entering is at a low temperature.

CONTINUOUS FILTRATION THROUGH A FILTER OF BROKEN STONE 10½ FEET IN DEPTH.

Filter No. 117, $\frac{1}{20000}$ of an Acre in Area.

As our experiments upon rapid filtration continued, it seemed probable from the results obtained that sewage could be purified satisfactorily even when passed continuously through filters of coarse material, if it was allowed to flow in such volume that the surface of the filter would never be covered with sewage, and air and sewage would be in intimate contact throughout the entire depth of the filter. Consequently, at the beginning of May, 1899, a filter was constructed of broken stone, all of which would pass through a screen with a 2-inch mesh and very little through a screen with a ½-inch mesh. This filter, 10½ feet in depth, received sewage for a large portion of its period of operation at the rate of 2,000,000 gallons per acre daily; the actual rate during the entire period of operation being 1,897,000 gallons per acre daily, or a rate nearly twice as great as we had ever before attempted. Through this filter the sewage flowed in a continuous stream, and by experiment it was demonstrated that most of it passed from the top to the bottom of the filter in less than 1½ hours. The rate of filtration here followed was nearly three times as great as that which we have been able to maintain with the contact filters and achieve good results, and from twenty to one hundred times as great as with intermittent sand filters receiving untreated sewage, but because of the depth of the filter, the coarseness of the filtering material and the method of operation followed, this filter has removed during its period of operation 85 per cent. of the organic impurities of the sewage applied to it as shown by the determinations of albuminoid ammonia, 73 per cent. as shown by the determinations of oxygen consumed, and 95 per cent. of the bacteria. The free ammonia in the effluent has always been low, the nitrates high, averaging 1.88 parts for its period of operation here described, and its effluent generally had very little odor and a considerable percentage of free oxygen (see table on page 439).

The regular station sewage was applied to the filter without any preliminary treatment. This sewage we class as stale sewage; that is, as explained in the last report of the Board, it is sewage of such age that it contains no free oxygen, but the anaerobic action has not been carried so far as in septic sewage, and consequently the organic matter is not so finely divided nor in a condition to be so easily oxidized as in septic sewage. In this filter also oxidation was depended upon entirely to destroy the organic matter, there being, owing to the system of operation, probably no period of the day when free oxygen was not present in the open space of the filter, and consequently the accumulation of carbonic acid and marsh gas and the encouragement of anaerobic action did not occur. On this account it might reasonably be expected that in the course of time this filter, operating at so high a rate, would become clogged by the more stable bodies in the sewage, which oxidation could not destroy quite as fast as they were applied in the sewage. To test this, late in the year two filters of a similar character but of a still greater depth were put in operation, — Filters Nos. 135 and 136, — one to receive station sewage and the other septic sewage. Filter No. 117 could have been operated at an equal rate as a contact filter. Whether as good results could have been obtained is not known at the present time, but will be determined during the coming year.

Effluent of Filter No. 117.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
May, . . .	1,877,000	58	64	Decided.	.60	0.1240	.1320	3.74	1.84	.8000	1.54	-
June, . . .	1,992,000	70	69	Slight.	.37	0.7546	.0725	6.55	1.16	.0200	0.64	98,500
July, . . .	1,996,000	73	76	Slight.	.27	0.4925	.0807	4.77	2.06	.0294	1.77	49,000
August, . . .	1,852,000	71	72	Slight.	.39	0.9700	.0610	8.43	3.92	.0085	0.58	58,800
September, . .	1,577,000	66	66	Decided.	.46	0.7600	.0987	6.41	1.14	.0050	0.82	157,500
October, . .	1,896,000	58	58	Decided.	.38	0.8443	.0960	5.71	1.30	.0038	0.91	93,000
November, . .	2,088,000	48	40	Decided.	.45	1.1400	.1330	6.12	1.75	.0065	1.34	407,000
Average, . .	1,897,000	63	63	-	.42	0.7265	.0963	5.96	1.88	.1247	1.09	144,000

Sewage applied, 100 gallons per day, May 22 to November 18. Filter not operated August 30 to September 5. October 13, surface dug over to a depth of 6 inches.

Filter No. 134, $\frac{1}{20000}$ of an Acre in Area.

Filter No. 134 is constructed of broken stone of the same grade as that in Filter No. 117, but is only 5 feet in depth. To it the effluent from the upward filtration septic tank (see page 426) has been applied during the last two months of the year, and the rate of filtration has been approximately 1,000,000 gallons per acre daily. Nitrification started during the second month of operation, as shown by the following average analyses: —

Effluent of Filter No. 134.

[Parts per 100,000.]

	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.		Nitrates.	Nitrites.		
November, . . .	3.92	.1760	7.91	.013	.0050	1.79	531,500
December, . . .	5.68	.1880	9.37	.173	.0173	1.64	154,000

Filters Nos. 135 and 136, $\frac{1}{20000}$ of an Acre in Area.

These filters contain 18 feet in depth of broken stone of approximately the same grade, although somewhat finer, as the stone used in Filter No. 117, just described. The sewage is applied in practically the same way as to Filter No. 117, but is distributed more evenly over the surface of each filter, by means of trays and automatic tipping basins that flush the sewage first over one portion of the surface of the filter and then over the other. To one of these filters — Filter No. 135 — the station sewage has been applied as applied to Filter No. 117, and to the other — Filter No. 136 — sewage which had been twenty-four hours in passing through a septic tank; the idea being that the organic matter in the septic sewage reaching Filter No. 136 would be in a condition more easily oxidized by the air always present in the interspace of this filter than would the organic matter in the ordinary station sewage applied to Filter No. 135. These filters were put in operation at an approximate rate of 1,000,000 gallons per acre daily. At the time of writing they have been in operation about four months, and no general conclusions can as yet be drawn from them. Started in a colder season of the year than Filter No. 117, nitrification did not begin as quickly, but nitrates began to appear in the effluents about three weeks after they were started. Determinations of dissolved oxygen showed that it was always present in the effluents during the first two months, in amounts equal to 50 and sometimes even 75 per cent. of that necessary for saturation. The surfaces were free from clogging, the appearance and character of the effluents were improving and both filters were apparently on the way to satisfactory nitrification and purification, when suddenly, that is, within a period of time equal to but a day or two, the effluents ceased to contain any dissolved oxygen, and the sewage while disappearing from the surface fast enough to prevent an entire covering of the surface at any time, still disappeared more slowly than had been the case previously. At this time both of these filters were in a like condition, together with Filter No. 134, previously described, which received the sewage from the upward filtration septic tank, and the filtering material was clogged. In this connection it is important to note that the septic sewage applied to Filters Nos. 134 and 136 was in both instances almost entirely free from matters in suspension, while on the other hand the sewage applied to Filter No. 135 had contained the usual amount of matters in suspension that we always find in regular station sewage. An examination of all three filters showed that the clogging, which extended to the depth of a number of feet and perhaps through the entire depth of each filter, was due to a quick and vigorous growth of Beggiatoa, with some slight amount of bacterial jelly, — a condition very different from what formerly occurred in Filters Nos. 15 B and 16 B, at times of clogging, already referred to on page 440; that is to say, this clogging was not caused, in two of the filters at least, by matters in suspension that had been caught by the filtering material, but by a vigorous vegetable growth, and this lived and increased upon the matters in *solution* in the sewage.

At this time the operation of all these filters was interrupted, and air was blown through them from below for two hours daily for a period of one week, and to them was applied each day a small amount of effluent from two of the contact filters in successful operation at the station, in order to re-establish nitrification. Following this treatment of Filters Nos. 134, 135 and 136, the clogging matter disappeared as rapidly as it grew, and the filters were again put into operation in the same manner as before this interruption, but at a lower rate, the idea being to increase the rate daily, through a period of three weeks, until it had attained the former rate of 1,000,000 gallons per acre daily. The filters under this treatment began to nitrify, and are now in successful operation. As they were in operation, however, only a little more than one month during 1899, tables of analyses are not presented here, but will be given in the next annual report of the Board.

Filter No. 131, $\frac{1}{10000}$ of an Acre in Area.

This filter consists of six separate sections or filters, one above the other, and each section contains 10 inches in depth of small pieces of coke above 1 inch of coarser coke, the coke being practically the same size as that in Filter No. 103 (see page 427). There is a space of 4 inches between the bottom of one section and the top of the next, and hence the sewage becomes more or less aerated as it passes from section to section. To this filter sewage has been applied at an average rate of 1,735,000 gallons per acre daily and the manner of application is as follows: —

A continuous stream of sewage flows into an automatic tipping basin, which empties every four and one-half minutes, flushing the sewage first over one half of the upper section of the filter and then over the other half. The tables of analyses of the sewage applied to and the effluent from this filter are given below, together with tables showing the change taking place in the sewage as it passes through the successive sections of the filter. Studying the tables, it will be seen that there is a great reduction of the free and albuminoid ammonia of the applied sewage not accounted for by the amount of nitrates and nitrites present in the effluent, suggesting a large percentage of loss of nitrogen; and the amount of chlorine increases regularly from section to section, due, without doubt, to evaporation of the sewage, great opportunity for which is offered by the method of construction and operation of this filter. The surface material in each section has needed more or less raking, but this has been caused rather more by a vigorous growth of Crenothrix upon these surfaces than to clogging by organic matter. The effluent of the filter has been practically free from organic matter in suspension, and it seems probable that, where a small volume of sewage must be treated upon a limited space, this method might be worked with more or less success.

Effluent of Filter No. 131.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
September, . .	2,040,000	66	56	V. slight.	.07	2.6800	.0360	9.50	0.00	.0120	0.34	62,500
October, . .	2,052,000	58	57	Great.	.48	2.8100	.1200	8.09	0.06	.0278	0.92	514,800
November, . .	1,315,000	48	48	Great.	.65	1.7300	.1127	8.74	1.30	.0077	0.96	61,500
December, . .	1,532,000	46	43	Great.	.88	4.0300	.1580	8.84	0.61	.0058	1.58	175,400
Average, .	1,735,000	55	51	-	.52	2.8100	.1067	8.79	0.49	.0133	0.95	203,400

Filter not operated November 19 to November 25. Surface of each of the five pans raked 1 inch November 15; surface of top pan raked 1 inch December 7 and December 13; surface of two upper pans raked 1 inch December 19; surface of bottom pan raked 1 inch December 21.

Result of the Analyses of a Series of Samples collected November 8 and December 7 from the Various Sections of Filter No. 131.

November 8.

	Temperature.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. In Solution.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
Section No. 1,	49	Great.	.70	3.60	.3520	-	6.88	0.11	.0030	2.54	617,000
Section No. 2,	48	Great.	.70	3.16	.2720	-	7.05	0.25	.0040	2.20	303,000
Section No. 3,	47	Decided.	.67	2.88	.1560	-	7.45	0.58	.0050	1.30	152,500
Section No. 4,	47	Decided.	.60	2.80	.1140	-	7.70	0.81	.0060	1.15	125,500
Section No. 5,	46	Decided.	.57	2.32	.1080	-	7.80	1.08	.0070	0.99	95,500
Outlet, . .	45	Decided.	.65	2.20	.0940	-	8.00	1.11	.0080	0.88	55,000

December 7.

	Temperature.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. In Solution.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
Section No. 1,	42	Great.	.65	6.00	.5700	.3100	7.90	.017	.0010	4.60	1,327,800
Section No. 2,	42	Great.	.65	6.00	.5600	.4100	7.90	.022	.0010	3.96	1,080,000
Section No. 3,	41	Great.	.65	5.76	.3520	.2800	8.25	.097	.0030	3.00	461,500
Section No. 4,	40	Decided.	.70	5.60	.2520	.2400	8.50	.347	.0030	2.28	412,000
Section No. 5,	40	Decided.	.80	5.20	.2120	.1560	8.78	.535	.0050	1.87	152,500
Outlet, . .	40	Decided.	.93	4.56	.1520	.1520	8.75	.675	.0050	1.47	243,000

Straining Sewage through Coke.

Results in Regard to Percentage Removal of Organic Matter, together with the Volume of Coke used per Million Gallons of Sewage strained.

During 1894 various experiments were made to find the most suitable material that could be used as a strainer of sewage; that is, to simply remove from the sewage the matters in suspension without purification by nitrification, and with a removal from the strainer from time to time of the straining material used, and which had become clogged and exhausted, together with the matters strained or removed from the sewage. It was desired to make a comparison of the results obtained by straining sewage with the results obtained by sedimentation or chemical precipitation.

At this time the investigation seemed to show that coke was the most practical and effective material for the purpose, and a coke strainer was put in operation at the station, and sewage applied to it at the rate of 1,000,000 gallons per acre daily. This strainer contained at first 6 inches in depth of coke breeze, and the results obtained with it during the first year of its operation, in regard to the amount of organic matter removed from the sewage and the amount of coke used per 1,000,000 gallons of sewage strained, were given in the report of the Board for 1894. Approximately 48 per cent. of the organic matters were removed from the sewage during that year, while straining at the rate given, with an expenditure of about 10 cubic yards of coke breeze per 1,000,000 gallons of sewage strained.

On Nov. 26, 1895, the strainer was rebuilt with coke breeze of the character previously used, and from that date until the last of September, 1898, a period of approximately three years, it was kept in operation at the rate given above. The depth of coke in the strainer varied at different times from 12 inches to about 3 inches. Whenever the shallower depth was reached, caused by removing clogged coke, all the coke remaining in the strainer was taken out, fresh coke filled in to the depth of 6 or 9 inches, and the 3 inches of old coke placed upon the top of the new coke. From Sept. 26, 1895, to Sept. 12, 1898, a volume of sewage equal to 1,180,000,000 gallons upon a surface of 1 acre had passed through this strainer, and 72 inches in depth of clogged coke had been removed; that is, 1 inch in depth of coke for every 16,400,000 gallons of sewage strained per acre, or 8 cubic yards of coke per 1,000,000 gallons of sewage strained. During this period coke had been removed on a number of occasions when subsequent investigation proved that the cause of clogging and the slow flow of sewage through the strainer was the accumulation of fine coke dust in the underdrains of the strainer, rather than the accumulation of organic matter in the surface coke. If the coke removed on this account could be ascertained and subtracted from the amount given, the amount used per 1,000,000 gallons of sewage strained would be somewhat less, but the decrease would probably not be more than 5 per cent. In beginning this investigation it was considered that the coke used and removed from the strainer would, when dried out to some degree, be as valuable for purposes of combustion as before use, and this was found to be true.

All the coke used during the period from the date of starting the strainer until Oct. 1, 1898, was coke *breeze*, containing a mixture of pieces of coke of various sizes, together with coke dust. Upon this latter date, however, the strainer was again rebuilt, and was so arranged as to contain 15 inches in depth of small pieces of coke of the same grade as that in Filter No. 103 (see page 427), free from coke dust. Since that date until Jan. 1, 1899, sewage equal in volume to 400,000,000 gallons upon an acre has been passed through the strainer without clogging it, and hence without the removal of any coke.

The percentage removal of organic matter obtained during these years has been as follows: during 1895, 54 per cent. of the organic matter as represented by the albuminoid ammonia and 35 per cent. as represented by the oxygen consumed; during 1896, 47 per cent. and 49 per cent. respectively; during 1897, 62 per cent. and 50 per cent.; during 1898 up to October 1, 52 per cent. and 53 per cent. During the remainder of 1898 — that is, after rebuilding the strainer with coarser coke — the percentage removal was 32 per cent. and 37 per cent. respectively, and during 1899 45 per cent. and 38 per cent. For some weeks during the last part of 1898 the sewage was applied to the strainer at a rate of 2,000,000 gallons per acre daily, and this accounts in part for the smaller percentage of organic matter removed during these months than during 1899, when the rate was again 1,000,000 gallons per acre daily.

With the strainer of fine coke the surface was usually covered about twelve to fifteen hours per day when in good operation, and as the surface gradually clogged, this period increased until the maximum of twenty-four hours per day was reached, when the surface of the strainer was scraped. With the new strainer of coarser coke the surface is seldom covered more than four or five hours per day.

Filter No. 14 A, $\frac{1}{20000}$ of an Acre in Area.

A portion of the strained sewage during all these years has been applied to Filter No. 14 A, and exceedingly good purification has been obtained. This filter was in good condition and disposing of the strained sewage readily until the change in the character of the coke in the strainer, its rate of filtration being approximately 320,000 gallons per acre daily up to this time. With the poorer removal of organic matter by the strainer, however, the surface sand of the filter became clogged, and the rate of filtration had to be reduced to 160,000 gallons per acre daily. The surface layers became more badly clogged during the year 1899, moreover, and the filter was put out of operation at the end of the year. For four and one-half years this filter, receiving sewage freed of organic matter to the extent denoted by the figures previously given, was able to continue in operation at the rate of approximately 320,000 gallons per acre daily without serious surface clogging, and produce a very well purified effluent, as shown by the tables of analyses given in previous reports. With the amount of organic matter stored in the upper foot of the filter during this period, however, increased greatly by the sewage applied during the poor operation of the strainer in 1898 when its rate was doubled, the upper foot of filtering material became badly clogged. The lower 4 feet in depth of sand in the filter were in good condition, however, and capable of being kept in use for many years longer.

Average Analyses of Sewage applied to the Coke Strainer, 1899.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Total.	In Solution.	In Suspension.			
January,	45	2.30	0.44	.29	.15	4.49	2.90	1,722,000
February,	45	1.89	0.37	.24	.13	4.41	2.73	1,375,000
March,	47	1.36	0.30	.22	.08	3.19	2.57	743,000
April,	47	2.18	0.41	.24	.17	4.41	2.97	1,613,000
May,	56	2.54	0.36	.20	.16	6.55	2.47	5,605,000
June,	70	1.91	0.30	.13	.17	6.45	2.70	1,155,000
July,	73	2.75	0.38	.18	.20	7.21	2.75	610,000
August,	71	2.18	0.23	.10	.13	4.68	1.74	553,000
September,	65	4.30	0.62	.31	.31	10.21	4.27	1,808,000
October,	55	3.17	0.41	.21	.20	5.55	3.17	1,644,000
November,	45	4.33	0.97	.30	.67	6.51	6.67	2,953,000
December,	44	5.13	1.05	.44	.61	7.70	7.13	4,160,000
Average,	55	2.84	0.49	.24	.25	5.95	3.51	1,994,700

Sewage strained through Coke.

[Parts per 100,000.]

1899.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Total.	In Solution.	In Suspension.			
January,	1.91	.34	.29	.05	4.46	2.29	407,000
February,	1.68	.26	.21	.05	4.68	2.05	393,000
March,	1.29	.23	.18	.05	3.59	1.83	270,000
April,	1.78	.29	.22	.07	4.78	2.00	276,500
May,	1.60	.25	.18	.07	6.10	1.37	367,500
June,	0.89	.16	.08	.08	4.05	1.10	236,000
July,	1.53	.17	.12	.05	5.58	1.18	289,600
August,	1.37	.13	.10	.03	5.72	1.00	189,700
September,	2.80	.39	.25	.14	11.18	2.33	1,668,000
October,	1.77	.24	.16	.08	5.64	1.96	409,500
November,	2.93	.46	.30	.16	6.79	3.85	813,000
December,	4.50	.51	.37	.14	7.65	4.60	806,000
Average,	2.00	.29	.21	.08	5.84	2.17	506,700

Effluent of Filter No. 14 A.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	160,000	49	47	1h. 34m.	None.	.22	0.0023	.0229	4.37	1.38	.0000	0.32	284
February,	160,000	49	46	1h. 34m.	None.	.19	0.0020	.0187	4.77	1.56	.0000	0.27	1,639
March,	160,000	49	47	2h. 10m.	None.	.17	0.0012	.0172	4.59	1.41	.0000	0.23	2,067
April,	83,200	57	51	1h. 18m.	None.	.11	0.0012	.0168	7.98	1.76	.0000	0.21	309
May,	142,200	63	56	46m.	None.	.13	0.0011	.0175	6.65	2.51	.0001	0.22	4,554
June,	160,000	76	72	40m.	None.	.16	0.0009	.0174	6.12	2.08	.0000	0.22	1,246
July,	160,000	78	71	54m.	None.	.09	0.0007	.0137	5.02	1.88	.0000	0.20	27
August,	148,100	75	70	1h. 12m.	None.	.09	0.0014	.0118	7.00	3.63	.0000	0.17	111
September,	135,400	63	66	1h. 1m.	None.	.08	0.0015	.0139	9.91	2.16	.0000	0.19	133
October,	160,000	60	59	2h. 13m.	None.	.10	0.0007	.0124	11.15	1.98	.0000	0.17	45
November,	123,100	50	46	1h. 8m.	None.	.10	0.0684	.0193	8.64	3.13	.0015	0.20	136
December,	160,000	48	48	4h. 15m.	None.	.22	2.0000	.1120	9.83	1.07	.0025	1.69	309
Average,	146,000	60	57	1h. 35m.	None.	.14	0.1735	.0245	7.17	2.04	.0003	0.34	905

Four gallons of sewage, strained through coke, applied twenty-four times a week. No sewage applied August 30 to September 5. April 16 to May 4, experiment interrupted by freshet. Surface raked 3 inches deep twice each week.

The stopping of Filter No. 14 A concluded a series of experiments upon high rates of filtration of sewage through fine sand of an effective size of 0.19 millimeter after partial purification of regular station sewage by four different methods: (1) coarse filters of gravel aerated; (2) sedimentation; (3) chemical precipitation; (4) straining through coke. Briefly reviewing the results obtained, as given in this and previous reports, we find the following: —

The coarse filters of gravel, with currents of air drawn or forced through them, were operated at the rate of approximately 500,000 gallons per acre daily during a period of five years, and produced effluents with nitrification well started; but these filters, on account of continual clogging from reasons not then thoroughly understood but now ascertained and outlined on page 441, were not considered to be a practical success, because of the necessity of removing the filtering material from time to time and washing it. Aerating these filters appeared also to be too expensive for economical application upon a large scale. The effluents of the filters, however, containing free oxygen and with oxidation well under way, could be and were purified for more than five years by filtration through sand of an effective size of 0.19 millimeter, at an approximate rate for the whole period of 625,000 gallons per acre daily. An examination of the notes upon the daily operation of this filter, — Filter No. 12 A, — as given in the reports of the Board for its years of operation, shows the great attention that had to be given to the upper layers of it; frequent raking, spading and even removing and washing the surface sand being necessary to keep the filter in successful operation. The organic matter in suspension in the sewage was not at all thoroughly destroyed by the aerated filters, and that passing from the outlets of these filters and going upon the surface of the fine filter was undergoing slow oxidation, and hence accumulated in and clogged the surface of the filter of fine sand. The main body of the filter, however, was always in good condition, and at the end of the period of operation was fit for an indefinite number of years' use. The highest average rate of filtration obtained by this combination of Filters Nos. 15 B, 16 B and 12 A, taking into consideration the combined areas, was 248,300 gallons per acre daily and for the year 1893. During the period of operation of Filter No. 12 A, a volume of partially purified sewage equal to 996,280,000 gallons upon an acre was applied to it.

The sewage partially clarified by sedimentation was applied to Filter No. 13 A from Sept. 20, 1893, to March 1, 1898, at an average rate for most of this period of 160,000 gallons per acre daily; and the sewage partially purified by chemical precipitation was applied to Filter No. 19 A from Sept. 20, 1893, to Jan. 1, 1898, at an average rate for most of this period of 200,000 gallons per acre daily. At the end of the period these two filters were, with the exception of some clogging in the upper few inches of material, in good condition, and capable of being continued in operation for an indefinite period; Filter No. 13 A having filtered a volume of partially purified sewage equal to 241,400,000 gallons upon an acre and Filter No. 19 having filtered a volume of sewage equal to 328,980,000 gallons upon an acre.

Filter No. 14 A had filtered at the end of its period of operation a volume of sewage equal to 456,340,000 gallons upon an acre. The surface sand was, as stated, badly clogged with organic matter and some fine coke dust at this time, and, in order to have kept it in operation at a high rate, about 7 inches in depth of sand would have had to be removed, or the filter given a long period of rest. Assuming that this was removed and the filter continued in operation, it would have meant a removal of about 2½ cubic yards of sand per 1,000,000 gallons of strained sewage filtered during its period of operation.

STRAINING SEWAGE THROUGH BITUMINOUS COAL.

During 1899 the coal strainer, containing a layer of fine bituminous coal varying in thickness from 2 to 8 inches during different portions of the year, has been continued in operation. The rate of straining has been 1,000,000 gallons per acre daily, with the results shown by the following table, the sewage applied being represented by the table on page 457, giving analyses of the sewage applied to the coke strainer. Comparing the tables, we find that the strainer has removed during the year 57 per cent. of the organic matter of the sewage as represented by the albuminoid ammonia, and 36 per cent. of that represented by the oxygen consumed. From the date of starting this strainer, Sept. 16, 1898, up to the end of December, 1899, 8 inches in depth of coal had become clogged and removed, equal to 2.8 cubic yards per 1,000,000 gallons of sewage strained.

Effluent of the Coal Strainer.

[Parts per 100,000.]

1899.	Free Ammonia.	Albuminoid Ammonia.			Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Total.	In Solution.	In Suspension.			
January,	2.23	.32	.25	.07	4.51	2.18	475,000
February,	1.99	.37	.25	.12	4.51	2.48	595,000
March,	1.69	.25	.22	.03	3.49	1.84	462,000
April,	2.35	.33	.22	.11	4.62	2.11	1,170,000
May,	2.60	.28	.21	.07	5.62	1.50	569,500
June,	1.80	.14	.12	.02	5.88	1.13	349,400
July,	2.41	.16	.13	.03	5.69	1.06	235,500
August,	2.42	.15	.12	.03	5.67	1.14	243,000
September,	4.27	.53	.27	.26	11.58	3.34	1,183,000
October,	2.93	.28	.19	.09	5.15	2.32	423,100
November,	4.60	.52	.30	.22	6.80	4.21	992,000
December,	4.40	.46	.25	.21	7.68	3.50	816,000
Average,	2.81	.32	.21	.11	5.98	2.23	625,300

At the beginning of October the effluent of this coal strainer began to be applied to contact Filter No. 108, containing 2 feet in depth of coke, at the rate and with the results shown by the following table: —

Effluent of Filter No. 108.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
October, . .	330,000	60	59	Decided.	.49	1.2400	.1133	7.12	1.58	.0070	0.88	141,200
November, . .	253,900	50	52	Great.	.60	1.0200	.0920	7.38	1.45	.0020	0.90	61,500
December, . .	330,000	48	46	Great.	.93	1.9800	.1950	8.31	1.82	.0045	1.58	304,500
Average, .	304,600	53	52	-	.67	1.4133	.1334	7.60	1.62	.0045	1.12	169,100

October 2 to December 31, filter received 10 gallons effluent of coal strainer twelve times a week; filter allowed to stand covered three hours, and then allowed to drain slowly. Filter not operated November 20 to November 25.

Application to Filters of Differing Volumes of Sewage containing Equal Amounts of Organic Matter.

Filters Nos. 128, 129 and 130, $\frac{1}{20000}$ of an Acre in Area.

The volume of sewage that can in intermittent sand filtration be applied to a filter with satisfactory purification results must vary with the degree of concentration of the sewage. A town having a weak sewage, owing to the extravagant use of its public water supply or to a large percentage of ground and surface water entering the sewers, should be able to purify this sewage at a greater rate per acre of filter beds than a town having a smaller volume of stronger sewage to purify. To illustrate this, Filters Nos. 128, 129 and 130 were put into operation during the year. These filters each contain 5 feet in depth of sand of an effective size of 0.26 millimeter. To Filter No. 128 station sewage has been applied at an average rate of 89,800 gallons per acre daily; to Filter No. 129, the same volume of sewage plus an equal volume of river water, and the average rate has been 179,600 gallons per acre daily; to Filter No. 130, an equal volume of sewage plus twice as much river water, making the average rate 269,500 gallons per acre daily. By this method of operation the sewage applied to Filters Nos. 129 and 130 has generally contained some dissolved oxygen, but not a greater amount than would probably be often found in actual practice, when sewage diluted by a large volume of ground and surface water leaking or wasting into the sewers is applied to an area.

It will be noticed, from a study of the tables following, showing the average analyses of the effluents of these three filters, that in each case a satisfactory effluent was obtained, and the large volume of sewage applied to Filter No. 130 disappeared from the surface of the filter as rapidly as the smaller volume applied to Filter No. 128, the reason being that there was practically an equal amount of matter in suspension in the unequal volumes of sewage applied.

Effluent of Filter No. 128.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
August, .	87,500	71	70	-	V. slight.	.15	.0574	.0212	6.26	2.86	.0405	.28	8,800
September,	84,600	66	66	8m.	None.	.11	.0101	.0145	12.19	4.05	.0029	.22	9,400
October, .	100,000	58	57	12m.	None.	.12	.0067	.0136	8.39	2.81	.0070	.20	8,400
November, .	77,000	48	53	10m.	None.	.10	.0305	.0152	7.54	3.84	.0075	.21	6,200
December, .	100,000	46	48	32m.	V. slight.	.18	.4500	.0290	9.27	3.48	.0420	.44	35,600
Average,	89,800	58	59	16m.	-	.13	.1113	.0207	8.78	3.41	.0200	.27	13,700

Five gallons of regular sewage applied six times a week, August 14 to December 31. Surface raked 3 inches deep once each week. Filter not operated August 30 to September 5 and November 20 to November 25.

Effluent of Filter No. 129.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
August, .	175,000	73	69	-	V. slight.	.17	.0407	.0175	2.59	2.85	.0060	.24	11,200
September,	169,200	67	65	18m.	V. slight.	.15	.0040	.0157	4.93	0.97	.0030	.27	13,700
October, .	200,000	58	55	11m.	Slight.	.13	.0028	.0157	3.81	1.44	.0008	.19	12,200
November, .	154,000	44	52	11m.	V. slight.	.11	.0023	.0193	3.71	1.37	.0008	.25	7,700
December, .	200,000	39	48	34m.	V. slight.	.15	.1607	.0281	4.93	2.23	.0090	.27	10,450
Average,	179,600	56	58	17m.	-	.14	.0421	.0193	3.99	1.78	.0043	.24	11,050

Sewage applied, 5 gallons regular sewage and 5 gallons of canal water six times a week, August 14 to December 31. Surface raked 3 inches deep once each week. Filter not operated August 30 to September 5 and November 20 to November 25.

Effluent of Filter No. 130.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
August, .	262,500	73	69	-	Slight.	.16	.0182	.0163	2.78	0.51	.0067	.27	17,800
September,	253,800	67	65	14m.	V. slight.	.14	.0029	.0147	3.86	0.44	.0041	.23	19,500
October, .	300,000	58	54	10m.	Slight.	.14	.0012	.0169	2.54	0.89	.0080	.23	10,500
November, .	231,000	44	51	11m.	V. slight.	.18	.0035	.0169	2.59	0.69	.0018	.24	19,400
December, .	300,000	39	47	31m.	V. slight.	.15	.0567	.0217	3.44	1.06	.0115	.29	17,700
Average,	269,500	56	57	17m.	-	.14	.0165	.0173	2.94	0.72	.0063	.25	17,000

Sewage applied, 5 gallons regular sewage and 10 gallons of canal water six times a week, August 14 to December 31. Surface raked 3 inches deep once each week. Filter not operated August 30 to September 5 and November 20 to November 25.

Purification of Wool Liquor.

Filters Nos. 70 and 112.

Filter No. 70, containing 4½ feet in depth of sand of an effective size of 0.23 millimeter, was put in operation in June, 1896. The liquor applied to it was a mixture of station sewage and scouring and rinse liquor from a wool-washing establishment. A description of the operation of this filter and the results from it to Jan. 1, 1899, are given in the last report. Beginning in September, 1898, the wool liquor which was mixed with the sewage applied was obtained from the Bigelow Carpet Mills in Clinton, as it was evident that this liquor would have to be disposed of upon the filtration area of the Clinton sewerage system, and has been so disposed of since October, 1899.

The liquor forwarded to the experiment station has been collected from the outlet of a settling tank at the mill, in which considerable sedimentation takes place, but the sediment in the liquor as it reaches the station amounts to from 1 to 3 per cent. of its volume. From 60 to 90 per cent. of this sediment is very fine sand or mineral matter and the remainder organic matter, the proportion varying from time to time. The effective size of the fine sand in the sediment is 0.02 millimeter, and 96 per cent. of it by weight is finer than 0.08 millimeter. The mixture of organic matter present makes it appear to be still finer, and, when applied to sand filters, their surfaces are quickly clogged. This liquor has been mixed with station sewage in the proportion of one part wool liquor to eleven parts sewage, and the following tables give the character of the waste as received from the mills and of the sewage applied to and the effluent from Filter No. 70: —

Waste Liquor from Bigelow Carpet Mills.

[Parts per 100,000.]

1899.	Appearance.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.*	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.	Albuminoid. In Suspension.		Nitrates.	Nitrites.		
January,	Great.	Brown.	8.03	7.54	3.38	4.16	15.52	.121	.0000	86.30 56.80	-
February,	Great.	Brown.	5.25	7.45	3.70	3.75	13.71	.097	.0025	90.00 60.00	-
March,	Great.	Brown.	11.40	8.30	3.72	4.58	19.18	.084	.0000	102.00 63.60	-
April,	Great.	Brown.	4.30	6.90	3.74	3.16	12.09	.115	.0000	75.50 58.80	-
May,	Great.	Brown.	6.10	5.38	2.31	3.07	10.64	.094	.0000	57.52 38.79	1,510,000
June,	Great.	Brown.	6.50	6.80	2.84	3.96	16.20	-	.0000	101.00 70.00	70,000
July,	Great.	Brown.	5.50	3.80	2.40	1.40	10.78	.042	.0000	57.00 45.20	-
August,	Great.	Brown.	6.65	3.25	1.50	1.75	9.60	.100	.0000	46.00 34.40	2,155,000
October,	Great.	Brown.	8.65	7.10	3.28	3.82	15.75	.133	.0000	88.00 56.13	1,150,000
November,	Great.	Brown.	4.00	8.50	4.24	4.26	13.45	.100	.0000	85.00 66.60	1,975,000
December,	Great.	Brown.	1.85	7.80	2.32	5.48	7.05	.100	.0000	80.50 43.60	10,075,000
Average,	-	-	6.20	6.62	3.04	3.58	13.09	.099	.0002	79.00 53.10	2,812,500

* Total and in solution.

Sewage applied to Filter No. 70.

[Parts per 100,000.]

1899.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Oxygen Consumed.
January,	2.86	1.11	6.93	13.13
February,	3.33	1.09	7.71	13.50
March,	2.69	0.80	6.80	10.25
April,	3.12	1.30	7.59	13.23
May,	3.07	1.31	8.17	7.57
June,	2.51	0.67	9.14	7.35
July,	2.43	0.70	7.36	7.16
August,	3.35	0.67	7.62	6.85
September,	3.98	0.80	10.36	7.25
October,	3.88	1.34	8.80	11.74
November,	4.40	1.52	9.83	13.70
December,	5.26	1.32	10.15	12.26
Average,	3.41	1.05	8.37	10.33

Effluent of Filter No. 70.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature, Deg. F. Sewage.	Temperature, Deg. F. Effluent.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, . .	42,800	44	46	V. slight.	2.47	.0347	.2573	5.23	0.87	.0017	3.66	11,800
February, . .	50,000	45	43	V. slight.	1.86	.0310	.1810	6.49	1.61	.0008	3.25	12,500
March, . . .	51,900	45	44	Slight.	1.83	.0340	.1660	5.88	1.64	.0003	2.77	11,700
April, . . .	24,000	47	49	Slight.	2.00	.0220	.1760	6.82	1.92	.0010	3.08	15,800
May, . . .	44,400	58	59	Slight.	0.90	.0200	.1127	6.77	5.44	.0020	1.56	60,600
June, . . .	50,000	70	70	Slight.	0.85	.0170	.1080	7.52	4.30	.0020	1.58	16,900
July, . . .	50,000	73	78	Slight.	1.07	.0130	.1180	6.05	3.69	.0010	1.82	9,700
August, . . .	40,700	71	78	Slight.	0.81	.0120	.0890	6.30	4.62	.0000	1.37	1,750
September, . .	42,300	66	70	Slight.	0.94	.0150	.1000	9.60	4.44	.0000	1.48	22,400
October, . .	50,000	58	67	V. slight.	0.90	.0120	.0930	8.50	3.39	.0000	1.28	6,900
November, . .	42,300	48	45	V. slight.	1.53	.0150	.1420	8.47	2.77	.0000	2.12	8,600
December, . .	50,000	46	43	V. slight.	1.63	.0360	.1220	7.94	3.32	.0015	1.97	8,200
Average, . .	44,800	56	58	-	1.40	.0218	.1379	7.13	3.17	.0009	2.16	15,600

Surface of filter raked 3 inches deep once each week. Filter not operated April 16 to May 4, August 30 to September 5.

Filter No. 112.

Filter No. 112 contains the same depth and grade of sand as Filter No. 70, and to it has been applied the same mixture of sewage and wool liquor as applied to Filter No. 70, the only difference during the year being that before the mixture was applied to this filter it was passed through a small septic tank, being forty-eight hours within the tank. This septic tank was put into operation Feb. 20, 1899. It soon attained a state of active fermentation, and more gas per volume of sewage entering was evolved than from septic tanks receiving ordinary station sewage. At the end of its period of operation, March 15, 1900, when these two filters ceased to be operated, and after thirteen months' operation of the tank, there was less than 3/4 inch in depth of sediment in it, although sewage equal in volume to 85 times its capacity had passed through. A table, showing the rate of filtration and the average analysis of the effluent of this filter, is here presented: —

Effluent of Filter No. 112.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, . .	53,700	44	49	V. slight.	1.37	.0207	.1467	6.13	2.26	.0130	2.27	4,700
February, . .	53,700	45	49	V. slight.	1.50	.1150	.1675	5.94	0.90	.0415	2.60	7,300
March, . . .	53,700	45	49	Slight.	1.16	.2827	.1207	5.70	2.12	.0207	1.95	13,200
April, . . .	38,600	47	57	Slight.	0.80	.0180	.1060	6.19	3.64	.0023	1.77	1,150
May, . . .	53,700	58	63	V. slight.	0.75	.0130	.1207	6.21	3.82	.0023	1.41	3,100
June, . . .	53,700	70	76	V. slight.	0.67	.0090	.0680	7.03	3.78	.0020	1.20	23,900
July, . . .	53,700	73	78	V. slight.	0.82	.0180	.1040	6.62	3.07	.0020	1.48	4,800
August, . . .	43,700	71	75	Slight.	0.74	.0530	.1030	6.50	2.45	.0005	1.29	2,900
September, . .	45,400	66	68	V. slight.	0.90	.1960	.0780	10.98	3.85	.0010	1.34	37,000
October, . .	53,700	58	60	V. slight	0.75	.0650	.0930	8.90	3.80	.0020	1.16	9,100
November, . .	45,400	48	50	V. slight.	1.32	.0230	.1150	8.45	3.28	.0010	1.84	26,500
December, . .	65,800	46	48	V. slight.	1.25	.0190	.1180	9.00	4.82	.0020	1.65	16,300
Average, .	51,200	56	60	-	1.00	.0694	.1134	7.30	3.15	.0075	1.66	12,400

Purification of Creamery Waste.

Filter No. 106.

An experiment upon methods of purifying the wastes from creameries was begun at the experiment station during 1898, when Filter No. 106, containing 4 feet in depth of sand of an effective size of 0.23 millimeter, was put into operation. As stated in the last report, various other filters, of differing materials and with modifications of intermittent sand filtration, were tried without particularly successful results. Satisfactory purification was obtained with Filter No. 106, however, during the last half of 1898, as stated in the last report. The filter was continued in operation during 1899 up to the end of November, and up to June 14 in approximately the same way as described in the last report. Beginning on this date, however, the water mixed with the milk was at the boiling point at the time of mixing, and when applied to the filter it was still at about 100 degrees F. This treatment was begun as at the creameries the cans, churns, etc., are washed with boiling water; and not only was it wished to ascertain what effect this treatment of the milk washed from the utensils would have upon the purification of it by the bacteria in the filter, but the question of high temperature of the waste when reaching the surface of the filter was also involved.

Upon July 10 enough salt was also added to the creamery waste applied to the filter to increase the chlorine present to over 500 parts; this being done because at the creamery in Uxbridge, in regard to the disposal of the waste from which this experiment was started, considerable ice cream is made during the summer months, and consequently the waste from the creamery contains a large amount of salt. Nitrification within the filter was not seriously disturbed by either of these changes, however, although the amount of free and albuminoid ammonia in the effluent increased slightly. The filter continued to successfully purify the waste, as is shown by the following tables, giving the average analyses of the liquor applied to and the effluent from the filter: —

Creamery Waste applied to Filter No. 106.

[Parts per 100,000.]

1899.	Ammonia.		Chlorine.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.			
January,	.2067	2.46	1.76	26.43	1,907,000
February,	.1958	3.99	2.34	34.57	6,387,000
March,	.2650	4.01	2.87	30.00	4,025,000
April,	.2600	4.49	2.33	31.00	9,895,000
May,	.2000	5.06	2.80	36.00	10,780,000
June,	.0260	5.32	2.95	37.40	110,000
July,	.2840	5.39	371.10	40.80	-
August,	.4200	7.00	524.00	50.00	-
September,	.4800	5.95	542.00	16.00	-
October,	.4800	8.86	515.00	65.60	-
November,	.5000	6.70	525.00	62.00	-
Average,	.2764	4.98	208.00	35.82	-

Effluent of Filter No. 106.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature, Deg. F. Sewage.	Temperature, Deg. F. Effluent.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, . .	26,300	43	49	V. slight	.16	0.6280	.0824	1.16	3.21	.0084	0.34	25,300
February, . .	27,800	49	49	V. slight	.15	0.5900	.0635	2.06	3.58	.0560	0.32	6,300
March, . . .	27,800	41	49	V. slight	.15	0.3150	.0650	2.03	4.64	.0430	0.31	19,500
April, . . .	22,200	43	57	Slight.	.21	0.3300	.1040	2.01	6.33	.0067	0.47	24,500
May, . . .	27,800	52	63	Slight.	.15	0.3400	.0853	2.06	9.64	.1033	0.56	5,300
June, . . .	26,700	62	76	Slight.	.31	0.4150	.0660	2.30	13.67	.1100	0.54	54,200
July, . . .	25,000	67	78	Slight.	.32	1.1000	.1522	176.44	11.15	.2960	0.92	9,220
August, . . .	24,100	70	75	Slight.	.22	0.7300	.1350	562.25	6.91	.4000	1.29	332,800
September, . .	23,000	64	66	Slight.	.22	0.6100	.1220	565.00	6.34	.2900	1.10	25,300
October, . .	25,000	50	60	Slight.	.18	0.6450	.1250	533.00	4.35	.2200	0.81	3,600
November, . .	25,000	51	50	Slight.	.28	0.5800	.0960	525.00	3.86	.1000	0.81	6,200
Average, .	26,400	54	61	-	.21	0.5665	.0909	214.85	6.61	.1504	0.65	46,400

CINDERS AND ASHES AS FILTERING MATERIALS.

Intermittent Filter No. 95.

The use of cinders as a filtering material was begun at the experiment station during 1896, and cinder and ash filters have been continued in operation since that date. Contact filters of these materials have already been described in this report, and the work of Filter No. 5 B is given on page 478. Filter No. 95 contains 4½ feet in depth of ashes from the combustion of soft coal, and was put in operation during the last part of October, 1897, as an intermittent filter, at an average rate of 100,000 gallons per acre daily. This rate has been continued up to the end of 1899, and the filter has produced a clear, practically colorless effluent, containing very little unoxidized organic matter, as shown by the table below, giving the average analyses of its effluent during the year: —

Effluent of Filter No. 95.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	100,000	44	45	29m.	Slight.	.17	.0575	.0258	4.28	1.47	.0003	.26	645
February, .	100,000	45	44	24m.	V. slight.	.07	.0205	.0143	4.84	1.92	.0002	.17	710
March, . .	100,000	45	45	28m.	V. slight.	.06	.0067	.0127	4.39	1.75	.0001	.12	312
April, . .	84,000	47	52	1h. 19m.	V. slight.	.05	.0050	.0139	5.86	2.82	.0002	.16	157
May, . .	100,000	58	55	28m.	None.	.05	.0098	.0123	8.48	3.28	.0004	.18	54
June, . .	100,000	70	71	33m.	None.	.06	.0101	.0128	7.49	2.50	.0004	.18	223
July, . .	100,000	73	72	25m.	None.	.03	.0016	.0114	6.44	2.53	.0000	.14	52
August, .	93,700	71	69	50m.	None.	.01	.0259	.0121	7.14	4.10	.0002	.14	4
September, .	84,600	66	66	2h. 18m.	V. slight	.04	.0122	.0141	12.07	2.52	.0004	.14	210
October, .	100,000	58	56	2h. 55m.	V. slight.	.06	.0052	.0129	6.93	2.25	.0000	.16	44
November, .	77,000	48	48	51m.	V. slight.	.06	.1427	.0197	9.13	2.57	.0003	.19	347
December, .	100,000	46	44	1h.	V. slight.	.11	.0276	.0190	7.95	3.11	.0002	.18	128
Average,	94,900	56	56	-	-	.06	.0270	.0151	7.08	2.58	.0002	.16	241

On the Action of Iron in the Filtration of Sewage.

Filters Nos. 88, 96 A, 121 and 123.

Metallic iron and iron oxides have been much used in the purification of water and sewage, and many positive statements have been made with regard to their influence, but their action has really been very little investigated. In some cases, as, for instance, in the Anderson process, metallic iron is first dissolved by the water, going into solution as protoxide, and is subsequently oxidized by aeration, when the hydrated sesquioxide is precipitated and acts as a coagulant on the suspended matter present. In this case the purification effected by the iron may be said to be mainly mechanical. In the experiments which have been made at the Lawrence Experiment Station we have aimed to solve the question whether iron can be usefully employed as a carrier of oxygen and thereby assist the bacterial purification, or whether a chemical purification can be substituted to any extent for the action of micro-organisms.

Filter No. 88.

Filter No. 88, 20 inches in diameter and containing 5 feet in depth of a mixture of sand of an effective size of 0.23 millimeter and iron filings in the proportion of two parts of sand to one of iron by bulk, was put into operation in July, 1897. In the last annual report of the Board the action of this filter was described up to January, 1899. The effluent was shown to be the best in all respects for its rate (namely, 115,000 gallons daily) of all the intermittent filters ever operated at the station. In November, 1899, the rate was increased to 200,000 gallons per acre daily, but this resulted in clogging the filter, and it was necessary to give it a rest during the last ten days of the month. In December sewage was again applied at the increased rate. The following table gives the record of the operation of this filter for the year: —

Effluent of Filter No. 88.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	115,200	44	49	21m.	None.	.04	.0074	.0074	4.30	1.43	.0018	.05	9
February, .	115,200	45	47	24m.	None.	.04	.0069	.0063	4.57	1.58	.0019	.10	76
March, .	115,200	45	48	33m.	None.	.08	.0060	.0066	4.21	1.49	.0017	.05	24
April, . .	96,800	47	55	18m.	None.	.04	.0201	.0075	6.07	2.21	.0029	.10	13
May, . .	115,200	58	59	23m.	None.	.06	.0066	.0061	5.84	2.18	.0019	.08	16
June, . .	115,200	70	73	11m.	None.	.06	.0128	.0049	7.89	2.04	.0029	.05	496
July, . .	115,200	73	73	11m.	None.	.05	.0094	.0046	5.01	1.73	.0015	.07	13
August, .	106,700	71	70	20m.	None.	.08	.0090	.0055	6.71	3.47	.0014	.07	16
September, .	97,500	66	69	25m.	None.	.06	.0119	.0067	9.41	2.39	.0045	.05	79
October, .	115,200	58	60	31m.	None.	.04	.0034	.0056	7.30	2.74	.0008	.05	11
November, .	154,000	48	48	36m.	Slight.	.26	.2875	.0137	7.94	2.74	.0067	.17	1,432
December, .	200,000	46	51	1h. 23m	Slight.	.76	.3404	.0190	9.50	2.59	.0225	.18	2,780
Average,	121,800	56	59	-	-	.12	.0601	.0076	6.56	2.22	.0042	.08	414

Surface raked three inches deep once each week. Filter not operated August 30 to September 26 and November 20 to November 25.

Filter No. 96 A.

This filter, 6 inches in diameter and 4½ feet in depth, was filled with fine iron filings and turnings, and operated intermittently during 1898 and the first five months of 1899. It was practically a continuation of Filter No. 96, first put into operation in December, 1897 (see page 45, report of 1898). The purification of the sewage was somewhat less satisfactory in this filter in 1899 than in 1898, as the following average results show: —

[Parts per 100,000.]

Rate. — Gallons per Acre Daily.	Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Free.	Albuminoid.		Nitrates.	Nitrites.		
90,000	.63*	2.32	.1225	5.70	.0114	.0014	1.28	148,600

* After the iron had precipitated.

Filters Nos. 121 and 123.

These filters were operated as contact filters. Filter No. 121 was 20 inches in diameter and 5 feet deep, filled with iron turnings and coarse coke in the proportion of one-third turnings to two-thirds coke by bulk; septic sewage was applied to it at the rate of 429,000 gallons daily. Filter No. 123 was 3 inches in diameter and 4 feet deep, and was filled only with iron filings and turnings; regular station sewage was applied to it at the rate of 1,000,000 gallons daily. Following are the average results of these two filters for the seven months of their operation in 1899: —

[Parts per 100,000.]

Filter Number.	Rate. — Gallons per Acre Daily.	Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
			Free.	Albuminoid.		Nitrates.	Nitrites.		
121	429,000	.45*	3.14	.0703	6.03	.0040	.0002	.59	126,900
123	1,058,000	Yellow.	1.88	.1132	7.32	.0080	.0036	.79	380,500

* After the iron had precipitated.

The foregoing experiments have given us many important facts in regard to the effect which iron and iron oxides produce in sewage filters, but owing to the variable conditions under which the filters have been operated, we cannot as yet say that we know accurately in all cases the nature of the changes which have taken place.

These conditions have not always been under control, nor have we always known, except inferentially, whether there was free oxygen in the filters at any given time; and on this fact, namely, whether or not free oxygen is present, depends the nature of the action of the iron. The first action of the metallic iron is to appropriate the free oxygen dissolved in the sewage or in the air of the tank, subsequently it will appropriate the oxygen of the nitrates and nitrites if present, reducing them to ammonia. Again, the fragments of iron become quickly coated with a hydrated sesquioxide of iron, and whether the oxygen in this coating plays any part in the process remains to be definitely proved. Further, to what extent this more or less porous coating prevents the metallic iron from exerting its reducing action is unknown. It is interesting to note in this connection that pieces of these rusty iron filings and turnings taken from Tank No. 88, after it had been in operation two years, showed that the oxidation was only superficial, and that the greater part of the metallic iron was yet intact.

From the composition of the effluents of these filters containing metallic iron we can draw some inferences as to the nature of the action going on in the filters. Thus, where the effluent contains iron in solution in the form of protoxide, we know that the air, at least in the lower part of the tank, contains no oxygen, and that nitrification is out of the question; and yet when this condition exists a notable degree of purification is effected, as shown by the reduced amount of albuminoid ammonia and oxygen consumed. This purification may have taken place in the upper part of the filter and the lower part have been inoperative. When Filter No. 96 A was emptied it was found that only the upper part of the iron was oxidized, and that the lower portion was more brightly metallic than when placed in the filter. Or it is possible that, in the presence of a reducing agent like metallic iron, putrefaction, or an action similar to that which goes on in the septic tank, takes place. Filter No. 123, operated as a contact filter, gave fully as good results as an intermittent filter as Filter No. 96 A, although receiving ten times as much sewage. A satisfactory explanation of the changes which took place in these filters must wait for further experiments on the action of metallic iron on sewage both with and without free oxygen.

When we find, as in Filter No. 88, that the effluent contains practically no iron in solution, that the nitrates are high and that dissolved oxygen is also present, we know that there has been free oxygen present during the entire passage of the sewage. Can we, then, attribute any action in this filter to the metallic iron or to its coating of hydrated oxide? During the first year of the operation of this filter the free ammonia was persistently higher than would be the case with a sand filter showing the same high purification and nitrification. This was evidently due to the action of the metallic iron in reducing the nitrates. The free ammonia given in the preceding table, showing the results for the year 1899, has not been as high as in the previous year, yet it is still somewhat out of proportion to the other determinations, showing that the metallic iron is still active to some degree as a reducing agent.

But, as stated above, the general result of the operation of this tank was, up to the time when the dose was raised from 115,000 to 200,000 gallons per acre daily, more uniformly satisfactory than any intermittent filter which has ever been installed at the station. We were driven, therefore, to the conclusion that this admixture with the sand of fragments of metallic iron does have a favorable effect on the oxidation of organic matter of the sewage and also in the reduction of the number of bacteria; and it is highly probable that the active agent in promoting the purification of the sewage is the hydrated oxide of iron which forms on the surface of the iron fragments, and that iron does under these conditions act on sewage as it is known to act in many cases where it is in contact with organic matter exposed to the air, — namely, as a carrier of oxygen to hasten decay.

It is also clear from the foregoing tables that iron is best used disseminated through sand; that a filter composed entirely of iron fragments exerts such a strong reducing action that bacterial oxidation must be hindered or even suspended.

The question naturally arises, why not make a filter entirely of iron oxide, to get the maximum favorable effect of iron as an oxidizing agent? This question we have attempted to answer by filling a tank entirely with a natural iron ore, most closely allied to the rusty coating formed on the iron filings, — namely, limonite or brown hematite, a hydrous sesquioxide of iron. This formed Filter No. 125, which was 4½ feet in depth and 10 inches in diameter. The screened iron ore used had an effective size of 1.00 millimeter, unfortunately too coarse to be used as an intermittent filter at a high rate and too fine to be advantageously used as a contact filter.

As shown in the following table, the filter was operated as an intermittent filter for three months, at a rate of 20,000 gallons per acre daily, with good results, and was then changed to a contact filter, at a rate of over 1,000,000 gallons. But this rate could not be maintained, owing to the fineness of the material, which became badly clogged.

The filter was given a rest of two weeks following this clogging, and at the end of this time the effluent, on the reapplication of sewage, contained iron in solution, showing that the hematite had been reduced, in the absence of free oxygen, by the organic matter present.

Effluent of Filter No. 125.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.	Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
May, . . .	20,000	58	63	None.	.08	0.1800	.0340	6.40	0.355	.0850	.45	54,000
June, . . .	20,000	70	76	None.	.08	0.0460	.0124	4.65	0.982	.0072	.10	10,900
July, . . .	20,000	73	78	None.	.09	0.0075	.0180	5.73	1.560	.0006	.11	14,800
August, . .	1,185,000	71	67	Decided.	.26	0.5740	.1370	6.61	2.430	.1700	.69	203,000
September, . .	1,063,000	66	65	Decided.	.35	0.4600	.1213	8.16	3.280	.0193	.94	574,000
October, . .	1,280,000	58	60	Decided.	.29	0.2290	.0877	6.24	1.900	.0111	.68	177,000
November, . .	757,000	48	52	Decided.	.31	0.5933	.0720	7.23	0.675	.0267	.64	139,000
December, . .	480,000	46	48	Decided.	.57	1.8000	.1180	10.12	0.105	.0030	.93	245,000
Average, .	605,600	61	64	-	.25	0.4862	.0744	6.89	1.410	.0341	.57	177,200

In conclusion, we may therefore assert that we have obtained a distinct advantage in the intermittent filtration of sewage in the use of metallic iron mixed with sand, a higher rate being maintained with efficient purification than has been found to be possible with sand alone. This rate, which was twice as great as with sand filters giving equally good results, could, however, only be maintained on the large scale in case the filter areas were kept clean, so as to allow the constant presence of free oxygen in the filters. The exhaustion of the oxygen would certainly be followed by the presence of iron in the effluent and a general derangement of the action of the filter.

Further experiments are needed to show whether a natural hydrous hematite, either alone or mixed with sand, will give as good results as metallic iron which has become coated with hydrous sesquioxide. It is unlikely that other natural iron ores, such as anhydrous hematite or magnetite, will be as easily reduced as the hydrous hematites.

Operation of the Large Intermittent Experimental Filters, $\frac{1}{200}$ of an Acre in Area.

The large filters in the field outside of the station have accomplished their usual satisfactory work during the year. Some of these filters have been in operation twelve years and are still in good physical condition; that is to say, the sand of which they are constructed is free from clogging, and contains no more stored organic matter than for several years past. The results obtained from these filters and observations in regard to their continuance in operation become more interesting and valuable each year. Intermittent sand filtration will probably meet, better than any other method yet known, the requirements of most Massachusetts municipalities that have to install sewage purification plants for many years in the future. No other kind of filter can probably be constructed as cheaply as sand filters, where areas of sandy land are found without difficulty; and observations of the large filtration areas in the State and analyses of their effluents prove their satisfactory work, even where they are not cared for as efficiently as could be wished. They are, in short, a practical success, while purification of sewage by means of contact filters is still in the experimental stage, and it does not seem probable that effluents of equal purity can be obtained by them. The following table shows the period of service of the large filters at the station, together with the date upon which they were started, their rate of operation, etc., and their average purification of sewage, for the year 1899: —

Average Purification, etc., of Filters Nos. 1 to 10, inclusive, 1899.

Number of Filter.	Dimensions of Filters. Depth (Inches).	Mean Diameter (Inches).	Date when Sewage was first Applied.	Actual Number of Gallons applied to Jan. 1, 1900.	Gallons per Acre.	Average Rate of Filtration (Gallons per Acre Daily) Six Days in a Week — 1899.	Average (1899) per Cent. Removal of Albuminoid Ammonia.	Oxygen Consumed.	Bacteria.
1, ...	60	200	Jan. 10, 1889	1,442,445	288,720,000	54,300	91	87	98.60
2, ...	60	200	Dec. 19, 1887.	731,565	146,313,000	34,400	95	95	98.90
4, ...	60	200	Dec. 19, 1887.	479,656	95,317,200	16,300	95	97	99.90
5 B, ...	60	200	Mar. 5, 1888.	224,100	44,820,000	81,700	80	86	97.46
6, ...	44	200	Jan. 12, 1888.	1,043,130	208,627,000	59,400	94	91	99.72
9 A, ...	60	200	Nov. 13, 1888.	965,382	193,076,400	59,500	92	87	99.60
10, ...	60	200	July 18, 1894.	225,010	67,502,000	25,000	68	90	98.74

Filter No. 1.

Filter No. 1 contains 60 inches in depth of coarse sand of an effective size of 0.48 millimeter, and is $\frac{1}{200}$ of an acre in area. The surface of this filter has been raked 1 inch deep each week and spaded over to a depth of 6 inches on April 16 and August 31. The following table gives the rate of operation and the monthly averages of the analyses of the effluent for the year: —

Effluent of Filter No. 1.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, .	76,200	40	40	4h. 24m.	Decided.	.45	1.1800	.1200	6.88	1.48	.0125	0.90	21,100
February, .	70,000	40	38	4h. 8m.	Decided.	.55	2.3600	.1624	7.87	1.15	.0193	0.95	158,900
March, .	60,000	48	39	1h. 14m.	V. slight.	.35	0.5200	.0692	7.01	2.77	.0024	0.74	13,800
April, .	48,000	47	46	45m.	V. slight.	.20	0.0900	.0456	4.50	3.27	.0005	0.45	15,740
May, . .	60,000	56	59	3m.	V. slight.	.17	0.0600	.0387	7.56	4.18	.0002	0.39	9,650
June, . .	57,700	68	68	2m.	Slight.	.20	0.0377	.0585	6.61	3.05	.0003	0.46	10,500
July, . .	60,000	74	75	2m.	Slight.	.14	0.0011	.0264	1.85	1.90	.0003	0.27	3,500
August, .	8,900	70	74	-	Slight.	.15	0.1158	.0455	5.44	2.99	.0004	0.46	19,800
September,	50,800	66	69	7m.	Slight.	.16	0.1775	.0427	8.80	2.83	.0004	0.41	30,700
October, .	60,000	57	59	4m.	Slight.	.14	0.0783	.0251	6.75	2.62	.0001	0.31	11,800
November, .	46,200	47	48	26m.	Slight.	.14	0.2745	.0400	7.60	2.27	.0010	0.38	25,500
December, .	60,000	46	48	51m.	Decided.	.50	1.5900	.1060	7.72	2.27	.0065	1.28	22,900
Average,	54,300	56	55	-	-	.26	0.5404	.0650	6.52	2.57	.0037	0.50	28,700

Sewage applied, 900 gallons six times a week. During January, 10½ inches of snow and 1½ inches of ice removed from surface; during February, 38 inches of snow and 2½ inches of ice; during March, 12½ inches of snow. Filter allowed to rest from August 1 to August 25 inclusive.

Filter No. 2.

This filter is $\frac{1}{200}$ of an acre in area, and contains 60 inches in depth of fine sand of an effective size of 0.08 millimeter, with two circular trenches 1 foot wide and 2 feet deep, of medium sand of an effective size of 0.19 millimeter, the surface of these trenches being below the surface of the remainder of the filter and to them the sewage is applied. The surface of the trenches has been raked 1 inch deep each week, and they were dug over to a depth of 6 inches on April 15 and August 31. The following table gives the rate of operation and the monthly averages of the analyses of the effluent: —

Effluent of Filter No. 2.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January, .	37,700	49	40	10h. 26m.	None.	.09	0.8500	.0320	7.79	1.15	.0680	.35	164
February, .	35,000	49	39	7h. 22m.	None.	.22	1.2480	.0464	7.34	0.48	.0600	.58	1,903
March, .	38,500	49	38	2h. 34m.	Slight.	.25	1.5840	.0560	7.07	1.28	.0712	.69	135
April, . .	32,000	48	44	2h. 55m.	None.	.17	0.8238	.0407	4.31	2.41	.0587	.42	88
May, . .	40,000	56	54	5m.	None.	.14	0.1894	.0242	4.98	3.88	.0059	.30	134
June, . .	38,500	68	64	4m.	None.	.14	0.0227	.0238	8.49	3.01	.0001	.27	43
July, . .	40,000	74	73	4m.	None.	.12	0.0015	.0218	3.85	1.87	.0000	.24	21
August, .	5,900	70	74	–	None.	.08	0.0028	.0144	1.32	0.88	.0000	.16	9
September,	33,900	65	71	27m.	None.	.10	0.0023	.0170	6.50	2.99	.0000	.19	26
October, .	40,000	56	61	17m.	None.	.09	0.0014	.0121	7.37	3.30	.0000	.14	35
November, .	30,800	48	54	35m.	None.	.07	0.0015	.0098	6.53	2.82	.0000	.14	143
December, .	40,000	46	46	3h. 32m.	None.	.10	0.0990	.0182	8.12	2.14	.0460	.30	50
Average,	34,400	57	55	–	–	.13	0.4022	.0264	6.14	2.18	.0254	.32	329

Sewage applied, 200 gallons six times a week. July 29 and August 31, cut grass and weeds on surface. During January, 10¼ inches of snow removed from surface and 8¾ inches of ice from trenches; during February, 37½ inches of snow and 8¼ inches of ice; during March, 11¼ inches of snow. Filter allowed to rest from August 1 to August 25 inclusive.

Filter No. 4.

This filter is $\frac{1}{200}$ of an acre in area, and contains 60 inches in depth of fine river silt of an effective size of 0.04 millimeter, with two circular trenches about 14 inches wide and 12 inches deep, of coarse sand of an effective size of 0.48 millimeter. The surface of these trenches is below the surface of the remainder of the filter, and to them the sewage is applied. They have been raked 1 inch deep each week and spaded to a depth of 6 inches on April 15 and August 31. The following table gives the rate of operation of the filter for the year and the monthly averages of the analyses of the effluent: —

Effluent of Filter No. 4.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F.		Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Sewage.	Effluent.		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.		
January,	19,200	48	43	11h.	None.	.01	.0069	.0097	6.55	1.27	.0011	.09	5
February,	16,700	49	42	12h. 47m.	None.	.02	.0650	.0154	6.45	0.72	.0048	.15	302
March,	19,300	48	40	2h. 46m.	None.	.04	.2990	.0288	5.95	0.86	.0280	.25	487
April,	11,200	49	43	1h. 10m.	None.	.06	.3950	.0270	3.97	1.61	.0400	.22	21
May,	19,300	56	55	6m.	None.	.04	.1427	.0117	3.77	3.01	.0006	.12	17
June,	18,900	68	64	4m.	None.	.08	.0639	.0106	5.46	3.00	.0000	.10	103
July,	20,000	75	69	6m.	None.	.02	.0069	.0116	8.69	1.94	.0000	.12	19
August,	3,000	70	-	-	-	-	-	-	-	-	-	-	-
September,	18,500	65	68	20m.	None.	.05	.0023	.0127	5.61	1.45	.0000	.11	69
October,	20,000	56	62	11m.	None.	.06	.0016	.0092	8.09	3.13	.0000	.10	8
November,	15,400	47	51	30m.	None.	.01	.0011	.0089	6.25	2.86	.0000	.10	10
December,	20,000	46	46	2h. 36m.	None.	.04	.0026	.0106	8.17	2.64	.0007	.08	3
Average,	16,792	56	53	-	-	.03	.0897	.0142	6.27	2.04	.0068	.13	95

Sewage applied, 200 gallons three times a week. July 29 and August 31, cut grass and weeds on surface. During January, 9½ inches of snow removed from surface and 3 inches of ice from trenches; during February, 27 inches of snow and 5 inches of ice; during March, 4½ inches of snow. Filter allowed to rest from August 1 to August 25 inclusive.

Filter No. 5 B.

This filter is $\frac{1}{200}$ of an acre in area, and contains 60 inches in depth of a mixture of cinders and ashes from the combustion of soft coal. It was first put into operation on March 5, 1898, and was operated during that year at an average rate of 73,000 gallons per acre daily. During 1899 the rate of operation was increased.

Owing to the coarseness of the material in this filter, sewage enters it more readily than any of the other large filters, and this is a condition especially favorable for good work during cold winter weather, as noted on page 446. The surface of the filter has been raked 1 inch deep each week. The following table gives the rate of operation and the monthly averages of the analyses of the effluent of the filter: —

Effluent of Filter No. 5 B.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	100,000	44	40	38m.	Decided.	.36	2.0200	.0890	6.43	1.15	.0075	0.63	88,400
February,	95,800	44	39	6h.	Decided.	.41	2.1550	.1215	6.92	1.50	.0065	0.86	79,700
March,	100,000	45	41	18m.	Slight.	.21	1.1060	.0576	5.97	2.37	.0076	0.46	87,500
April,	56,000	48	47	10m.	Slight.	.12	0.1700	.0422	5.69	2.80	.0065	0.29	7,600
May,	100,000	56	59	3m.	Slight.	.09	0.1575	.0269	7.31	3.79	.0005	0.22	10,200
June,	100,000	70	70	6m.	V. slight.	.06	0.0629	.0237	7.08	2.70	.0001	0.17	7,600
July,	100,000	74	76	4m.	V. slight.	.09	0.0386	.0181	8.05	1.51	.0000	0.14	9,200
August,	11,100	71	-	-	-	-	-	-	-	-	-	-	-
September,	84,600	67	70	35m.	Decided.	.23	0.8409	.1047	10.87	2.59	.0059	0.67	95,800
October,	100,000	57	59	17m.	Decided.	.29	0.7250	.0760	7.45	2.62	.0041	0.69	73,600
November,	73,100	48	49	14m.	Decided.	.24	0.6500	.0820	7.44	3.06	.0205	0.65	59,000
December,	100,000	47	43	1h. 29m.	Great.	.61	2.2000	.1720	8.12	1.68	.1150	2.01	105,000
Average,	81,700	56	54	-	-	.25	0.9201	.0740	6.94	2.34	.0158	0.62	52,000

Sewage applied, 500 gallons six times a week. During January, 12½ inches of snow and 1 inch of ice removed from surface; during February, 25¾ inches of snow and 5¼ inches of ice; during March, 9¾ inches of snow. Filter allowed to rest from August 1 to August 25 inclusive.

Filter No. 6.

This filter is $\frac{1}{200}$ of an acre in area, and contains 44 inches in depth of mixed coarse and fine sand of an effective size of 0.35 millimeter. The surface of the filter has been raked to a depth of 1 inch each week and spaded to a depth of 6 inches on April 3 and August 31. The following table gives the rate of operation during the year and the monthly averages of the analyses of the effluent of the filter: —

Effluent of Filter No. 6.

[Parts per 100,000.]

1899.	Quantity Applied. Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, .	100,000	46	38	7h.	Decided.	.37	0.6750	.0630	3.80	1.16	.0013	.61	11,900
February, .	95,800	47	38	7h.	Decided.	.49	1.0050	.0850	4.15	0.73	.0068	.71	12,500
March, .	86,700	45	39	5h. 40m.	V. slight.	.23	0.1164	.0683	3.14	1.21	.0022	.46	3,877
April, . .	26,400	48	44	1h. 13m.	V. slight.	.14	0.1706	.0385	4.73	3.21	.0067	.34	3,600
May, . .	60,000	56	56	10m.	V. slight.	.15	0.0020	.0303	6.00	4.38	.0000	.33	3,950
June, . .	60,000	68	68	8m.	None.	.14	0.0016	.0249	7.00	3.08	.0001	.27	2,900
July, . .	60,000	72	74	5m.	None.	.11	0.0012	.0196	5.55	2.75	.0001	.19	2,000
August, .	8,900	71	-	-	-	-	-	-	-	-	-	-	-
September,	50,800	66	71	50m.	V. slight.	.14	0.0568	.0258	9.72	3.78	.0002	.27	7,700
October, .	60,000	56	62	18m.	V. slight.	.14	0.0025	.0193	5.42	3.25	.0000	.23	3,050
November, .	43,800	48	50	19m.	V. slight.	.12	0.0638	.0210	6.75	2.72	.0000	.24	1,300
December, .	60,000	45	41	2h. 53m.	Slight.	.34	1.4800	.0690	8.63	2.08	.0140	.70	10,700
Average,	59,400	56	53	-	-	.22	0.3250	.0409	5.90	2.58	.0022	.40	5,800

Sewage applied, 300 gallons six times a week. During January, 12 inches of snow and 5½ inches of ice removed from surface; during February, 26½ inches of snow and 4 inches of ice; during March, 7 inches of snow and ½ inch of ice. Filter allowed to rest August 1 to 25 inclusive.

Filter No. 9 A.

This filter is $\frac{1}{200}$ of an acre in area, and contains 5 feet in depth of sand of an effective size of 0.17 millimeter. The surface of the filter has been raked 1 inch deep each week and spaded to a depth of 6 inches on April 15 and August 31. The surface of the filter during the winter of 1899-1900 was so arranged that the sewage was applied to only one-half the area, thus giving a greater depth of sewage over the surface at the time of application and by this means keeping the filter freer from frost, and this resulted in better nitrification during most of the winter months than has usually been the case with this filter. The following table gives the rate of operation during the year and the monthly averages of the analyses of the effluent of the filter: —

Effluent of Filter No. 9A.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. — Sewage.	Temperature. Deg. F. — Effluent.	Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance. — Turbidity.	Appearance. — Color.	Ammonia. — Free.	Ammonia. — Albuminoid.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, .	100,000	44	39	5h. 17m.	Slight.	0.32	0.7000	.0620	4.15	0.78	.0025	0.58	8,800
February, .	91,700	45	38	8h. 18m.	Slight.	0.38	1.3050	.0835	4.90	0.88	.0065	0.79	24,300
March, .	92,600	45	38	2h. 22m.	Slight.	0.31	0.3420	.0584	4.06	1.35	.0020	0.57	7,800
April, .	28,800	47	42	56m.	V. slight.	0.17	0.2784	.0426	4.81	2.49	.0005	0.37	620
May, . .	58,300	58	55	6m.	V. slight.	0.16	0.0083	.0320	6.23	4.15	.0001	0.35	2,448
June, . .	60,000	70	67	4m.	None.	0.14	0.0018	.0233	5.49	3.26	.0000	0.26	259
July, . .	60,000	73	74	4m.	None.	0.11	0.0014	.0196	4.94	2.58	.0000	0.22	125
August, .	11,100	71	73	5m.	None.	0.11	0.0466	.0228	7.71	3.66	.0002	0.27	33
September,	50,800	66	71	28m.	None.	0.11	0.1064	.0232	8.45	3.30	.0001	0.26	585
October, .	60,000	58	61	24m.	None.	0.18	0.0120	.0193	7.44	3.70	.0003	0.22	520
November, .	46,200	48	51	1h. 27m.	None.	0.18	0.0821	.0264	7.84	2.09	.0002	0.28	18
December, .	60,000	46	42	2h. 38m.	Decided.	1.55	3.7600	.2333	8.75	0.70	.0118	2.30	51,400
Average,	59,500	56	54	-	-	0.30	0.5537	.0539	6.23	2.41	.0020	0.54	8,100

Sewage applied, 300 gallons six times a week. During January, 12 inches of snow and 2½ inches of ice removed from surface; during February, 27¾ inches of snow and 5¼ inches of ice; during March, 15¾ inches of snow. Filter allowed to rest August 1 to 25 inclusive.

Filter No. 10.

This filter is $\frac{1}{200}$ of an acre in area, and contains 5 feet in depth of mixed coarse and fine sand of an effective size of 0.35 millimeter. No underdrains are beneath the sand except directly above and around the outlet pipe. A partition extending 3 feet below the surface separates the quarter of the surface farthest from the underdrains from the remainder of the surface. To this quarter of the surface the sewage is applied, and the rate upon this area is four times as great as the rate given in the table below, which is calculated upon the entire surface of the filter. In the fall of 1899 about 8 inches in depth of loam was placed over the portion of the surface to which sewage is not applied, in order that the filter might resemble more closely large filtration areas, where the sewage is applied to certain portions from which the surface loam and soil have been removed, but the remainder of the area left covered with this loam. The effect of this covering was to keep the filter somewhat warmer during the year, as would naturally be expected, and better purification resulted.

Effluent of Filter No. 10.

[Parts per 100,000.]

1899.	Quantity Applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature. Deg. F. Sewage.	Temperature. Deg. F. Effluent.	Length of Time Sewage Remained on Surface. — Hours and Minutes.	Appearance. Turbidity.	Appearance. Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January, .	27,700	42	40	9h.	Decided.	.43	1.0000	.1170	6.06	0.77	.0140	.87	24,900
February, .	22,500	42	38	5h. 19m.	Decided.	.51	1.7500	.1055	7.83	1.21	.0111	.92	17,900
March, .	30,000	43	38	1h. 26m.	Slight.	.27	0.8760	.0716	5.54	1.48	.0182	.57	12,700
April, . .	18,400	47	43	2h. 15m.	Slight.	.25	0.6000	.0620	5.68	1.97	.0125	.52	4,050
May, . .	26,700	58	55	5m.	V. slight.	.16	0.1685	.0388	6.39	4.29	.0006	.35	1,577
June, . .	30,000	70	67	4m.	V. slight.	.13	0.0186	.0279	5.90	3.65	.0001	.27	290
July, . .	30,000	74	75	3m.	V. slight.	.11	0.0046	.0214	3.41	2.25	.0002	.21	154
August, .	5,600	70	71	3m.	None.	.07	0.0054	.0200	8.94	3.13	.0002	.17	103
September,	25,400	65	70	25m.	None.	.10	0.0019	.0157	6.75	3.13	.0001	.19	130
October, .	30,000	58	61	6m.	None.	.12	0.0007	.0143	5.58	2.64	.0000	.17	206
November, .	23,100	49	53	14m.	None.	.10	0.0074	.0155	7.75	3.22	.0000	.18	118
December, .	30,000	46	45	51m.	V. slight.	.19	0.7500	.0400	3.77	2.80	.0370	.48	796
Average,	25,000	55	55	-	-	.20	0.4315	.0458	6.56	2.55	.0074	.41	5,250

Sewage applied, 150 gallons six times a week. August 16, grass and weeds removed from that part of surface which is not flooded, and 4 inches of loam put on surface and packed down hard. October 19, 6 inches of dirt put over the loam. During January, 13 inches of snow and 8⅝ inches of ice removed from surface; during February, 27½ inches of snow and 14⅞ inches of ice; during March, 11½ inches of snow. Filter allowed to rest August 1 to 25 inclusive.

FILTRATION OF WATER.

Studies upon the purification of water by sand filtration have been continued at the experiment station during 1899, and a number of experimental filters have been in operation. Several of them have received water from the Merrimack River while to others a more polluted water has been applied. During a portion of the year this polluted water has been the filtered city supply and sewage, and during a portion of the year the unfiltered river water and sewage. The results obtained during the period when city water and sewage was applied, compared with those obtained during the period when river water and sewage was applied, have given interesting information upon the different degrees of clogging of filter surfaces caused by sand, silt and organic matter in the applied water. Two experimental filters have been used for preliminary work upon studies of the removal of color from water, and much experimental work has been done as in previous years upon methods of removing iron from ground water.

B. Coli Communis.

Besides the bacterial work necessary for the determinations of the bacterial efficiency of the filters, many hundred samples of the river water and the filtered water from the various filters, etc., have been examined to determine the presence or absence of *B. coli communis*, the characteristic organism of sewage-polluted water supplies. This work has been done in order to determine the efficiency of sand filters in removing this organism. Particularly have we followed the work of the Lawrence city filter, and its efficiency in removing this germ from the Merrimack River water.

These studies upon the removal of *B. coli communis* by filtration were begun several years ago, as it is evident that it is of more importance that a filter shall remove all of the few disease germs that may be present in a polluted water than 99 or even 100 per cent. of the large number of ordinary harmless water bacteria present; and these studies with *B. coli communis* were of direct application to this fact as follows: The detection in water of the germ of typhoid fever — the principal water-borne disease in this country at least — is of rare occurrence, and must necessarily be so, on account of the great dilution, in most instances, of the infecting matter with the water, and the small volume of water that can be examined in the laboratory for this germ, even when many examinations are made. The typhoid bacillus cannot occur naturally in water, however, without the occurrence of large numbers of *B. coli communis;* and the determination of the absence of this latter germ from filtered water is conclusive evidence, we believe, of the absence of the typhoid germ. For instance, when one considers the very large number of people in the cities of Lowell, Manchester, etc., who are contributing *B. coli communis* to the sewage that flows into the Merrimack River from the sewers of those cities, and also considers that it is of rare occurrence to find more than fifty of these bacilli in 1 cubic centimeter of the river water at the intake of the Lawrence city filter, we can understand how few must be the typhoid germs contained in the river water in comparison with the number of *B. coli communis*, even when an epidemic of typhoid fever is occurring in the cities above Lawrence, owing to the small percentage of the inhabitants of those cities that have typhoid fever, even at times of a severe epidemic.

The volume of water to be tested for *B. coli communis* has been an object for special study, as it is evident that we are more likely to find the germ in 100 cubic centimeters or 50 cubic centimeters of water than in 1 cubic centimeter. Following out this line of thought, therefore, the question arises, when filtering a water as polluted as that of the Merrimack River, Is a degree of filtration that eliminates *B. coli communis* from the water essential in order to feel sure that all disease germs are eliminated, or is it only necessary that the filtration shall be so effective that this germ is not found, or but seldom found, in 1 cubic centimeter or perhaps 5 cubic centimeters of the filtered water examined?

Lawrence City Filter.

This filter is 2.5 acres in area, and is unprotected from the weather by any roof. It was first put into operation in September, 1893.

After the disturbances made in the filter in December, 1898, recorded in the report of last year, the bacterial results of filtration continued less satisfactory than usual through the cold months of January and February, 1899, but resumed their normal condition in March.

The following facts can be noted: During January, the average number of bacteria in the effluent of the filter was 83 per cubic centimeter, and the bacterial efficiency of the filter was 98.31 per cent.; *B. coli communis* was found, however, in 1 cubic centimeter of 14 of the 26 samples examined for it during the month. During February, the average number of bacteria in the effluent of the filter was 108 per cubic centimeter, and the bacterial efficiency of the filter was 98.17 per cent.; *B. coli communis* was found, however, in 1 cubic centimeter of 13 of the 21 samples examined during the month. In March, the average number of bacteria in the effluent of the filter was 45 per cubic centimeter, and its bacterial efficiency was 99.30 per cent., and *B. coli communis* was found in 1 cubic centimeter of only 2 of the 26 samples examined during this month. That is to say, the poorest bacterial efficiency during any one of these three months was only 1.13 per cent. less than the best bacterial efficiency. This difference was not particularly striking, and ordinarily not much significance would be attached to this small variation. In the month of January, however, 54 per cent. of the samples contained *B. coli communis* in the 1 cubic centimeter of each sample examined, during February 62 per cent. of the samples contained *B. coli communis* in the 1 cubic centimeter of each sample examined, while during the month of March only 8 per cent. of the samples examined contained this germ in the 1 cubic centimeter examined.

A comparison of the different determinations indicates that the test for *B. coli communis* in filtered water may develop an importance which has not hitherto been sufficiently recognized.

During the year 180 samples of the river water collected at the intake of the filter were examined for *B. coli communis*, and it was found in all but one of these samples. The number per cubic centimeter averaged 47 for the entire year, and the average number varied from 8 per cubic centimeter in August to 140 per cubic centimeter in December. During the same period 189 samples of the filtered water collected at the pumping station were examined for this germ, and it was found in 1 cubic centimeter of 45 of these samples. Twenty-seven of the samples in which it was found, however, were collected during the months of January and February. Probably never more than one colony per cubic centimeter was present in any of these samples of effluent from the city filter. For further results of work along this line, see table, page 496.

Number of Bacteria and B. Coli Communis per

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1, . . .	-	-	4,400	13	7,000	52	3,100	-	2,200	12	-	-
2	2, . . .	5,700	43	4,500	5	12,000	32	-	-	3,400	3	-	-
3	3, . . .	5,200	35	4,200	30	7,000	37	2,000	0	1,400	37	-	-
4	4, . . .	2,700	37	3,500	21	8,700	73	1,200	16	3,500	27	-	-
5	5, . . .	6,400	32	-	-	-	-	4,200	20	1,000	42	3,500	140
6	6, . . .	4,800	28	5,200	21	11,200	8	1,100	12	1,900	11	-	-
7	7, . . .	9,800	67	6,300	4	-	-	1,600	30	-	-	-	-
8	8, . . .	-	-	4,500	17	7,200	6	3,700	5	600	4	-	-
9	9, . . .	3,300	45	5,700	56	8,300	7	-	-	1,000	24	-	-
10	10, . . .	1,800	37	7,000	67	5,800	8	3,000	53	400	12	-	-
11	11, . . .	8,300	15	3,500	11	4,600	17	1,200	30	3,000	25	-	-
12	12, . . .	3,100	33	-	-	-	-	3,100	-	1,400	7	11,000	-
13	13, . . .	3,600	28	-	-	12,000	32	3,000	25	-	-	-	-
14	14, . . .	4,500	5	-	-	8,700	48	2,000	7	-	-	-	-
15	15, . . .	-	-	3,000	77	4,200	12	3,000	10	2,000	20	-	-
16	16, . . .	5,000	56	10,000	95	5,300	5	-	-	-	-	-	-
17	17, . . .	6,700	40	4,800	58	3,400	11	5,200	28	-	-	-	-
18	18, . . .	4,800	9	3,300	30	4,900	5	4,800	16	-	-	-	-
19	19, . . .	4,400	11	-	-	-	-	-	-	-	-	1,700	8
20	20, . . .	2,800	5	4,800	15	3,500	2	3,100	22	-	-	-	-
21	21, . . .	8,000	13	8,000	8	3,800	0	3,300	11	-	-	-	-
22	22, . . .	-	-	-	-	4,800	7	4,000	0	2,200	23	-	-
23	23, . . .	2,600	9	10,000	12	1,900	64	-	-	-	-	-	-
24	24, . . .	4,400	32	8,300	26	1,700	23	3,100	4	-	-	-	-
25	25, . . .	12,500	40	7,400	18	2,900	5	2,100	8	-	-	-	-
26	26, . . .	5,500	6	-	-	-	-	3,000	20	-	-	-	-
27	27, . . .	5,500	21	4,800	37	2,200	11	1,800	24	-	-	-	-
28	28, . . .	5,200	37	5,400	40	7,800	5	2,400	10	-	-	3,400	-
29	29, . . .	-	-	-	-	16,800	7	3,200	8	2,600	43	-	-
30	30, . . .	3,500	32	-	-	4,900	4	-	-	-	-	-	-
31	31, . . .	3,800	14	-	-	3,900	12	-	-	-	-	-	-
32	Average, .	4,900	28	5,900	31	6,300	19	2,900	12	1,900	21	4,700	74

Cubic Centimeter in Merrimack River Water, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
-	-	-	-	-	-	-	-	12,300	34	9,000	126	1
-	-	-	-	-	-	12,600	10	9,600	54	4,100	212	2
-	-	-	-	-	-	-	-	4,500	26	-	-	3
-	-	-	-	-	-	-	-	6,900	48	11,200	266	4
-	-	-	-	1,300	66	-	-	-	-	11,200	118	5
3,800	2	-	-	-	-	-	-	4,000	7	7,300	153	6
-	-	-	-	-	-	-	-	8,200	89	11,000	209	7
-	-	1,200	18	-	-	-	-	4,200	53	2,000	60	8
-	-	-	-	-	-	-	-	5,300	50	8,400	141	9
8,300	73	-	-	-	-	14,200	0	5,300	116	-	-	10
1,400	123	-	-	8,000	1	-	-	6,500	182	8,300	17	11
-	-	-	-	-	-	-	-	-	-	13,800	162	12
-	-	-	-	-	-	-	-	8,300	12	18,400	88	13
-	-	9,100	-	-	-	-	-	4,200	14	22,400	258	14
-	-	-	-	-	-	-	-	8,800	74	5,200	220	15
-	-	-	-	-	-	5,300	4	13,500	59	20,800	160	16
-	-	-	-	-	-	-	-	7,300	25	-	-	17
900	47	-	-	9,800	14	-	-	3,300	45	11,600	65	18
-	-	-	-	-	-	-	-	-	-	4,400	119	19
-	-	-	-	-	-	-	-	11,200	95	7,500	114	20
-	-	6,600	9	-	-	-	-	8,600	-	7,400	194	21
-	-	-	-	-	-	-	-	6,000	72	8,400	180	22
-	-	-	-	-	-	-	-	69,200	85	8,200	121	23
1,500	75	-	-	-	-	10,300	91	5,300	71	-	-	24
-	-	-	-	-	-	-	-	6,000	51	-	-	25
-	-	-	-	1,500	92	-	-	-	-	11,900	69	26
-	-	-	-	-	-	-	-	14,500	42	4,700	117	27
-	-	-	-	-	-	-	-	3,800	104	2,000	113	28
-	-	3,000	2	-	-	-	-	7,700	146	5,300	105	29
-	-	-	-	-	-	4,000	7	-	-	6,500	112	30
6,000	118	-	-	-	-	-	-	-	-	-	-	31
3,700	73	5,000	8	5,200	43	9,300	22	9,800	60	9,800	140	32

Number of Bacteria and B. Coli Communis per Cubic

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1,	-	-	97	1	45	1	86	0	20	0	-	-
2	2,	158	1	122	1	58	1	-	-	17	0	-	-
3	3,	47	0	50	0	110	0	7	0	8	0	-	-
4	4,	26	0	124	1	48	0	18	0	34	0	-	-
5	5,	98	1	-	-	-	-	17	0	18	0	14	0
6	6,	43	0	90	1	55	0	12	0	18	0	-	-
7	7,	171	0	102	0	-	-	51	1	-	-	-	-
8	8,	-	-	185	1	84	0	140	1	28 -	0	-	-
9	9,	93	1	284	1	82	0	-	-	11	0	-	-
10	10,	22	0	183	0	45	0	151	1	14	0	-	-
11	11,	122	1	115	1	61	0	89	0	88	0	-	-
12	12,	114	1	-	-	-	-	22	0	10	0	325	0
13	13,	56	0	-	-	64	0	22	0	-	-	-	-
14	14,	68	1	-	-	44	0	16	0	-	-	-	-
15	15,	-	-	66	1	88	0	28	0	10	0	-	-
16	16,	86	1	79	1	89	0	-	-	-	-	-	-
17	17,	142	1	111	1	85	0	42	0	-	-	-	-
18	18,	103	1	95	0	52	0	86	0	-	-	-	-
19	19,	64	1	-	-	-	-	-	-	-	-	85	0
20	20,	44	0	119	0	48	0	40	0	-	-	-	-
21	21,	82	0	86	0	29	0	22	0	-	-	-	-
22	22,	-	-	-	-	64	0	14	0	13	0	-	-
23	23,	51	0	40	0	89	0	-	-	-	-	-	-
24	24,	65	0	63	1	36	0	26	1	-	-	-	-
25	25,	102	1	152	0	25	0	11	0	-	-	-	-
26	26,	34	0	-	-	-	-	12	0	-	-	-	-
27	27,	78	1	131	1	19	0	38	0	-	-	-	-
28	28,	95	1	127	1	17	0	118	0	-	-	65	0
29	29,	-	-	-	-	42	0	41	0	4	0	-	-
30	30,	140	0	-	-	82	0	-	-	-	-	-	-
31	31,	59	1	-	-	27	0	-	-	-	-	-	-
32	Average,	83	-	108	-	45	-	40	-	17	-	110	-

January 6, beds 22-25 inclusive were scraped; January 10, bed 21; January 13, beds 18-20; January 17, beds 14-17; January 20, beds 1-3; January 24, beds 4 and 5; January 28, beds 8 and 9; January 31, bed 10; February 3, beds 11 and 12; February 7, beds 13 and 14; February 21, beds 15-17; February 22, beds 18 and 19; February 23, beds 20 and 21; February 24, bed 22; March 1, beds 23-25; March 4, beds 1-3; April 5, beds 12-22; April 6, beds 1-11 and 20-25; April 26, beds 1-3 and 17-22; April 27, beds 6-16 and 23-25; April 28, beds 4 and 5; May 4, beds 5 and 6; May 9, beds 7 and 8; May 11, beds 9, 12 and 13; May 18, beds 1-4, 11 and 14; May 23, beds 15-20; May 25, beds 21-25; May 31, bed 12; June 1-November 1, all the beds were scraped seven times; November 8, beds 12, 21 and 25; November 10, beds 1, 2, 11, 12, 22, 23 and 24; November 21, beds 13-25; November 24, beds 1-12; December 5, beds 20-25; December 7, beds 1 and 11-19; December 8, beds 2-10; December 16, beds 16-25; and December 19, beds 1-14.

On different dates during the year all the beds were refilled to grade; that is to say, sand was placed upon the bed in sufficient depth to equalize the sand removed from it by scraping.

Centimeter in Effluent of Lawrence City Filter, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
-	-	-	-	-	-	-	-	9	0	85	1	1
-	-	-	-	-	-	29	0	86	0	7	0	2
8	0	-	-	-	-	-	-	18	0	-	-	3
-	-	-	-	-	-	-	-	4	0	286	0	4
-	-	-	-	8	0	-	-	-	-	24	1	5
18	0	-	-	-	-	-	-	47	0	48	0	6
-	-	-	-	-	-	-	-	15	0	30	0	7
-	-	15	0	-	-	-	-	11	0	27	0	8
-	-	-	-	-	-	-	-	16	0	8	0	9
17	0	-	-	-	-	72	0	5	0	-	-	10
6	0	-	-	29	0	-	-	22	1	48	0	11
-	-	-	-	-	-	-	-	-	-	57	0	12
-	-	-	-	-	-	-	-	42	1	45	0	13
-	-	36	0	-	-	-	-	19	0	26	0	14
-	-	-	-	-	-	-	-	16	0	30	1	15
-	-	-	-	-	-	298	0	12	0	25	0	16
-	-	-	-	-	-	-	-	24	0	-	-	17
5	0	-	-	83	0	-	-	25	0	85	0	18
-	-	-	-	-	-	-	-	-	-	30	1	19
-	-	-	-	-	-	-	-	48	1	95	0	20
-	-	8	0	-	-	-	-	19	0	25	0	21
-	-	-	-	-	-	-	-	143	1	39	0	22
-	-	-	-	-	-	-	-	159	1	48	0	23
22	1	-	-	-	-	10	0	20	0	-	-	24
-	-	-	-	-	-	-	-	71	0	-	-	25
-	-	-	-	9	0	-	-	-	-	325	1	26
-	-	-	-	-	-	-	-	350	1	8	0	27
-	-	-	-	-	-	-	-	11	0	9	0	28
-	-	30	0	-	-	-	-	21	0	21	0	29
-	-	-	-	-	-	68	0	-	-	40	0	30
11	0	-	-	-	-	-	-	-	-	-	-	31
12	-	22	-	31	-	95	-	46	-	56	-	32

Volume of Water filtered during 1899.

100.3 million gallons of water were filtered during January.
87.8 " " " " " February.
90.5 " " " " " March.
91.1 " " " " " April.
101.5 " " " " " May.
106.0 " " " " " June.
108.0 " " " " " July.
99.2 " " " " " August.
109.8 " " " " " September.
95.9 " " " " " October.
90.5 " " " " " November.
91.4 " " " " " December.

1,172.0 million gallons of water filtered during the year.

Number of Bacteria and B. Coli Communis per Cubic

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1, . . .	-	-	114	0	120	0	26	0	13	0	-	-
2	2, . . .	248	1	100	0	96	1	-	-	58	0	-	-
3	3, . . .	78	0	106	1	105	1	606	0	21	0	-	-
4	4, . . .	161	0	113	0	78	0	21	0	14	0	-	-
5	5, . . .	165	1	-	-	-	-	62	0	37	0	14	0
6	6, . . .	119	1	57	0	113	0	30	0	23	0	-	-
7	7, . . .	122	0	58	0	-	-	50	0	-	-	-	-
8	8, . . .	-	-	72	1	126	0	37	0	32	0	-	-
9	9, . . .	164	1	51	0	154	0	-	-	32	0	-	-
10	10, . . .	123	1	-	-	102	0	77	0	30	0	-	-
11	11, . . .	135	0	368	1	52	0	61	0	35	0	-	-
12	12, . . .	135	0	-	-	-	-	62	0	10	0	32	0
13	13, . . .	114	1	-	-	61	0	118	0	-	-	-	-
14	14, . . .	489	0	-	-	75	0	67	0	-	-	-	-
15	15, . . .	-	-	96	1	72	0	77	0	6	0	-	-
16	16, . . .	83	0	171	1	66	0	-	-	-	-	-	-
17	17, . . .	82	0	144	0	86	0	32	0	-	-	-	-
18	18, . . .	169	0	97	0	30	0	23	0	-	-	-	-
19	19, . . .	187	0	-	-	-	-	-	-	-	-	85	0
20	20, . . .	449	0	71	1	180	0	30	0	-	-	-	-
21	21, . . .	145	0	117	1	43	0	30	0	-	-	-	-
22	22, . . .	-	-	-	-	78	0	28	0	28	0	-	-
23	23, . . .	184	0	75	0	31	0	-	-	-	-	-	-
24	24, . . .	127	0	106	0	46	0	23	0	-	-	-	-
25	25, . . .	102	0	164	0	85	0	27	0	-	-	-	-
26	26, . . .	98	0	-	-	-	-	22	0	-	-	-	-
27	27, . . .	108	0	201	0	30	0	22	0	-	-	-	-
28	28, . . .	70	0	119	1	35	0	46	0	-	-	105	0
29	29, . . .	-	-	-	-	71	0	24	0	25	0	-	-
30	30, . . .	132	0	-	-	99	0	-	-	-	-	-	-
31	31, . . .	242	0	-	-	47	0	-	-	-	-	-	-
32	Average, .	163	-	124	-	78	-	67	-	26	-	59	-

Centimeter in Filtered Water at Outlet of Reservoir, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
-	-	-	-	-	-	-	-	15	0	14	1	1
-	-	-	-	-	-	24	0	18	0	126	0	2
143	0	-	-	-	-	-	-	31	0	-	-	3
-	-	-	-	-	-	-	-	14	0	38	0	4
-	-	-	-	8	0	-	-	-	-	24	0	5
120	0	-	-	-	-	-	-	10	0	97	0	6
-	-	-	-	-	-	-	-	36	0	95	0	7
-	-	65	0	-	-	-	-	100	0	36	1	8
-	-	-	-	-	-	-	-	20	0	22	0	9
63	0	-	-	-	-	28	0	28	0	-	-	10
-	-	-	-	25	0	-	-	48	1	18	0	11
-	-	-	-	-	-	-	-	-	-	46	0	12
-	-	-	-	-	-	-	-	24	0	106	0	13
-	-	18	0	-	-	-	-	18	0	16	0	14
-	-	-	-	-	-	-	-	40	0	38	0	15
-	-	-	-	-	-	48	0	24	0	58	1	16
-	-	-	-	-	-	-	-	23	0	-	-	17
41	1	-	-	60	0	-	-	30	0	26	0	18
-	-	-	-	-	-	-	-	-	-	36	0	19
-	-	-	-	-	-	-	-	54	0	14	0	20
-	-	42	0	-	-	-	-	50	0	16	0	21
-	-	-	-	-	-	-	-	228	0	18	0	22
-	-	-	-	-	-	-	-	33	1	30	1	23
38	0	-	-	-	-	24	0	62	0	-	-	24
-	-	-	-	-	-	-	-	38	0	-	-	25
-	-	-	-	42	0	-	-	-	-	16	0	26
-	-	-	-	-	-	-	-	58	0	14	0	27
-	-	-	-	-	-	-	-	25	0	8	0	28
-	-	42	0	-	-	-	-	46	0	23	0	29
-	-	-	-	-	-	16	0	-	-	64	1	30
22	0	-	-	-	-	-	-	-	-	-	-	31
71	-	42	-	34	-	27	-	43	-	39	-	31

Number of Bacteria and B. Coli Communis per Cubic

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1, ...	-	-	81	1	36	0	93	0	15	0	-	-
2	2, ...	137	1	79	0	45	1	-	-	33	0	-	-
3	3, ...	49	0	52	0	64	0	19	0	11	0	-	-
4	4, ...	72	0	68	1	34	1	29	0	43	0	-	-
5	5, ...	65	0	-	-	-	-	32	0	18	0	9	0
6	6, ...	82	0	75	0	70	0	18	0	5	0	-	-
7	7, ...	84	0	48	0	76	0	34	0	-	-	-	-
8	8, ...	-	-	62	0	28	0	31	0	22	0	-	-
9	9, ...	126	0	59	1	80	0	-	-	7	0	-	-
10	10, ...	92	0	106	0	63	0	49	0	21	0	-	-
11	11, ...	109	0	110	0	41	0	21	0	17	0	-	-
12	12, ...	94	1	-	-	-	-	22	0	13	0	20	0
13	13, ...	125	1	59	1	51	0	42	0	-	-	-	-
14	14, ...	106	0	-	-	32	0	38	0	-	-	-	-
15	15, ...	-	-	78	0	34	0	56	0	8	0	-	-
16	16, ...	89	0	74	0	67	1	-	-	-	-	-	-
17	17, ...	39	0	49	0	17	0	40	0	-	-	-	-
18	18, ...	100	0	54	0	49	0	9	0	-	-	-	-
19	19, ...	167	0	-	-	-	-	-	-	-	-	50	0
20	20, ...	104	0	61	0	39	0	81	0	-	-	-	-
21	21, ...	106	1	50	0	33	0	38	0	-	-	-	-
22	22, ...	-	-	-	-	28	0	56	0	8	0	-	-
23	23, ...	46	0	68	0	18	0	-	-	-	-	-	-
24	24, ...	60	0	70	0	25	0	17	0	-	-	-	-
25	25, ...	118	1	38	0	32	0	18	0	-	-	-	-
26	26, ...	79	0	-	-	-	-	16	0	-	-	-	-
27	27, ...	86	0	59	1	28	0	14	0	-	-	-	-
28	28, ...	69	0	111	0	24	0	34	0	-	-	113	0
29	29, ...	-	-	-	-	42	0	25	0	20	0	-	-
30	30, ...	100	0	-	-	37	0	-	-	-	-	-	-
31	31, ...	40	0	-	-	32	0	-	-	-	-	-	-
32	Average, .	90	-	69	-	42	-	33	-	17	-	48	-

Centimeter in Filtered Water collected from a Tap at the City Hall.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
-	-	-	-	-	-	-	-	33	0	26	0	1
-	-	-	-	-	-	42	1	22	0	66	0	2
65	0	-	-	-	-	-	-	23	0	-	-	3
-	-	-	-	-	-	-	-	22	0	34	0	4
-	-	-	-	9	0	-	-	-	-	32	0	5
25	0	-	-	-	-	-	-	36	0	26	0	6
-	-	-	-	-	-	-	-	25	0	143	0	7
-	-	120	0	-	-	-	-	36	0	25	0	8
-	-	-	-	-	-	-	-	23	0	14	0	9
95	0	-	-	-	-	18	0	21	0	-	-	10
-	-	-	-	-	-	-	-	31	0	24	0	11
-	-	-	-	32	0	-	-	-	-	17	0	12
-	-	-	-	-	-	-	-	23	0	148	0	13
-	-	35	0	-	-	-	-	23	0	17	0	14
-	-	-	-	-	-	-	-	137	0	16	0	15
-	-	-	-	-	-	7	0	22	0	61	0	16
-	-	-	-	-	-	-	-	34	0	-	-	17
32	0	-	-	28	0	-	-	28	0	13	0	18
-	-	-	-	-	-	-	-	-	-	16	0	19
-	-	-	-	-	-	-	-	24	0	22	0	20
-	-	19	0	-	-	-	-	26	0	34	0	21
-	-	-	-	-	-	-	-	41	0	29	0	22
-	-	-	-	-	-	-	-	28	0	51	0	23
36	0	-	-	-	-	34	0	23	0	-	-	24
-	-	-	-	-	-	-	-	23	0	-	-	25
-	-	-	-	23	0	-	-	-	-	26	0	26
-	-	-	-	-	-	-	-	43	0	14	0	27
-	-	-	-	-	-	-	-	25	0	7	0	28
-	-	15	0	-	-	-	-	175	0	24	0	29
-	-	-	-	-	-	22	0	-	-	34	0	30
40	0	-	-	-	-	-	-	-	-	-	-	31
49	-	47	-	23	-	25	-	38	-	37	-	32

Number of Bacteria and B. Coli Communis per Cubic Centimeter

	Day.	January. Water Bacteria.	January. B. Coli Communis.	February. Water Bacteria.	February. B. Coli Communis.	March. Water Bacteria.	March. B. Coli Communis.	April. Water Bacteria.	April. B. Coli Communis.	May. Water Bacteria.	May. B. Coli Communis.	June. Water Bacteria.	June. B. Coli Communis.
1	1, . . .	-	-	67	0	29	1	54	0	14	0	5	0
2	2, . . .	103	0	45	0	06	0	-	-	16	0	8	0
3	3, . . .	57	0	46	0	50	0	26	0	8	0	11	0
4	4, . . .	63	0	25	0	35	0	26	0	8	0	-	-
5	5, . . .	86	1	-	-	-	-	22	0	23	0	18	0
6	6, . . .	84	0	5	1	50	0	16	0	12	0	20	0
7	7, . . .	86	0	60	0	42	0	33	0	-	-	14	0
8	8, . . .	-	-	40	0	46	0	20	0	21	0	22	0
9	9, . . .	60	0	61	0	46	0	-	-	10	0	25	0
10	10, . . .	45	1	60	0	50	0	57	0	22	0	30	0
11	11, . . .	106	1	57	0	28	0	52	0	30	0	-	-
12	12, . . .	62	0	-	-	-	-	33	0	16	0	28	0
13	13, . . .	62	0	40	0	36	0	22	0	18	0	21	0
14	14, . . .	20	0	62	0	12	0	44	0	-	-	39	0
15	15, . . .	-	-	53	0	23	0	22	0	8	0	22	0
16	16, . . .	61	0	94	0	27	0	-	-	34	0	18	0
17	17, . . .	61	1	48	0	47	0	23	0	13	0	-	-
18	18, . . .	44	1	34	0	30	0	19	0	29	0	-	-
19	19, . . .	96	0	-	-	-	-	-	-	20	0	38	0
20	20, . . .	113	0	54	0	27	0	18	0	4	0	28	0
21	21, . . .	47	0	62	0	93	0	93	0	-	-	34	0
22	22, . . .	-	-	-	-	41	0	30	0	21	0	36	0
23	23, . . .	77	1	-	-	40	0	-	-	22	0	30	0
24	24, . . .	45	0	37	0	30	0	33	0	32	0	85	0
25	25, . . .	38	0	34	0	35	0	22	0	19	0	-	-
26	26, . . .	57	0	-	-	-	-	18	0	11	0	47	0
27	27, . . .	45	0	22	0	27	0	32	0	14	0	128	0
28	28, . . .	35	0	42	0	30	0	26	0	-	-	32	0
29	29, . . .	-	-	-	-	47	0	8	0	42	0	27	0
30	30, . . .	30	0	-	-	45	0	-	-	-	-	40	0
31	31, . . .	30	0	-	-	40	0	-	-	19	-	-	-
32	Average, . .	63	-	48	-	41	-	32	-	18	-	33	-

in Filtered Water collected from a Tap at the Experiment Station.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
28	0	50	0	21	0	-	-	41	0	19	0	1
-	-	22	0	15	0	14	0	24	0	5	0	2
58	0	76	0	-	-	68	0	46	0	-	-	3
-	-	48	0	-	-	18	0	23	0	58	0	4
33	0	46	0	12	0	49	0	-	-	27	0	5
33	0	-	-	34	0	32	0	19	0	34	0	6
33	0	50	0	30	0	24	0	32	0	10	0	7
33	0	27	0	25	0	-	-	37	0	52	0	8
-	-	30	0	17	0	21	0	36	0	12	0	9
23	0	50	0	-	-	14	0	46	0	-	-	10
30	0	48	0	33	0	25	0	27	0	22	0	11
58	0	35	0	22	0	11	0	-	-	10	1	12
22	0	-	-	41	0	18	0	34	0	63	0	13
26	0	23	0	28	0	-	-	20	0	24	0	14
4	0	31	0	37	0	-	-	-	-	28	0	15
-	-	57	0	35	0	59	0	25	0	68	0	16
15	0	63	0	-	-	32	0	29	0	-	-	17
9	0	27	0	22	0	9	0	38	0	14	0	18
10	0	14	0	47	0	34	0	-	-	18	0	19
24	0	-	-	33	0	35	0	44	0	5	0	20
20	0	18	0	16	0	28	0	41	0	17	0	21
12	0	20	0	17	0	-	-	29	0	16	1	22
2	0	24	0	33	0	57	0	34	0	20	0	23
22	0	14	0	-	-	37	0	20	0	-	-	24
19	0	29	0	110	0	21	0	37	0	-	-	25
7	0	16	0	36	1	23	0	-	-	24	0	26
12	0	-	-	30	0	95	0	41	0	24	0	27
24	0	25	0	28	0	18	0	16	0	16	0	28
19	0	4	0	20	0	-	-	30	1	21	0	29
-	-	12	0	-	-	24	0	-	-	20	0	30
30	0	15	0	-	-	35	0	-	-	-	-	31
23	-	32	-	31	-	32	-	38	-	25	-	32

Summary of Bacterial Analyses, 1899.

Samples from—	Average Number of Bacteria per Cubic Centimeter.	Per Cent. Removed (Efficiency).	Number of Samples Tested for B. Coli Communis.	Number of Times B. Coli Communis was found.	Average Number of B. Coli Communis.	Per Cent. of Samples Containing B. Coli Communis.
River at experiment station,	13,900	-	114	114	103	100.00
River at intake of filter,	5,800	-	180	179	47	99.44
City filter,	55	99.05	189	45	-	23.81
Outlet of reservoir,	64	-	187	13	-	6.95
Tap at City Hall,	43	-	-	-	-	-
Tap at experiment station,	35	-	300	12	-	4.00

As previously stated, the samples of filtered water have probably never contained more than one *B. coli communis* per cubic centimeter, and the table shows that the average number in the water applied to the filter has been 47 per cubic centimeter; that is, 179 samples of the river water at the intake contained 8,413 *B. coli communis* and 189 samples of the effluent of the filter contained 45 *B. coli communis*, — a removal of 99.49 per cent.

Averages of the Chemical Analyses of Merrimack River Water and Filtered Water, 1899.

Merrimack River Water as it flows upon the Lawrence City Filter.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Soluble.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
January,	33	.40	.0052	.0133	.0129	.14	.019	.0000	.33	0.9
February,	33	.34	.0099	.0192	.0170	.15	.020	.0001	.36	0.9
March,	34	.37	.0048	.0140	.0129	.19	.017	.0001	.38	0.9
April,	43	.35	.0025	.0163	.0119	.13	.012	.0001	.41	0.7
May,	50	.37	.0064	.0155	.0145	.17	.012	.0002	.34	1.0
June,	72	.42	.0095	.0213	.0160	.29	.012	.0003	.73	1.3
July,	76	.37	.0142	.0246	.0166	.32	.010	.0003	.33	1.5
August,	78	.35	.0089	.0251	.0159	.27	.013	.0003	.35	1.4
September,	67	.32	.0310	.0274	.0224	.34	.012	.0007	.34	1.7
October,	57	.28	.0209	.0230	.0195	.36	.015	.0006	.32	1.7
November,	41	.37	.0112	.0238	.0193	.32	.018	.0003	.48	1.2
December,	34	.33	.0109	.0206	.0175	.29	.016	.0002	.42	1.3
Average,	52	.36	.0118	.0203	.0164	.25	.015	.0003	.36	1.2

Effluent from the City Filter.

[Parts per 100,000.]

1899.	Temperature. — Deg. F.	Color.	Ammonia.			Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
			Free.	Albuminoid.			Nitrates.	Nitrites.		
				Total.	Soluble.					
January, ...	34	.40	.0090	.0099	.0099	.16	.038	.0000	.33	1.2
February, ...	35	.35	.0099	.0102	.009	.17	.044	.0000	.27	1.5
March, ...	34	.31	.0103	.0074	.0074	.21	.036	.0000	.25	1.3
April, ...	43	.30	.0107	.0075	.0073	.15	.036	.0001	.25	1.4
May, ...	60	.31	.0065	.0067	.0065	.17	.040	.0000	.22	1.4
June, ...	72	.47	.0090	.0103	.0095	.31	.017	.0007	.19	1.8
July, ...	72	.31	.0063	.0077	.0072	.32	.025	.0001	.16	1.8
August, ...	75	.33	.0077	.0066	.0061	.24	.044	.0001	.20	1.7
September, ...	65	.24	.0057	.0063	.0079	.36	.032	.0003	.15	1.9
October, ...	58	.23	.0048	.0073	.0073	.37	.039	.0000	.15	2.0
November, ...	43	.34	.0093	.0086	.0084	.34	.040	.0000	.29	1.8
December, ...	37	.33	.0103	.0094	.0090	.30	.045	.0001	.26	1.9
Average, . .	52	.33	.0083	.0083	.0080	.26	.036	.0001	.23	1.6

Water from the Outlet of the Distributing Reservoir.

[Parts per 100,000.]

1899.	Temperature. — Deg. F.	Color.	Ammonia.			Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
			Free.	Albuminoid.			Nitrates.	Nitrites.		
				Total.	Soluble.					
January, ...	34	.40	.0077	.0101	.0095	.17	.049	.0000	.31	1.3
February, ...	35	.34	.0079	.0099	.0096	.17	.049	.0000	.27	1.5
March, ...	35	.30	.0075	.0078	.0078	.21	.044	.0000	.25	1.3
April, ...	43	.32	.0058	.0073	.0071	.18	.040	.0001	.23	1.3
May, ...	59	.32	.0005	.0074	.0072	.17	.034	.0000	.25	1.2
June, ...	69	.28	.0010	.0083	.0075	.29	.033	.0000	.15	1.6
July, ...	74	.21	.0010	.0076	.0074	.32	.035	.0002	.15	1.7
August, ...	78	.17	.0014	.0070	.0069	.34	.039	.0004	.17	1.5
September, ...	66	.16	.0012	.0076	.0074	.35	.048	.0001	.15	1.6
October, ...	57	.18	.0007	.0073	.0070	.38	.053	.0000	.12	1.7
November, ...	43	.32	.0020	.0093	.0087	.35	.049	.0000	.23	1.6
December, ...	36	.34	.0066	.0111	.0102	.32	.044	.0001	.26	1.8
Average, . .	52	.28	.0036	.0084	.0080	.27	.043	.0001	.21	1.5

Water from a Tap at Lawrence City Hall.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
January,	37	.30	.0063	.0093	.16	.048	0	.30	1.4
February,	39	.33	.0056	.0090	.18	.047	0	.26	1.4
March,	38	.30	.0064	.0072	.21	.043	0	.25	1.3
April,	44	.31	.0051	.0071	.18	.040	0	.23	1.3
May,	58	.30	.0005	.0071	.19	.034	0	.24	1.3
June,	69	.23	.0007	.0068	.29	.035	0	.16	1.5
July,	73	.18	.0004	.0071	.33	.036	0	.14	1.6
August,	72	.17	.0008	.0062	.34	.044	0	.17	1.5
September,	66	.11	.0006	.0069	.35	.056	0	.14	1.6
October,	59	.16	.0002	.0063	.30	.052	0	.13	1.8
November,	46	.31	.0020	.0091	.34	.050	0	.12	1.7
December,	46	.36	.0059	.0107	.32	.048	0	.28	1.7
Average,	54	.27	.0028	.0077	.27	.044	0	.21	1.5

Water from a Tap at Lawrence Experiment Station.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.
January,	43	.36	.0027	.0087	.16	.051	0	.27	1.4
February,	40	.32	.0039	.0085	.18	.049	0	.25	1.4
March,	41	.29	.0036	.0071	.21	.044	0	.23	1.2
April,	43	.27	.0020	.0066	.18	.043	0	.21	1.3
May,	52	.22	.0001	.0057	.20	.037	0	.20	1.3
June,	62	.14	.0002	.0061	.29	.037	0	.15	1.5
July,	67	.10	.0002	.0058	.33	.038	0	.13	1.7
August,	70	.12	.0002	.0060	.34	.045	0	.17	1.5
September,	64	.11	.0006	.0069	.35	.043	0	.14	1.6
October,	59	.13	.0002	.0059	.38	.052	0	.12	1.7
November,	51	.28	.0004	.0079	.34	.048	0	.19	1.8
December,	48	.30	.0087	.0092	.32	.045	0	.28	1.7
Average,	53	.22	.0015	.0070	.27	.044	0	.20	1.5

Filters Nos. 3 B and 8 A.

These two filters were first put into operation during the last part of September, 1893. When first constructed, they contained over gravel underdrains 5 feet in depth of sand of an effective size of 0.23 millimeter, this being the same grade as a large proportion of the sand placed in the city filter. Each filter is $\frac{1}{200}$ of an acre in area, and Filter No. 3 B has always been operated as an intermittent filter, with its surface free from water for about two hours each day, and its outlet open and the filter draining, so that air enters the interstices of the sand of the filter to a certain extent daily. Filter No. 8 A, on the other hand, has always been operated as a continuous filter, and its surface has never been intentionally freed from water except at times when it was necessary to remove the accumulated organic matter and silt from the surface; that is, no air has been allowed to enter this filter, except at times of scraping, beyond the air dissolved in the water applied.

The results obtained from these two filters, in regard to daily bacterial efficiency, the percentage removal of *B. prodigiosus* germs applied for purposes of experiment, etc., have been given in each annual report, and at the present time a summary of many of the results of their operation since March 26, 1895, not as yet given in the reports, is here presented.

Summary.

Upon March 26, 1895, after they had been in operation for one year and six months and a certain depth of sand removed by scraping, they were refilled with clean sand to their original depth. Each filter was first scraped, and the first few inches of the new sand applied to the surface was thoroughly mixed with the upper few inches of the old sand remaining in the filter.

Rates of Operation and Depth and Volume of Sand removed.

Upon Dec. 31, 1899, after they had been in operation for four years and nine months from the date of refilling, the depth of sand remaining in Filter No. 3 B was 27½ inches and in Filter No. 8 A 28½ inches; that is to say, in order to keep the filters in operation at the rates desired, 32½ inches of sand had been removed from Filter No. 3 B and 31½ inches from Filter No. 8 A.

The average rate of operation of Filter No. 3 B during different portions of this period had varied from 1,300,000 gallons per acre daily to 3,850,000 gallons per acre daily, and a volume of water equal to 4,130,000,000 gallons upon an area of one acre had passed through the filter; this volume being equal to the volume that would have passed through a filter one acre in area if it had been operated for each day of the 1,736 days in the period under discussion at an average rate of 2,380,000 gallons per acre daily. In the table on page 508 the rate is given according to the *actual* days of operation. The depth of sand removed, 32½ inches, equals .78 of an inch for each 100,000,000 gallons of water filtered per acre, and the volume of sand removed would equal 4,646 cubic yards upon an acre, or 1.12 cubic yards per 1,000,000 gallons of water filtered.

Filter No. 8 A was operated, during different portions of this period of four years and nine months, at average rates varying from 1,750,000 gallons per acre daily to 4,440,000 gallons per acre daily, and through this filter had passed a volume of water equal to 5,022,-000,000 gallons through an area of one acre; that is, the volume of water was equal to the volume that would have passed through a filter one acre in area if it had been operated during the entire period of 1,736 days at an average rate of 2,900,000 gallons per acre daily. The depth of sand removed equalled .62 of an inch for each 100,000,000 gallons of water filtered, and the volume of sand removed equalled 4,378 cubic yards upon an area of one acre, or .88 of a cubic yard per 1,000,000 gallons of water filtered.

In the tables on pages 508 and 509 two columns will be found, giving the actual rate of filtration during different periods of operation and the prescribed rate at which it was intended that each filter should be operated. With Filter No. 8 A, during a large portion of each period, the actual rate equalled the prescribed rate; but, as there were always several days just after scraping and always several days just before scraping when the actual rate did not equal the rate prescribed, the average actual rate of the period is always less than the prescribed rate. Owing, however, to the uncovering of the surface of Filter No. 3 B and the admission of air to its pores, the frictional resistance of the filter to the flow of water was increased, as shown by the smaller percentage that the actual rate that could be followed with Filter No. 3 B was of the prescribed rate than was the actual rate of Filter No. 8 A of the prescribed rate;

that is to say, the actual rate of Filter No. 3 B was only 75 per cent. of the prescribed rate, while the actual rate of filtration of Filter No. 8 A was 94 per cent. of the prescribed rate. From the same table it will be found that, in order to keep Filter No. 3 B in operation at a rate approaching that desired, it was necessary to scrape this filter 72 times during this period from March 26, 1895, to Dec. 31, 1899, and the average depth of sand removed per scraping was .46 of an inch. In order to keep Filter No. 8 A in operation at a rate approaching that desired, it was necessary to scrape it 59 times; but once, for purpose of experiment, — Oct. 5, 1898, — two inches in depth of sand was removed, thus increasing the total number of scrapings to 60, and the average depth of sand removed per scraping was .52 of an inch. This extra scraping and the sand removed are included in all calculations of average depth of scrapings, volume of sand removed, etc., in the summary.

Gallons of Water passed per Scraping.

The length of the different periods of operation at various rates of filtration are given in the tables on pages 508 and 509, and the volume of water passed per scraping during each period of operation at different rates is shown by the following tables: —

Filter No. 3 B.

Period.	Rate.	Million Gallons of Water passed per Scraping.
1,	3,850,000	82.4
2,	1,300,000	44.1
3,	3,560,000	79.2
4,	3,470,000	40.8
5,	2,800,000	54.2
6,	1,960,000	47.5
7,	2,590,000	44.9
8,	2,110,000	-
9,	2,320,000	-
Average volume,	-	56.2

Filter No. 8 A.

Period.	Rate.	Million Gallons of Water passed per Scraping.
1,	4,440,000	76.0
2,	1,750,000	57.0
3,	4,240,000	86.0
4,	2,250,000	77.0
5,	3,250,000	89.0
6,	2,150,000	146.0
7,	3,260,000	79.0
Average volume,	-	77.3

It is evident from these figures that the average volume of water passed per scraping was more uniform with Filter No. 8 A than with Filter No. 3 B, and that, taking the entire period given, it is difficult to see that there is much difference in the volume passed per scraping during cold or warm weather (seasons given on tables, pages 508 and 509); although what slight showing there is in this respect indicates that the access of cold air into Filter No. 3 B at times of uncovering during winter weather increased the frictional resistance more than did the access of air during warmer weather. The large volume of water passed per scraping during Period No. 6, Filter No. 8 A, was due to the fact that during the previous period two inches in depth of sand was at one time, for purposes of experiment, scraped from the filter.

Bacterial Efficiency at Different Rates.

From a study of the tables given on pages 508 and 509, it will be noted that the average bacterial efficiency of Filter No. 3 B during every period but one was 99 per cent. or more, and that the average bacterial efficiency of Filter No. 8 A was above 99 per cent. during each of the periods of operation at different rates. It will also be noted that with Filter No. 8 A the bacterial efficiency was practically the same at whatever rate operated within the limits followed, and the efficiency at the end of the period, when there was only one-half as great a depth of sand within the filter, was equal to that at the beginning of the period. With Filter No. 3 B, at the end of the period, with one-half the depth of sand in the filter that was present at the beginning of the period, the efficiency was somewhat less, but only a fraction of a per cent., this end efficiency being over

99 per cent. The bacterial efficiency of Filter No. 3 B for the entire period, obtained by averaging all the bacterial results, was 99.42 per cent.; and the bacterial efficiency of Filter No. 8 A, calculated in the same way, was 99.65 per cent.

Number of Bacteria in the Effluent.

During all this period determinations of the number of bacteria present in the effluents of the filters were made by examining always at least two samples per day from each filter, and generally three samples. The number of times that the average daily number of bacteria in the effluents was greater than 100 per cubic centimeter is shown by the following tables, giving the number first by years and second by the subdivisions of the entire period already noted, when the rates of filtration varied: —

Number of Times that the Bacteria in the Effluents of Filters Nos. 3 B and 8 A exceeded 100 per Cubic Centimeter (by Years).

Year.	Filter No. 3 B.	Filter No. 8 A.	Year.	Filter No. 3 B.	Filter No. 8 A.
1895,	6	3	1898,	13	6
1896,	21	12	1899,	40	18
1897,	53	19			

Number of Times that the Bacteria in the Effluents of these Two Filters exceeded 100 per Cubic Centimeter (by Periods).

Filter No. 3 B.

Period.	Rate (Million Gallons per Acre Daily).		Number of Times.
	Actual.	Prescribed.	
Mar. 26, 1895, to Nov. 23, 1895,	3.85	5.00	6
Nov. 24, 1895, to Apr. 19, 1896,	1.30	1.50	7
Apr. 20, 1896, to June 28, 1896,	3.56	4.00	0
June 29, 1896, to June 30, 1897,	3.47	5.00	50
July 1, 1897, to Jan. 6, 1898,	2.80	4.00	21
Jan. 7, 1898, to Aug. 7, 1898,	1.98	2.50	1
Aug. 8, 1898, to Nov. 13, 1898,	2.59	4.00	2
Nov. 14, 1898, to Aug. 8, 1899,	2.11	2.00	20
Aug. 9, 1899, to Dec. 31, 1899,	2.32	4.00	17

Filter No. 8 A.

Period.	Actual.	Prescribed.	Number of Times.
Mar. 27, 1895, to Nov. 24, 1895,	4.44	5.00	3
Nov. 25, 1895, to Apr. 18, 1896,	1.75	2.00	0
Apr 19, 1896, to Jan. 6, 1898,	4.24	4.00	33
Jan. 7, 1898, to Aug. 7, 1898,	2.25	2.50	1
Aug. 8, 1898, to Nov. 13, 1898,	3.25	4.00	3
Nov. 14, 1898, to Aug. 8, 1899,	2.15	2.00	8
Aug. 9, 1899, to Dec. 31, 1899,	3.26	4.00	5

Maximum Rate of Sand.

At the time these two filters were first started the sand placed in them had a maximum rate of 43,000,000 gallons per acre daily; that is to say, with the surface of the filters covered with water, with a free outlet and with a loss of head equal to the depth of the filter, this volume of water would pass through an acre of this sand in twenty-four hours. The maximum rate has decreased steadily on account of the accumulation of organic matter within the filter by the seven years of operation, but it is now about 70 per cent. of that at the start. The period between scrapings at the present time and in the case of each filter and the volume of water passed between scrapings are, under similar conditions, practically the same, as far as can be ascertained, as at the beginning of the period of operation. The filters are operated with nearly the same actual head now as at the beginning of the period; that is to say, at that time there was about 5 feet 6 inches in depth of water and sand, and the depth of sand was 5 feet; at the present time there is practically the same depth of water and sand, but the depth of water over the sand is nearly half the total depth. The tables on the following pages, giving the average chemical and bacterial analyses of the water applied to and the effluents from these two filters, show that both of them at the present time purify the water as well, both chemically and bacterially, as when a greater depth of sand was in them; and each is practically as efficient in removing color from the applied water as at any time since the first month or two of their operation.

Removal of Organic Matter.

Chemical Results of Filters Nos. 3 B and 8 A during the Period 1893–99 inclusive.

The three following tables give the average yearly analyses of the canal water applied to these filters during the entire period of their operation up to Jan. 1, 1900, and the average yearly analyses of the effluents of the filters. The two tables beyond these give the actual percentage of coloring matter and organic matter removed from the applied water during the period by filtration through these filters, as shown by the determination of color and of free and albuminoid ammonia and oxygen consumed.

For doing this work of removal of organic matter by oxidation, Filter No. 3B has always been supplied with more air than Filter No. 8 A, owing to its method of operation, and the effluent of the filter has always contained as much, or nearly as much, free oxygen as the water applied. Filter No. 8 A, on the other hand, has had to perform its work of oxidation with only the oxygen that enters it with the water applied. This has always been sufficient in volume to produce oxidation of organic matter within the filter and not become exhausted by the process of oxidation, as denoted by its unfailing presence in the effluent of the filter. During the summer of 1899, however, owing to the small volume of water flowing in the river and its consequent degree of pollution, the amount of dissolved oxygen in the effluent of the filter was very small, showing that the river water was for a time in a condition approaching that where continuous filtration of it could not be successfully followed without preliminary aeration of the water.

Yearly Averages of Chemical Analyses of Canal Water (Merrimack River).

[Parts per 100,000.]

Year.	Color.	Ammonia.			Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.
		Free.	Albuminoid.			Nitrates.	Nitrites.		
			Total.	Soluble.					
1893,	.39	.0087	.0183	-	.21	.018	.0002	.45	91
1894,	.41	.0071	.0188	.0156	.22	.014	.0001	.40	80
1895,	.46	.0087	.0215	.0176	.24	.017	.0002	.47	78
1896,	.40	.0065	.0177	.0159	.21	.016	.0001	.41	88
1897,	.45	.0042	.0176	.0155	.19	.019	.0000	.44	86
1898,	.45	.0057	.0181	.0154	.22	.016	.0001	.42	84
1899,	.34	.0102	.0182	.0159	.24	.018	.0003	.35	78
Average,	.41	.0076	.0186	.0160	.22	.016	.0001	.42	83

Yearly Averages of Chemical Analyses of Effluent of Filter No. 3 B.

[Parts per 100,000.]

Year.	Quantity of Effluent. — Gallons per Acre Daily.	Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.
			Free.	Albuminoid.		Nitrates.	Nitrites.		
1893, ...	1,899,000	.62	.0032	.0139	.21	.019	.0003	.34	99
1894, ...	2,451,000	.23	.0020	.0089	.22	.039	.0000	.29	85
1895, ...	2,883,000	.32	.0041	.0093	.24	.033	.0000	.33	75
1896, ...	2,834,000	.29	.0013	.0091	.21	.026	.0000	.29	83
1897, ...	3,276,000	.35	.0018	.0100	.19	.032	.0000	.34	81
1898, ...	2,817,000	.29	.0011	.0001	.22	.039	.0000	.30	82
1899, ...	2,163,000	.20	.0017	.0069	.25	.054	.0000	.22	73
Average, ...	2,546,000	.34	.0022	.0096	.22	.033	.0000	.30	83

Yearly Averages of Chemical Analyses of Effluent of Filter No. 8 A.

[Parts per 100,000.]

Year.	Quantity of Effluent. — Gallons per Acre Daily.	Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.
			Free.	Albuminoid.		Nitrates.	Nitrites.		
1893, ...	1,898,000	.42	.0027	.0121	.21	.018	.0002	.32	92
1894, ...	2,561,000	.27	.0019	.0090	.23	.027	.0000	.29	64
1895, ...	3,378,000	.32	.0021	.0087	.24	.029	.0001	.33	53
1896, ...	3,678,000	.29	.0017	.0086	.21	.027	.0001	.29	67
1897, ...	4,247,000	.32	.0018	.0096	.19	.031	.0000	.32	59
1898, ...	2,662,000	.31	.0012	.0094	.22	.030	.0000	.33	54
1899, ...	2,598,000	.22	.0011	.0076	.25	.032	.0001	.23	37
Average, ...	3,002,000	.31	.0018	.0093	.22	.028	.0001	.30	61

Percentage Removal of Coloring Matter, Free Ammonia and Organic Matter from the River Water attained by Filters Nos. 3B and 8A.

FILTER No. 3 B.					FILTER No. 8 A.				
Year.	Percentage Removal of			Oxygen Consumed.	Year.	Percentage Removal of			Oxygen Consumed.
	Color.	Ammonia. Free.	Ammonia. Albuminoid.			Color.	Ammonia. Free.	Ammonia. Albuminoid.	
1893, . .	-	68	24	24	1893, . .	-	69	34	29
1894, . .	32	72	53	23	1894, . .	34	73	52	23
1895, . .	30	53	57	30	1895, . .	30	76	60	30
1896, . .	28	85	49	29	1896, . .	28	80	51	29
1897, . .	22	57	43	23	1897, . .	29	57	45	27
1898, . .	36	81	50	29	1898, . .	31	79	48	21
1899, . .	41	83	62	37	1899, . .	41	89	58	34
Average, .	32	71	48	29	Average, .	32	75	50	23

Difference between Average Nitrates of Canal Water and Effluents of Filters Nos. 3B and 8A.

[Parts per 100,000.]

Year.	Filter No. 3 B.	Filter No. 8 A.	Year.	Filter No. 3 B.	Filter No. 8 A.
1893, ...	.006	.005	1897, ...	.013	.012
1894, ...	.016	.013	1898, ...	.023	.014
1895, ...	.016	.012	1899, ...	.036	.014
1896, ...	.010	.011	Average, ...	.017	.012

In the two following tables the averages given at the bottom of the columns are actual averages for the entire period of operation since March 26, 1895. Averaging the figures in the columns above would give different results, as the length of the periods varied.

Table showing Summary of the Operation of Filter No. 3 B from March 26, 1895, to Dec. 31, 1899.

Period.	Rate — Million Gallons per Acre Daily.		Quantity Passed (Million Gallons per Acre).	Depth of Sand when Rate was Changed (Inches).	Number of Times the Filter was scraped.	Depth of Sand Removed (Inches).	Sand Removed per Million Gallons Filtered.		Average Number of Bacteria per Cubic Centimeter.	Average Bacterial Efficiency.	Dates when scraped.
	Actual.	Intended.					Inches.	Cubic Yards per Acre.			
March 26, 1895, to Nov. 23, 1895.	3.35	5.00	359.5	60.00	8	3.61	.005748	0.7598	27	99.83	June 25, July 31, Aug. 26, Oct. 1, 16, 23,* Nov. 7, 18.
Nov. 24, 1895, to April 19, 1896.	1.30	1.50	176.6	56.40	4	1.81	.010505	1.4246	33	99.60	Jan. 3, 29, Feb. 11, April 3.*
April 20, 1896, to June 28, 1896.	3.56	4.00	237.6	54.60	3	1.35	.006046	0.8128	19	99.75	May 11, 27, June 17.
June 29, 1896, to June 30, 1897.	3.47	5.00	1,142.1	53.20	28	12.64	.011468	1.5959	66	99.17	July 7, 21, Aug. 5, 13, 31, Sept. 24, Oct. 13, 22, 29, Nov. 10, 19,* Dec. 10, 31, Jan. 12, 25, Feb. 6, 17, March 3, 5,* 24, 30, April 5, 29, May 6, 17, June 9, 21,* July 1.
July 1, 1897, to Jan. 6, 1898.	2.80	4.00	433.5	40.60	8	3.61	.008321	1.1994	61	99.84	July 20, Aug. 4, 26, Sept. 23, Oct. 27, Nov. 3, 18, Dec. 28.
Jan. 7, 1898, to Aug. 7, 1898.	1.98	2.50	332.6	37.00	7	3.16	.009184	1.2347	32	99.52	Jan. 25, Feb. 26, April 7, 30, May 31, July 7, 23.
Aug. 8, 1898, to Nov. 13, 1898.	2.59	4.00	224.5	33.84	5	2.28	.009367	1.2868	28	99.71	Aug. 23, Sept. 13, 30,* Oct. 20, Nov. 11.
Nov. 14, 1898, to Aug. 8, 1899.	2.11	2.00	425.4	31.58	5	2.26	.005319	0.8861	65	98.59	Dec. 7, Jan. 6, Feb. 23, June 29, July 26.
Aug. 9, 1899, to Dec. 31, 1899.	2.32	4.00	298.9	29.32	4	1.81	.006807	0.7136	68	99.08	Oct. 9, 30, Nov. 20, Dec. 1.*
Average, . . .	2.68	3.59	-	-	-	-	-	-	48	99.42	
Total, . . .	-	-	4,130.6	-	72	32.50	-	-	-	-	

Scraped 72 times. Dec. 31, 1899, 27½ inches sand in tank; 32½ inches removed by scraping. Average depth per scraping, 0.4514 of an inch. March 24, 1896, strip 3 feet wide scraped across filter and dug over 6 inches deep; Feb. 2, 1899, strip 3½ feet wide scraped across filter and raked over 2 inches deep; omitted in calculation of above table.

* Dug over 6 to 8 inches

Table showing Summary of the Operation of Filter No. 8 A from March 27, 1895, to Dec. 31, 1899.

Period.	Rate — Million Gallons per Acre Daily.		Quantity Passed (Million Gallons per Acre).	Depth of Sand when Rate was Changed (Inches).	Number of Times the Filter was scraped.	Depth of Sand Removed (Inches).	Sand Removed per Million Gallons Filtered.		Average Number of Bacteria per Cubic Centimeter.	Average Bacterial Efficiency.	Dates when scraped.
	Actual.	Intended.					Inches.	Cubic Yards per Acre.			
March 27, 1895, to Nov. 24, 1895.	4.44	5.00	987.6	60.0	18	6.39	.006737	0.9057	23	99.85	May 9, 23, June 11, 29, July 16, Aug. 2, 20, Sept. 2, 18, Oct. 4, 17, 28, Nov. 12.*
Nov. 25, 1895, to April 18, 1896.	1.75	2.00	227.4	58.3	4	1.97	.007657	1.0296	18	99.90	Dec. 18, Jan. 4, Feb. 6, April 11.*
April 19, 1896, to Jan. 6, 1898.	4.24	4.00	2,324.0	50.7	27	13.28	.005824	0.7812	36	99.56	May 21, June 15, July 6, 20, 28, Aug. 3, 15,* Sept. 11, Oct. 12, Nov. 4, Dec. 1,* Jan. 5, 23, Feb. 9, 23, March 15, April 17, May 12, 25, June 21,* Aug. 19, Sept. 15, Oct. 6, 26, Nov. 4,* Dec. 4, 22.
Jan. 7, 1898, to Aug. 7, 1898.	2.25	2.50	383.0	36.4	5	2.46	.005097	0.8627	18	99.63	Jan. 20, Feb. 10, May 16, July 18, Aug. 3.
Aug. 8, 1898, to Nov. 13, 1898.	3.25	4.00	266.1	33.8	3	3.47†	.014810	1.9906†	26	99.67	Aug. 23, Sept. 6, Oct. 5.* †
Nov. 14, 1898, to Aug. 8, 1899.	2.15	2.00	430.5	32.2	3	1.47	.002574	0.3460	27	99.41	Nov. 21, Jan. 25, July 2.
Aug. 9, 1899, to Dec. 31, 1899.	3.26	4.00	394.6	30.6	5	2.46	.006154	0.8274	23	99.63	Aug. 28, Oct. 17, Nov. 13, Dec. 11, 28.
Average, . .	3.40	3.61	-	-	-	-	-	-	23	99.65	
Total, . . .	-	-	5,022.3	-	60	31.50	-	-	-	-	

Scraped 60 times. Dec. 31, 1899, 29.50 inches of sand in tank; 31.50 inches removed by scraping. Average depth per scraping, 0.525 of an inch.

* Dug over 6 to 8 inches. † Oct. 5, 1898, 2 inches of sand removed for purposes of experiment.

Results with Filters Nos. 3 B and 8 A during 1899.

Summarizing by months the average number of bacteria in the water applied to and the effluents from these filters, the bacterial efficiency of each filter and the number of samples examined each month that contained *B. coli communis*, we have the following tables: —

Average Number of Bacteria in Water applied to and Effluents from Filters Nos. 3 B and 8 A, 1899, and Bacterial Efficiency of these Filters.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Canal water, . . .	4,100	5,400	4,400	1,700	3,300	9,600	4,700	2,000	3,100	7,500	8,500	7,500
Filter No. 3 B, . .	50	152	57	-	64	45	32	94	10	33	63	100
Filter No. 8 A, . .	30	45	64	-	16	14	16	10	9	36	65	42

These figures show that the average number of bacteria in the canal water during the year was 5,600; in the effluent of Filter No. 3 B, 68; in the effluent of Filter No. 8 A, 32; giving a bacterial efficiency for the year of 98.80 for Filter No. 3 B and 99.43 for Filter No. 8 A.

B. Coli Communis Results for 1899.

During the year 96.63 per cent. of the samples of canal water examined contained *B. coli communis* in 1 cubic centimeter, and determinations of the numbers showed that the average was 40 per cubic centimeter, and that the variation was from 9 per cubic centimeter in April to 104 per cubic centimeter in July. With Filter No. 3 B 22.27 per cent. of the samples examined contained *B. coli communis* in 1 cubic centimeter, and with Filter No. 8 A 14.17 per cent. of the samples examined during the year. In other words, the germ was found in 57 of the 256 samples of effluent of Filter No. 36 that were examined and in 35 of the 247 samples of effluent of Filter No. 8 that were examined.

In the last report a statement was made that, from the studies of *B. coli communis* in filtered water, it was thought probable that a rate which would be entirely safe, judging only from the determinations of the total number of bacteria present, might really be too high to produce safe water, judging from the *B. coli communis* determinations. Additional studies on this important point have been made, but, owing to contradictory results obtained, nothing can be added to the subject at this time. It is evident, however, that the statement then made, that seasonal variations of temperature affect the work of sand filters in eliminating *B. coli communis*, is true, as a study of the tables on pages 514 to 517 will make evident; the poorer work being done during the colder months of the year.

When comparing the number of times that *B. coli communis* was found in the effluents of these filters during the year with the number of times that it appeared in the effluent of the city filter, several points of difference must be considered. In the first place, the rates followed with these experimental filters were greater than the rate of filtration of the city filter; the chief difference, however, is that the results from the experimental filter are representative of the operation of the entire filter, while, when the germ was found frequently during a certain portion of the year in the effluent of the city filter, it was probably due, as stated, to poor work in a small section of the filter, and the actual number per cubic centimeter in the water from this section were distributed through the entire filtrate. The percentage of efficiency of Filter No. 3 B for the year, as regards the removal of *B. coli communis* (calculated as on page 496), was 99.45 per cent., and of Filter No. 8 A, 99.65 per cent. (see table, page 517).

The tables following give the average chemical and bacterial analyses of canal water (Merrimack River) taken from the Essex Company's canal and applied to these filters, and also the average chemical and bacterial analyses of the effluents of these two filters during the year: —

Number of Bacteria and B. Coli Communis per Cubic

	Day of Month.	January.		February.		March.		April.		May.		June.	
		Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.
1	1, . . .	-	-	4,000	19	5,500	22	1,100	-	500	0	12,300	-
2	2, . . .	4,200	40	2,600	7	5,000	31	-	-	3,000	32	4,400	34
3	3, . . .	4,000	43	3,800	38	4,000	17	300	0	600	14	7,000	53
4	4, . . .	1,600	20	2,700	8	7,400	12	1,300	11	2,700	10	-	-
5	5, . . .	4,000	0	-	-	-	-	1,200	8	900	20	4,000	122
6	6, . . .	5,600	16	5,200	16	9,700	17	900	11	700	11	12,500	94
7	7, . . .	7,200	45	6,000	12	8,100	8	300	4	-	-	10,300	96
8	8, . . .	-	-	5,100	20	4,300	8	200	10	1,200	17	12,100	216
9	9, . . .	4,100	19	4,700	52	6,700	10	-	-	1,200	17	11,500	12
10	10, . . .	1,300	32	3,100	26	4,000	9	900	14	1,300	9	5,000	0
11	11, . . .	3,000	53	16,400	1	4,000	11	900	30	1,200	38	-	-
12	12, . . .	2,900	37	-	-	-	-	1,000	-	1,000	26	7,200	46
13	13, . . .	2,900	27	7,000	4	8,300	30	1,400	12	2,700	21	2,000	22
14	14, . . .	2,600	142	4,700	77	5,500	12	1,300	6	-	-	7,500	306
15	15, . . .	-	-	2,700	8	3,000	17	800	3	1,000	22	15,300	94
16	16, . . .	2,900	41	5,600	34	3,000	16	-	-	4,000	22	3,000	12
17	17, . . .	3,300	47	9,400	34	2,200	4	2,600	10	2,300	24	-	-
18	18, . . .	4,200	41	3,800	9	5,300	8	2,200	8	5,400	38	-	-
19	19, . . .	5,100	7	-	-	-	-	-	-	2,900	38	1,000	12
20	20, . . .	4,000	7	5,300	56	3,000	0	4,600	8	7,300	1	1,000	22
21	21, . . .	2,600	12	4,300	18	2,100	4	4,100	11	-	-	4,900	106
22	22, . . .	-	-	-	-	1,800	6	2,300	0	1,200	33	10,500	75
23	23, . . .	3,300	7	6,800	20	2,800	19	-	-	5,100	63	21,800	215
24	24, . . .	2,800	32	5,000	20	400	19	1,900	3	5,000	64	8,000	106
25	25, . . .	14,500	38	7,400	3	1,000	10	1,200	25	7,000	7	-	-
26	26, . . .	3,100	19	-	-	-	-	1,100	35	6,300	37	2,900	37
27	27, . . .	5,800	44	2,500	35	1,200	14	3,000	18	6,200	0	3,000	68
28	28, . . .	3,700	100	4,300	46	2,100	8	1,300	6	-	-	17,000	93
29	29, . . .	-	-	-	-	7,100	15	2,800	5	5,900	25	16,000	108
30	30, . . .	3,300	6	-	-	2,800	0	-	-	-	-	28,300	123
31	31, . . .	4,000	13	-	-	5,100	6	-	-	5,500	90	-	-
32	Average, .	4,100	34	5,400	25	4,400	13	1,700	11	3,300	27	9,300	90

Centimeter in the Canal Water (Merrimack River), 1899.

July.		August.		September.		October.		November.		December.		
Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	
12,500	80	1,800	28	2,100	29	5,800	0	9,700	22	7,900	76	1
-	-	2,100	74	2,400	107	2,400	9	12,700	28	5,300	36	2
2,900	34	3,900	11	-	-	2,900	8	6,200	19	-	-	3
-	-	2,100	42	-	-	2,500	6	9,200	54	7,400	81	4
2,500	48	4,800	15	600	0	-	-	-	-	11,000	90	5
5,500	32	-	-	3,100	16	3,200	8	-	-	11,900	101	6
2,200	100	1,100	11	13,400	358	3,500	2	9,800	42	3,100	51	7
3,300	24	1,200	11	15,500	30	-	-	9,800	74	8,600	111	8
-	-	2,800	18	9,400	15	1,100	0	-	-	4,600	61	9
3,700	110	3,800	46	-	-	500	0	10,800	75	-	-	10
1,700	285	2,200	28	4,100	5	5,700	8	3,800	94	5,200	31	11
5,700	-	8,500	0	2,300	12	6,800	6	-	-	3,400	34	12
4,000	416	-	-	14,300	32	2,200	5	8,600	7	12,000	58	13
5,300	440	1,300	-	3,500	8	-	-	11,600	6	11,100	194	14
1,700	24	1,900	1	12,300	4	-	-	4,700	65	9,300	105	15
-	-	7,300	6	19,200	6	200	6	10,800	76	18,400	100	16
2,400	36	4,800	5	-	-	1,100	1	11,000	39	-	-	17
3,600	75	3,600	1	6,200	15	5,500	6	4,800	87	10,500	42	18
6,200	144	1,000	6	4,000	9	85,200	1	-	-	3,600	50	19
4,000	306	-	-	7,300	11	9,300	0	9,500	30	5,300	16	20
1,300	27	3,000	53	4,800	27	20,200	2	11,000	38	10,400	26	21
1,000	26	1,800	3	15,500	16	-	-	6,200	148	4,900	152	22
-	-	1,600	4	16,300	10	17,400	54	11,200	112	9,600	101	23
400	17	1,800	25	-	-	700	14	11,800	104	-	-	24
1,800	20	1,200	26	2,400	16	2,100	40	5,500	64	-	-	25
2,400	30	2,400	6	2,800	6	4,800	6	-	-	6,100	30	26
12,400	165	-	-	6,100	26	12,300	23	11,200	26	5,500	39	27
6,400	49	800	33	5,400	20	3,800	16	4,200	94	1,300	44	28
9,900	41	600	6	15,600	10	-	-	17,900	118	3,100	46	29
-	-	1,900	7	-	-	2,000	5	-	-	7,000	28	30
3,900	56	3,300	71	-	-	1,300	6	-	-	-	-	31
4,300	108	2,700	21	8,100	33	8,100	9	9,200	57	7,500	69	32

Number of Bacteria and B. Coli Communis per Cubic

	Day of Month.	January.		February.		March.		May.		June.	
		Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.
1	1,	-	-	40	0	254	1	-	-	19	0
2	2,	44	1	40	1	170	1	-	-	12	0
3	3,	25	1	70	1	145	1	-	-	15	0
4	4,	23	1	175	1	135	0	-	-	-	-
5	5,	23	0	-	-	-	-	438	1	7	0
6	6,	9	0	267	1	48	0	538	1	13	0
7	7,	85	0	365	1	21	0	-	-	12	0
8	8,	-	-	317	1	38	1	85	0	15	0
9	9,	100	0	288	1	47	0	67	0	12	0
10	10,	48	0	288	1	20	0	38	1	7	0
11	11,	126	1	112	0	23	0	34	0	-	-
12	12,	42	1	-	-	-	-	22	0	7	1
13	13,	97	0	85	0	16	0	28	0	10	0
14	14,	67	0	23	0	-	-	-	-	8	0
15	15,	-	-	25	1	-	-	17	0	15	0
16	16,	54	0	26	0	-	-	28	0	26	0
17	17,	70	0	23	1	-	-	21	0	-	-
18	18,	56	1	124	0	-	-	6	0	-	-
19	19,	61	1	-	-	-	-	17	0	5	0
20	20,	62	0	10	0	-	-	21	0	12	0
21	21,	92	1	12	9	-	-	-	-	14	0
22	22,	-	-	-	-	-	-	0	0	9	0
23	23,	21	0	97	1	262	0	4	0	10	0
24	24,	21	0	420	1	-	-	13	0	12	0
25	25,	23	1	200	1	-	-	37	0	-	-
26	26,	42	1	-	-	-	-	20	0	20	0
27	27,	30	0	267	1	-	-	10	0	108	0
28	28,	23	0	238	0	58	1	-	-	91	0
29	29,	-	-	-	-	76	0	10	0	82	0
30	30,	13	0	-	-	27	0	22	0	654	1
31	31,	10	0	-	-	-	-	13	0	-	-
32	Average,	51	-	182	-	30	-	64	-	43	-

Filter No. 3 B was scraped on the following dates: January 6; February 2 a strip 3½ feet wide was scraped across the filter and raked 2 inches deep; February 22, June 27, July 26, October 3, 30, November 30 and December 1. It was drained on the following dates: March 12-28, March 30, May 4, May 7, *Centimeter in the Effluent of Filter No. 3 B, 1899.*

July.		August.		September.		October.		November.		December.		
Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	
288	1	30	0	20	0	-	-	90	1	-	-	1
-	-	20	0	4	0	15	0	145	1	-	-	2
56	0	7	0	-	-	7	0	135	1	-	-	3
-	-	11	0	-	-	5	0	82	0	61	0	4
34	0	16	1	8	0	9	1	-	-	37	0	5
96	0	-	-	40	0	5	0	29	0	412	1	6
21	0	4	0	85	0	50	0	88	0	310	1	7
15	0	9	0	47	0	-	-	42	0	174	0	8
-	-	8	0	41	0	23	0	78	0	106	1	9
83	0	6	0	-	-	23	0	19	0	-	-	10
8	0	1	0	27	0	98	1	11	0	57	1	11
15	0	3	0	39	0	199	0	-	-	173	0	12
2	0	-	-	68	0	144	1	7	0	90	0	13
3	0	10	0	45	0	-	-	14	0	144	1	14
4	0	8	0	25	0	-	-	12	0	148	1	15
-	-	43	0	12	0	62	0	22	0	101	0	16
4	0	1,500	0	-	-	62	0	23	0	-	-	17
2	0	531	0	14	0	80	0	27	0	214	1	18
3	0	188	0	11	0	27	0	-	-	63	0	19
2	0	-	-	6	0	28	0	-	-	87	0	20
4	0	5	0	7	0	1	0	-	-	75	0	21
64	0	41	0	6	0	-	-	-	-	99	1	22
-	-	23	1	10	0	20	0	-	-	47	0	23
4	0	64	0	-	-	4	0	-	-	-	-	24
1	0	5	0	29	0	6	0	-	-	-	-	25
-	-	3	0	27	0	9	0	-	-	94	0	26
22	0	-	-	7	0	7	0	420	1	25	1	27
20	0	6	0	26	0	19	0	98	1	15	1	28
37	1	7	0	15	0	-	-	78	1	47	0	29
-	-	20	0	-	-	23	0	-	-	36	0	30
25	0	9	0	-	-	23	0	-	-	-	-	31
32	-	94	-	24	-	38	-	63	-	109	-	32

14, 21, 28, June 4, 11, 18, 25, July 2, 9, 16, 23, August 20, 27, October 22, 29, November 12 and 20-26. It was dug over 8 inches deep December 5.

Number of Bacteria and B. Coli Communis per Cubic

	Day of Month.	January.		February.		March.		May.		June.	
		Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.
1	1,	-	-	178	1	22	0	-	-	9	0
2	2,	16	0	137	0	25	0	-	-	9	0
3	3,	10	0	48	1	12	0	-	-	13	0
4	4,	0	1	114	1	20	0	-	-	-	-
5	5,	8	0	-	-	-	-	92	1	8	0
6	6,	11	0	42	0	28	0	38	0	10	0
7	7,	26	0	67	0	26	0	-	-	5	0
8	8,	-	-	70	0	10	0	28	0	14	0
9	9,	16	0	22	0	22	0	18	0	0	0
10	10,	20	0	25	0	16	0	17	0	4	0
11	11,	20	0	81	0	20	0	12	0	-	-
12	12,	46	1	-	-	-	-	14	9	5	0
13	13,	21	1	28	0	18	0	13	0	5	0
14	14,	18	0	31	9	-	-	-	-	22	0
15	15,	-	-	25	0	-	-	5	0	13	0
16	16,	20	9	14	1	-	-	47	0	18	0
17	17,	20	0	10	0	-	-	1	0	-	-
18	18,	17	0	10	0	-	-	18	0	-	-
19	19,	31	0	-	-	-	-	16	0	5	0
20	20,	22	0	18	9	-	-	5	0	8	0
21	21,	23	0	26	1	-	-	-	-	21	0
22	22,	-	-	-	-	-	-	14	0	20	0
23	23,	11	0	15	0	-	-	12	0	35	0
24	24,	17	0	15	0	-	-	6	0	15	0
25	25,	15	0	13	0	-	-	9	0	-	-
26	26,	-	-	-	-	-	-	7	0	20	0
27	27,	44	0	14	0	-	-	20	0	16	0
28	28,	90	0	32	0	122	0	-	-	30	0
29	29,	-	-	-	-	274	0	3	0	13	0
30	30,	257	1	-	-	194	1	7	0	13	6
31	31,	209	1	-	-	-	-	9	0	-	-
32	Average,	30	-	48	-	64	-	16	-	14	-

Filter No. 8 A was scraped on the following dates: January 26, July 2, August 28, October 17, November 13, December 11 and 29. It was drained on the following dates: March 13-28, March 30, May 4, May 7, 14, 21, 28, June 4, 11, 18, 25, July 2, 9, 16, 23, August 20, 27, October 5-17, 22, 29, November 12, 20 and 21.

Centimeter in the Effluent of Filter No. 8 A, 1899.

July.		August.		September.		October.		November.		December.		
Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	
28	0	7	0	18	0	-	-	6	0	76	1	1
-	-	9	0	8	0	20	0	25	0	8	0	2
20	0	8	0	-	-	9	0	17	0	-	-	3
-	-	14	0	-	-	31	0	11	0	17	1	4
12	0	6	0	7	0	4	0	-	-	17	0	5
15	0	-	-	5	0	-	-	-	1	30	1	6
10	0	5	0	18	0	-	-	12	0	25	0	7
9	0	10	0	6	0	-	-	9	0	22	0	8
-	-	5	0	9	0	-	-	13	0	5	0	9
15	0	17	0	-	-	-	-	14	0	-	-	10
15	0	5	0	5	0	-	-	25	0	25	1	11
12	0	24	0	8	0	-	-	-	-	87	0	12
7	0	-	-	7	0	-	-	-	-	56	0	13
6	0	5	0	3	0	-	-	40	0	86	1	14
4	0	8	0	7	0	-	[illegible]	223	1	116	1	15
-	-	2	0	13	0	-	-	80	1	161	0	16
4	0	2	0	-	-	-	-	65	1	-	-	17
3	0	5	0	3	0	-	-	37	1	40	0	18
21	0	7	0	11	0	33	0	-	-	23	1	19
5	0	-	-	7	0	85	1	34	0	34	0	20
6	0	-	-	4	0	44	1	-	-	44	0	21
33	0	3	0	8	0	-	-	-	-	48	0	22
-	-	27	1	12	0	45	0	21	0	20	1	23
3	0	13	1	-	-	34	1	58	0	-	-	24
4	0	5	0	7	0	45	0	163	1	-	-	25
2	0	6	0	25	0	94	0	-	-	17	0	26
4	0	-	-	10	0	32	1	430	1	19	0	27
6	0	5	0	5	0	27	0	78	1	24	0	28
8	0	8	0	10	0	-	-	60	1	34	0	29
-	-	23	0	-	-	24	0	-	-	68	0	30
6	0	18	0	-	-	11	0	-	-	-	-	31
10	-	10	-	9	-	36	-	65	-	42	-	32

Summary of Bacterial Analyses of Water applied to and Effluents from Filters Nos. 3 B and 8 A, 1899.

Samples from —	Average Number of Bacteria.	Per Cent. Removed (Efficiency).	Number of Samples Tested for B. Coli Communis.	Number of Times B. Coli Communis was found.	Average Number of B. Coli Communis.	Per Cent. of Samples Containing B. Coli Communis.
Canal water, . .	5,700	-	297	287	40	96.63
Filter No. 3 B, .	67	98.80	256	57	-	22.27
Filter No. 8 A, .	32	99.43	247	35	-	14.17

Monthly Averages of Analyses of Canal Water (Merrimack River).

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Soluble.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
January,	34	.38	.0056	.0170	.0152	.14	.018	.0002	.41	96.3	4,000
February,	34	.34	.0079	.0183	.0129	.17	.022	.0000	.34	88.1	5,400
March,	34	.36	.0066	.0188	.0134	.15	.023	.0000	.38	95.6	4,400
April,	-	.38	.0051	.0147	.0140	.15	.020	.0001	.39	99.3	1,700
May,	58	.40	.0036	.0155	.0146	.15	.016	.0001	.40	84.4	3,300
June,	73	.39	.0079	.0187	.0147	.23	.013	.0002	.29	71.1	9,600
July,	76	.34	.0155	.0245	.0166	.28	.015	.0004	.32	66.6	4,300
August,	74	.31	.0175	.0204	.0177	.28	.018	.0004	.30	58.3	2,700
September,	67	.28	.0137	.0196	.0177	.38	.018	.0006	.27	57.2	8,100
October,	58	.27	.0139	.0180	.0170	.35	.019	.0006	.30	58.7	8,100
November,	40	.37	.0131	.0226	.0199	.33	.019	.0003	.45	78.1	9,200
December,	36	.31	.0117	.0204	.0173	.30	.017	.0003	.38	84.3	7,500
Average,	53	.34	.0102	.0182	.0159	.24	.018	.0003	.35	77.8	5,700

Effluent of Filter No. 3 B.

[Parts per 100,000.]

1899.	Quantity of Effluent.* Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
January,	2,381,000	34	35	.30	.0009	.0067	.14	.028	0	.31	93.0	51
February,	1,993,000	34	34	.28	.0030	.0078	.18	.038	0	.26	85.6	152
March,	1,658,000	34	36	.25	.0008	.0064	.15	.032	0	.24	88.0	86
April,†	-	-	-	-	-	-	-	-	-	-	-	-
May,	2,309,000	58	58	.22	.0004	.0060	.15	.037	0	.25	79.9	64
June,	2,071,000	73	72	.18	.0002	.0058	.23	.068	0	.12	63.6	48
July,	1,921,000	76	77	.13	.0001	.0051	.28	.130	0	.16	58.5	32
August,	2,866,000	74	74	.12	.0005	.0061	.33	.079	0	.18	70.6	94
September,	2,859,000	67	67	.10	.0006	.0066	.35	.051	0	.13	54.8	24
October,	2,095,000	58	57	.13	.0007	.0063	.35	.059	0	.16	57.8	38
November,	2,087,000	40	42	.24	.0020	.0085	.32	.041	0	.30	80.1	68
December,	1,606,000	36	37	.24	.0097	.0090	.29	.035	0	.27	80.9	104
Average,	2,163,000	53	54	.20	.0017	.0069	.25	.054	0	.22	73.4	67

* The rates given under this heading upon all the tables are based upon the total volume of water filtered during each month; that is, in calculating this rate the volume passed is divided by the number of days the filters were in actual operation, including days just before, during or just after scraping, when the rate was lower than the prescribed rate.

† Out of operation.

Effluent of Filter No. 8 A.

[Parts per 100,000.]

1899.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
January, . .	2,072,000	34	34	.31	.0012	.0068	.14	.028	.0000	.32	82.1	39
February, .	2,306,000	34	34	.28	.0018	.0079	.17	.065	.0000	.26	70.3	43
March, . .	1,942,000	34	34	.29	.0004	.0068	.16	.028	.0000	.28	70.6	64
April,* . .	-	-	-	-	-	-	-	-	-	-	-	-
May, . . .	2,905,000	58	58	.23	.0002	.0061	.16	.023	.0000	.27	46.7	16
June, . .	1,835,000	73	73	.18	.0000	.0072	.23	.040	.0000	.14	9.9	14
July, . .	1,943,000	76	77	.14	.0008	.0058	.28	.024	.0000	.19	3.2	10
August, . .	2,880,000	74	74	.15	.0022	.0077	.28	.023	.0013	.19	2.6	10
September, .	3,315,000	67	67	.12	.0012	.0068	.35	.033	.0002	.12	3.7	9
October, . .	2,130,000	58	58	.16	.0017	.0075	.37	.051	.0000	.16	20.0	36
November, .	3,640,000	40	42	.29	.0030	.0106	.35	.032	.0000	.33	43.5	65
December, .	3,115,000	36	37	.25	.0004	.0068	.29	.040	.0000	.27	58.2	42
Average, .	2,596,000	53	53	.22	.0011	.0076	.25	.032	.0001	.23	37.3	32

* Out of operation.

Filters Nos. 68, 69 and 109.

These three filters were continued in operation during 1899 and the first three months of 1900. During most of the year they were flooded with a mixture of filtered city water and sewage, this water containing more organic matter than the river water applied to the remainder of the water filters, but less mineral matter in suspension. Beginning in November, however, and continuing during the remainder of their period of operation, the applied water consisted of a mixture of unfiltered river water and sewage. Discussion of the results obtained from them during their entire period of operation will be given in the next report of the Board.

The following tables present the average chemical and bacterial analyses of the water applied to and the effluents from these filters. Filter No. 68 was operated as an intermittent filter during most of the year, and Filters Nos. 69 and 109 as continuous filters. Filter No. 109 received the effluents of Filters Nos. 68 and 69.

Number of Bacteria and B. Coli Communis per Cubic Centimeter

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1, . . .	-	-	101,100	-	26,000	292	22,100	-	44,200	109	8,000	236
2	2, . . .	51,000	256	47,900	5	28,600	220	-	-	30,300	210	4,800	-
3	3, . . .	23,500	168	47,000	207	31,900	66	17,800	96	12,000	346	7,000	228
4	4, . . .	40,400	270	127,800	139	30,400	143	17,200	189	12,300	188	-	-
5	5, . . .	69,600	310	-	-	-	-	15,800	233	8,600	416	3,700	246
6	6, . . .	52,700	320	61,500	256	48,000	177	13,900	208	11,800	410	8,300	246
7	7, . . .	36,600	225	90,800	104	35,100	163	12,800	252	-	-	8,000	119
8	8, . . .	-	-	40,500	54	32,700	63	12,200	93	12,000	64	80,500	694
9	9, . . .	35,000	304	40,100	74	19,900	106	-	-	9,300	110	61,900	142
10	10, . . .	33,300	209	24,900	147	29,400	38	19,700	270	5,800	64	188,700	-
11	11, . . .	35,300	184	27,300	81	22,800	208	18,500	143	10,400	236	-	-
12	12, . . .	27,300	348	-	-	-	-	20,400	-	12,000	266	399,900	462
13	13, . . .	45,300	330	39,400	67	24,200	274	12,500	155	48,600	180	24,600	22
14	14, . . .	23,900	350	37,900	180	80,000	250	13,100	201	-	-	7,100	15
15	15, . . .	-	-	69,000	219	14,800	169	14,100	85	13,900	85	7,300	5
16	16, . . .	29,000	207	34,600	74	15,800	188	-	-	27,000	97	7,500	27
17	17, . . .	26,600	99	37,700	272	14,900	43	13,800	107	27,700	329	-	-
18	18, . . .	16,600	94	30,400	47	18,100	125	18,900	164	27,000	316	-	-
19	19, . . .	-	-	-	-	-	-	-	-	15,300	250	51,410	396
20	20, . . .	34,300	358	40,400	226	26,200	6	-	-	34,000	142	10,400	-
21	21, . . .	37,400	128	74,900	165	14,400	66	-	-	-	-	36,600	112
22	22, . . .	-	-	-	-	23,700	73	-	-	25,000	416	94,200	1,385
23	23, . . .	44,800	165	79,600	87	13,700	126	-	-	21,000	446	119,000	3,110
24	24, . . .	29,500	32	66,400	82	17,800	126	-	-	6,500	255	144,300	3,818
25	25, . . .	69,500	25	40,400	47	13,600	175	-	-	33,000	185	-	-
26	26, . . .	29,500	192	-	-	-	-	-	-	12,300	130	383,100	118
27	27, . . .	41,700	125	25,500	62	22,800	275	-	-	18,800	420	152,800	40
28	28, . . .	51,000	168	25,600	157	19,000	176	33,500	110	-	-	49,300	290
29	29, . . .	-	-	-	-	43,900	161	14,600	220	6,700	149	29,000	688
30	30, . . .	23,700	199	-	-	24,700	39	-	-	-	-	31,700	618
31	31, . . .	66,400	185	-	-	6,000	173	-	-	7,500	173	-	-
32	Average, .	39,000	206	52,700	120	2[illegible],500	140	20,600	159	17,900	278	74,500	592

in Applied Water for Filters Nos. 68 and 69, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
44,600	2,890	3,900	182	4,700	2	-	-	45,100	223	158,800	4,467	1
-	-	17,250	50	26,200	6	46,600	60	40,800	1,155	39,500	1,385	2
28,500	1,238	2,450	66	-	-	49,300	290	92,100	2,051	-	-	3
-	-	3,200	40	-	-	32,200	1,241	45,000	1,690	221,500	10,784	4
41,300	216	900	17	200	21	39,500	639	-	-	338,800	65,500	5
38,800	50	-	-	1,000	1	54,600	1,221	41,100	54	207,500	10,500	6
11,500	32	3,400	3	37,200	368	110,900	340	58,600	156	130,000	3,400	7
5,700	17	5,900	4	54,300	402	-	-	22,000	406	94,800	1,200	8
-	-	2,700	4	63,500	530	27,100	9	14,000	139	67,500	2,400	9
2,400	-	1,150	10	-	-	28,100	0	39,000	203	-	-	10
3,100	193	1,650	3	22,700	8	34,500	21	42,300	2,463	44,500	1,800	11
4,600	-	400	0	123,400	340	20,300	58	-	-	36,800	2,900	12
10,300	1,045	-	-	38,500	1,667	16,300	326	31,600	302	61,300	900	13
12,900	510	2,650	-	31,300	112	-	-	18,200	1,221	45,500	5,000	14
14,000	329	3,200	6	53,500	496	-	-	57,400	1,593	72,300	800	15
-	-	2,550	0	102,200	124	25,500	6	87,700	1,676	319,300	1,388	16
4,600	340	-	-	-	-	9,300	2	6,500	309	-	-	17
1,700	78	1,900	2	39,100	86	14,100	18	-	-	27,500	692	18
1,000	330	11,200	2	53,400	26	34,100	12	-	-	47,200	384	19
20,000	554	-	-	200,300	1,139	17,800	204	-	-	87,600	3,515	20
9,600	1,013	16,000	274	42,900	334	23,100	52	-	-	120,200	818	21
14,000	388	2,600	23	120,000	1,278	-	-	-	-	57,900	1,862	22
-	-	1,000	29	137,600	274	15,800	198	-	-	40,500	2,145	23
1,900	138	4,400	29	-	-	19,300	543	-	-	-	-	24
1,000	28	16,500	1,491	92,600	340	20,000	306	-	-	-	-	25
7,200	117	91,600	3,938	58,900	618	23,000	81	-	-	119,700	303	26
16,600	596	-	-	14,100	73	10,200	344	-	-	35,100	2,409	27
10,900	562	35,900	2,363	54,100	466	4,100	202	-	-	46,400	1,172	28
10,000	35	35,100	444	45,200	28	-	-	-	-	46,300	2,371	29
-	-	23,000	23	52,900	119	21,800	46	-	-	47,600	410	30
31,100	480	20,100	6	-	-	12,600	108	-	-	-	-	31
13,900	582	11,900	360	62,800	394	28,600	253	42,800	976	100,400	5,140	32

Number of Bacteria and B. Coli Communis per

	Day.	January. Water Bacteria.	January. B. Coli Communis.	February. Water Bacteria.	February. B. Coli Communis.	March. Water Bacteria.	March. B. Coli Communis.	April. Water Bacteria.	April. B. Coli Communis.	May. Water Bacteria.	May. B. Coli Communis.	June. Water Bacteria.	June. B. Coli Communis.
1	1, ...	-	-	72	0	285	0	[illegible]	0	406	0	2,641	0
2	2, ...	283	0	235	0	190	0	-	-	420	0	20	6
3	3, ...	145	0	300	0	342	0	10	0	40	0	21	0
4	4, ...	164	6	1,245	0	522	0	82	0	316	0	-	-
5	5, ...	260	0	-	-	-	-	47	0	240	1	26	0
6	6, ...	148	0	277	6	170	0	2,323	0	370	0	22	6
7	7, ...	538	0	240	0	230	0	3,921	0	-	-	24	0
8	8, ...	-	-	506	1	292	1	230	0	288	0	84	0
9	9, ...	170	6	246	0	160	0	-	-	73	0	1,441	0
10	10, ...	171	0	253	0	256	0	978	0	350	1	4,154	6
11	11, ...	87	0	140	0	1,931	0	1,303	0	288	0	-	-
12	12, ...	122	0	-	-	-	-	416	0	60	0	2,957	0
13	13, ...	100	0	337	6	190	0	2,242	0	28	0	125	2
14	14, ...	79	0	246	0	278	0	420	0	-	-	1,083	2
15	15, ...	-	-	260	0	264	0	245	6	6	0	2,571	6
16	16, ...	60	0	375	0	97	0	-	-	43	0	4,226	0
17	17, ...	362	0	645	0	364	0	206	0	114	0	-	-
18	18, ...	272	0	410	0	377	0	27	0	43	0	-	-
19	19, ...	-	-	-	-	-	-	-	-	135	0	2,756	0
20	20, ...	215	0	113	1	40	0	-	-	21	0	5,423	1
21	21, ...	73	0	267	0	160	1	-	-	-	-	2,932	0
22	22, ...	-	-	-	-	97	0	-	-	11	0	815	1
23	23, ...	600	0	566	0	340	0	-	-	28	0	518	0
24	24, ...	119	0	558	0	160	0	-	-	90	0	344	3
25	25, ...	80	0	256	0	282	0	-	-	2,278	0	-	-
26	26, ...	70	0	-	-	-	-	-	-	1,387	0	244	0
27	27, ...	55	0	654	0	98	0	-	-	73	0	315	0
28	28, ...	116	0	976	0	90	0	730	2	-	-	321	1
29	29, ...	-	-	-	-	166	0	-	0	1,496	0	91	0
30	30, ...	110	0	-	-	166	0	-	0	-	-	346	0
31	31, ...	160	0	-	-	93	0	-	-	4,490	0	-	-
32	Average, . .	181	-	408	-	262	-	859	-	608	-	1,348	-

Cubic Centimeter in Effluent of Filter No. 68, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
436	0	20	0	35	0	-	-	46	0	7,900	75	1
-	-	33	0	54	0	73	0	51	0	5,300	0	2
110	3	68	1	-	-	53	0	48	0	-	-	3
-	-	34	0	-	-	29	0	71	1	100	3	4
64	0	91	0	19	0	30	0	-	-	600	1	5
81	0	-	-	41	0	28	0	102	0	2,000	6	6
118	1	25	0	164	0	31	0	52	1	800	4	7
85	2	190	0	409	1	-	-	120	0	219	0	8
-	-	65	0	314	0	22	0	38	0	400	7	9
295	0	45	0	-	-	34	0	27	0	-	-	10
18	0	10	0	61	0	47	0	416	0	446	22	11
126	0	306	0	63	0	30	0	-	-	135	0	12
17	0	-	-	50	0	42	0	879	64	106	0	13
29	0	51	0	11	0	-	-	4,537	22	243	0	14
32	1	22	0	13	0	-	-	23,423	20	243	0	15
-	-	234	0	39	0	32	0	2,676	6	187	1	16
62	0	-	-	-	-	18	0	1,018	7	-	-	17
3	0	50	0	64	0	18	0	-	-	209	1	18
13	1	52	0	55	0	8	0	-	-	94	0	19
10	0	-	-	7	0	2	0	-	-	94	0	20
31	0	23	1	88	0	17	0	-	-	96	1	21
15	1	17	0	703	3	-	-	-	-	71	0	22
-	-	115	0	1,051	4	16	0	-	-	73	0	23
9	0	72	0	-	-	17	0	-	-	-	-	24
5	0	36	0	410	6	13	0	-	-	-	-	25
5	0	78	0	470	0	16	0	-	-	133	2	26
6	0	-	-	120	0	72	0	-	-	219	21	27
22	1	58	0	57	0	75	0	-	-	168	2	28
105	1	14	0	75	0	-	-	-	-	121	2	29
-	-	23	0	-	-	84	0	-	-	163	0	30
65	0	23	1	-	-	75	0	-	-	-	-	31
70	-	68	-	182	-	35	-	2,233	-	805	-	32

Number of Bacteria and B. Coli Communis per Cubic

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1, ...	-	-	470	0	45	0	45	0	22	0	871	0
2	2, ...	118	0	146	0	190	0	-	-	51	0	16	0
3	3, ...	155	0	40	0	198	0	9	0	24	0	548	0
4	4, ...	23	0	247	0	181	0	8	0	38	0	-	-
5	5, ...	47	0	-	-	-	-	107	0	115	0	31	0
6	6, ...	6	0	157	0	177	0	20	0	24	0	10	0
7	7, ...	124	0	55	0	326	0	118	0	-	-	8	0
8	8, ...	-	-	78	0	126	0	78	0	228	0	12	0
9	9, ...	568	0	91	0	156	0	-	-	73	0	6	1
10	10, ...	180	1	105	0	127	0	143	0	28	0	198	0
11	11, ...	151	0	75	0	183	0	175	0	84	0	-	-
12	12, ...	22	0	-	-	-	-	45	0	25	0	34	0
13	13, ...	57	0	53	0	83	0	228	0	33	0	23	0
14	14, ...	34	0	96	0	91	0	284	0	-	-	350	1
15	15, ...	-	-	92	0	183	0	39	0	95	0	153	0
16	16, ...	180	0	141	0	35	0	-	-	34	0	205	0
17	17, ...	30	0	79	0	118	0	109	0	133	0	-	-
18	18, ...	40	0	48	6	304	0	83	0	119	0	-	-
19	19, ...	-	-	-	-	-	-	-	-	87	0	12	0
20	20, ...	58	0	68	0	48	0	-	-	102	0	20	0
21	21, ...	28	0	396	0	78	0	-	-	-	-	163	0
22	22, ...	-	-	-	-	29	0	-	-	51	0	43	0
23	23, ...	263	-	50	0	114	0	-	-	31	0	38	1
24	24, ...	97	1	13	0	64	0	-	-	155	0	206	70
25	25, ...	38	0	42	0	44	0	-	-	37	0	-	-
26	26, ...	34	0	-	-	-	-	-	-	240	0	1,193	16
27	27, ...	26	0	23	0	74	0	-	-	13	0	416	9
28	28, ...	95	0	56	0	68	0	400	2	-	-	75	0
29	29, ...	-	-	-	-	70	0	50	2	285	0	120	0
30	30, ...	85	0	-	-	50	0	-	-	-	-	83	0
31	31, ...	122	0	-	-	17	0	-	-	327	0	-	-
32	Average, .	105	-	114	-	114	-	111	-	95	-	198	-

Centimeter in Effluent of Filter No. 69, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
62	0	4	1	26	0	-	-	52	0	8,700	360	1
-	-	23	0	45	0	58	0	126	3	8,100	33	2
8	0	13	0	-	-	68	0	118	1	-	-	3
-	-	7	0	-	-	20	0	196	1	11,200	75	4
45	2	5	0	37	0	51	0	-	-	5,500	330	5
103	0	-	-	5	0	58	0	183	1	8,300	362	6
48	0	4	0	21	0	55	0	143	1	7,100	150	7
65	1	6	0	57	0	-	-	104	1	10,700	126	8
-	-	13	0	27	·0	87	0	55	1	2,287	296	9
43	0	3	0	-	-	50	0	50	0	-	-	10
6	0	27	0	16	0	46	0	122	0	1,764	16	11
31	0	8	0	13	0	183	0	-	-	2,343	46	12
3	0	-	-	8	0	104	0	1,343	6	2,060	0	13
5	0	21	0	4	0	-	-	3,285	8	1,136	115	14
3	0	22	0	9	0	-	-	3,685	0	1,456	18	15
-	-	20	0	30	0	54	0	1,242	2	1,136	18	16
5	0	-	-	-	-	8	0	2,420	3	-	-	17
3	0	26	0	22	0	21	0	-	-	1,569	14	18
3	0	2	0	30	0	38	0	-	-	608	19	19
6	0	-	-	16	0	40	0	-	-	3,380	5	20
13	0	2	0	-	-	11	0	-	-	5,468	3	21
2	0	9	0	1,086	5	-	-	-	-	831	22	22
-	-	23	0	1,008	1	85	0	-	-	3,283	114	23
1	0	8	0	-	-	6	0	-	-	-	-	24
1	0	4	0	78	0	29	0	-	-	-	-	25
0	0	4	0	5,389	0	7	0	-	-	3,416	25	26
103	0	-	-	944	2	49	0	-	-	564	18	27
4	0	15	0	140	0	13	0	-	-	476	21	28
15	0	4	0	196	0	-	-	-	-	1,336	16	29
-	-	11	0	-	-	17	0	-	-	1,022	10	30
9	0	13	0	-	-	27	0	-	-	-	-	31
23	-	11	-	400	-	45	-	875	-	3,750	-	32

Number of Bacteria and B. Coli Communis per Cubic

	Day.	January.		February.		March.		April.		May.		June.	
		Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.
1	1, . . .	-	-	40	0	100	0	11	0	2,343	1	28	0
2	2, . . .	31	0	33	0	15	0	-	-	7,358	1	30	0
3	3, . . .	24	0	13	0	55	0	9	0	390	0	6	0
4	4, . . .	23	0	48	0	57	0	16	0	26	1	-	-
5	5, . . .	30	0	-	-	-	-	9	0	569	1	14	0
6	6, . . .	16	0	13	0	36	0	19	0	370	1	28	0
7	7, . . .	27	0	25	0	55	0	9	0	-	-	7	0
8	8, . . .	-	-	50	0	44	0	9	0	398	0	296	0
9	9, . . .	18	0	45	1	36	0	-	-	256	0	92	0
10	10, . . .	41	0	9	0	26	0	53	0	152	0	9	0
11	11, . . .	37	0	78	1	14	0	64	0	122	0	-	-
12	12, . . .	27	0	-	-	-	-	25	0	114	0	238	0
13	13, . . .	19	0	42	0	24	0	55	0	108	0	17	1
14	14, . . .	15	1	43	0	30	0	55	0	-	-	621	0
15	15, . . .	-	-	102	0	31	0	19	0	130	0	424	0
16	16, . . .	10	0	47	0	17	0	-	-	7	0	424	0
17	17, . . .	16	0	15	0	34	0	13	0	13	0	-	-
18	18, . . .	25	0	11	0	17	0	14	0	16	0	-	-
19	19, . . .	-	-	-	-	-	-	-	-	6	0	150	0
20	20, . . .	18	0	30	0	45	1	-	-	14	0	73	1
21	21, . . .	25	1	30	0	46	0	-	-	-	-	186	0
22	22, . . .	-	-	-	-	23	0	-	-	14	0	112	1
23	23, . . .	65	0	15	0	29	0	-	-	5	0	36	0
24	24, . . .	24	0	13	0	15	1	-	-	9	0	10	0
25	25, . . .	19	0	29	0	35	0	-	-	12	0	-	-
26	26, . . .	23	0	-	-	-	-	-	-	74	0	25	0
27	27, . . .	11	0	8	0	16	0	-	-	77	0	68	0
28	28, . . .	13	0	22	0	30	0	-	-	-	-	120	0
29	29, . . .	-	-	-	-	27	0	-	-	83	0	13	0
30	30, . . .	44	0	-	-	75	0	-	-	-	-	45	0
31	31, . . .	36	0	-	-	11	0	-	-	45	0	-	-
32	Average, .	26	-	34	-	37	-	25	-	490	-	123	-

Centimeter in Effluent of Filter No. 109, 1899.

July.		August.		September.		October.		November.		December.		
Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	Water Bacteria.	B. Coli Communis.	
26	0	12	0	4	1	-	-	4	0	1,808	1	1
-	-	6	0	73	0	9	0	5	0	550	1	2
23	0	4	0	-	-	15	0	6	0	-	-	3
-	-	9	0	-	-	10	0	22	0	554	1	4
45	0	9	0	16	0	12	0	-	-	602	1	5
10	0	-	-	9	0	5	0	20	0	675	1	6
306	0	9	0	28	0	10	0	18	0	512	1	7
15	0	14	0	35	0	-	-	4	1	412	0	8
-	-	12	0	43	0	14	0	11	1	522	1	9
33	0	11	0	-	-	15	0	9	0	-	-	10
5	0	8	0	13	0	20	0	30	0	236	0	11
12	0	16	0	13	0	21	0	-	-	310	1	12
4	0	-	-	4	0	27	0	-	-	216	0	13
4	0	7	0	5	0	-	-	346	0	221	0	14
8	0	12	0	107	0	-	-	5,645	1	166	1	15
-	-	7	0	9	0	18	0	1,480	1	128	0	16
3	0	-	-	-	-	12	0	506	1	-	-	17
3	0	7	0	8	0	2	0	-	-	119	0	18
17	0	6	0	5	0	2	0	-	-	116	0	19
0	0	-	-	24	0	8	0	-	-	83	0	20
4	0	10	1	5	0	18	0	-	-	135	0	21
5	0	6	0	216	0	-	-	-	-	133	0	22
-	-	15	0	83	1	13	0	-	-	123	0	23
3	0	10	0	-	-	8	0	-	-	-	-	24
1	0	5	0	1,117	1	5	0	-	-	-	-	25
1	0	16	1	153	1	10	0	-	-	123	1	26
26	0	-	-	34	0	2	0	-	-	155	1	27
23	0	5	0	33	0	13	0	-	-	124	1	28
14	0	2	0	32	0	-	-	-	-	136	1	29
-	-	13	0	-	-	12	0	-	-	173	1	30
11	0	14	0	-	-	2	0	-	-	-	-	31
24	-	9	-	88	-	11	-	579	-	338	-	32

Water applied to Filters Nos. 68 and 69.

[Parts per 100,000.]

1899.	Temperature. Deg. F.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Soluble.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Bacteria per Cubic Centimeter.
January,	43	.36	.0478	.0207	.0155	0.31	.057	.0002	.38	30,000
February,	40	.35	.0562	.0211	.0168	0.30	.054	.0002	.31	52,700
March,	41	.32	.0456	.0150	.0138	0.41	.042	.0001	.30	23,500
April,	43	.34	.0728	.0202	.0125	0.37	.041	.0002	.28	20,000
May,	52	.29	.0671	.0168	.0127	0.37	.048	.0001	.28	17,000
June,	62	.19	.0453	.0141	.0104	0.30	.043	.0003	.19	74,500
July,	67	.12	.0401	.0115	.0097	0.46	.042	.0001	.16	13,900
August,	70	.18	.0416	.0111	.0080	0.45	.043	.0001	.19	11,900
September,	64	.22	.0722	.0327	.0161	0.68	.045	.0003	.31	62,700
October,	50	.15	.0536	.0165	.0111	0.58	.051	.0002	.20	30,500
November,	41	.17	.0630	.0170	.0088	1.08	.044	.0003	.22	42,700
December,	52	.30	.3000	.0630	.0300	0.74	.023	.0007	.67	100,100
Average,	53	.26	.0750	.0217	.0147	0.50	.044	.0002	.29	40,700

Effluent of Filter No. 68.

[Parts per 100,000.]

1899.	Quantity of Effluent. Gallons per Acre Daily.	Temperature. Deg. F. Applied Water.	Temperature. Deg. F. Effluent.	Color.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
January,	1,720,000	46	55	.20	.0007	.0072	0.30	.101	.0000	.24	72.0	181
February,	1,645,000	45	55	.21	.0011	.0070	0.34	.111	.0000	.19	61.4	408
March,	1,657,000	45	50	.19	.0003	.0061	0.41	.084	.0000	.18	65.0	282
April,	1,602,000	50	56	.16	.0033	.0060	0.36	.092	.0001	.17	61.7	850
May,	1,786,000	58	58	.14	.0002	.0048	0.35	.118	.0000	.16	62.4	504
June,	1,706,000	69	71	.11	.0015	.0059	0.41	.169	.0040	.09	37.1	1,348
July,	1,914,000	73	75	.06	.0006	.0065	0.47	.072	.0000	.13	68.5	70
August,	1,830,000	73	74	.09	.0004	.0049	0.40	.093	.0000	.12	74.4	68
September,	1,796,000	66	67	.10	.0008	.0054	0.62	.119	.0000	.13	62.0	182
October,	1,743,000	60	63	.08	.0001	.0050	0.52	.129	.0000	.12	72.6	36
November,	1,560,000	45	51	.05	.0000	.0034	1.90	.149	.0000	.08	53.9	2,233
December,	1,306,000	52	53	.16	.0944	.0133	0.79	.214	.0061	.22	24.9	806
Average,	1,696,000	57	61	.13	.0086	.0065	0.50	.121	.0000	.15	59.7	581

Filter No. 68 was scraped August 8. It was drained on the following dates: January 22, April 18-27, June 4 and November 19-28. It was raked 1 inch deep on the following dates: March 20, September 21, November 13, 28, December 11, 18 and 26. It was run as a continuous filter June 5-19. Began to flood with canal water and sewage November 28.

Effluent of Filter No. 69.

[Parts per 100,000.]

1899.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
January,	1,657,000	46	53	.19	.0010	.0068	0.29	.092	.0000	.21	38.9	105
February,	1,631,000	45	50	.21	.0011	.0068	0.35	.089	.0000	.22	24.4	114
March,	1,596,000	45	49	.17	.0002	.0055	0.39	.075	.0000	.18	26.7	114
April,	1,602,000	50	51	.16	.0005	.0055	0.35	.094	.0000	.16	14.1	111
May,	1,617,000	58	57	.14	.0056	.0052	0.37	.092	.0030	.17	8.1	95
June,	1,539,000	69	71	.11	.0020	.0054	0.41	.068	.0055	.13	7.5	193
July,	1,595,000	73	78	.07	.0030	.0053	0.46	.066	.0021	.13	3.7	23
August,	1,611,000	78	70	.09	.0003	.0047	0.47	.087	.0000	.12	21.6	11
September,	1,591,000	66	65	.10	.0007	.0062	0.48	.047	.0050	.16	14.6	400
October,	1,570,000	60	60	.09	.0019	.0050	0.52	.113	.0018	.12	6.3	45
November,	1,435,000	45	50	.05	.0012	.0038	1.81	.127	.0028	.11	11.4	875
December,	1,421,000	52	51	.46	.0900	.0243	0.74	.005	.0000	.43	3.8	3,750
Average,	1,572,000	57	58	.15	.0091	.0070	0.55	.079	.0016	.18	15.1	486

Filter No. 69 was scraped on the following dates: January 9 and August 8. It was drained on the following dates: January 22, April 18-27, June 4 and November 19-28. It was raked 1 inch deep on the following dates: January 1, March 23, June 23, September 21, November 28 and December 18-22. It was flooded with canal water and sewage September 24-27. Began to flood it with canal water and sewage November 28.

Effluent of Filter No. 109.

[Parts per 100,000.]

1899.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.		
January,	2,397,000	54	53	.17	.0010	.0065	0.30	.055	.0000	.18	25
February,	2,776,000	53	49	.16	.0008	.0060	0.35	.094	.0000	.16	34
March,	2,672,000	50	48	.13	.0001	.0047	0.41	.092	.0000	.14	37
April,	2,574,000	54	51	.14	.0003	.0047	0.32	.063	.0000	.13	25
May,	2,602,000	58	57	.12	.0002	.0042	0.37	.068	.0000	.15	490
June,	2,621,000	71	70	.11	.0004	.0047	0.41	.056	.0000	.12	123
July,	2,565,000	74	73	.06	.0002	.0044	0.47	.065	.0000	.13	24
August,	2,693,000	72	70	.08	.0003	.0046	0.47	.083	.0000	.12	9
September,	2,923,000	66	65	.09	.0002	.0049	0.48	.067	.0000	.09	88
October,	2,797,000	62	59	.07	.0001	.0047	0.52	.116	.0000	.09	11
November,	2,547,000	51	50	.05	.0000	.0032	1.38	.111	.0000	.08	579
December,	2,337,000	52	52	.19	.0468	.0108	0.75	.105	.0095	.23	338
Average,	2,625,000	60	58	.11	.0042	.0053	0.52	.082	.0008	.14	149

Filter No. 109 was scraped August 8. It was drained January 22, April 18–May 1 and November 19–28.

Summary of Bacterial Analyses of Water applied to and Effluents from Filters Nos. 68, 69 and 109, 1899.

Samples from	Average Number of Bacteria.	Per Cent. Removed (Efficiency).	Number of Samples Tested for B. Coli Communis.	Number of Times B. Coli Communis was found.	Average Number of B. Coli Communis.	Per Cent. of Samples Containing B. Coli Communis.
Applied water for 68 and 69,	40,800	-	278	276	768.00	99.30
Filter No. 68,	581	98.82	282	49	0.76	17.38
Filter No. 69,	486	98.81	281	52	8.09	18.51
Filter No. 109,	149	A=99.46 B=72.00	280	39	-	13.93

A refers to applied water for Filters Nos. 68 and 69.
B refers to combined effluents from Filters Nos. 68 and 69.

FILTER NO. 86.

This filter, containing 48 inches in depth of coal ashes, was in operation during seven months of the year, filtering the river water at an average rate of 2,863,000 gallons per acre daily. The results of its operation were similar to those obtained in previous years; namely, good chemical purification of the applied water, but poor bacterial results. The filter was not scraped or raked during its period of operation. Tables giving the average monthly chemical and bacterial analyses follow: —

Number of Bacteria and B. Coli Communis per Cubic Centimeter in the Effluent of Filter No. 86.

Day of Month.	1899.													
	May.		June.		July.		August.		September.		October.		November.	
	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.	Bacteria.	B. Coli Communis.
1, ...	-	-	92	0	604	1	111	2	36	1	-	-	71	1
2, ...	430	0	32	0	-	-	116	0	31	6	12	0	166	1
3, ...	246	0	53	0	621	0	153	3	-	-	118	0	86	0
4, ...	413	0	-	-	-	-	285	0	-	-	95	0	126	1
5, ...	134	0	119	0	177	0	198	2	16	0	93	0	-	-
6, ...	109	0	56	0	506	1	-	-	530	0	16	0	-	-
7, ...	-	-	90	0	621	3	27	0	496	2	26	0	53	0
8, ...	396	0	64	2	1,299	2	18	1	590	0	-	-	100	1
9, ...	89	1	49	0	-	-	163	0	160	1	21	0	113	1
10, ...	54	1	69	0	346	0	35	0	-	-	78	0	117	0
11, ...	112	0	-	-	11	0	63	0	470	0	68	0	30	0
12, ...	34	0	153	0	89	0	54	1	323	0	26	0	-	-
13, ...	50	0	133	0	9	0	-	-	29	0	40	0	26	1
14, ...	-	-	96	1	13	0	216	-	25	0	-	-	42	0
15, ...	50	0	57	0	12	0	43	0	923	0	-	-	40	0
16, ...	256	0	290	0	-	-	82	0	366	0	91	0	142	0
17, ...	308	10	-	-	2	0	-	-	-	-	19	0	85	0
18, ...	155	0	-	-	2	0	56	0	110	0	27	0	133	0
19, ...	92	0	80	0	18	0	143	0	346	0	22	0	-	-
20, ...	143	0	37	0	11	0	-	-	296	0	118	0	73	0
21, ...	-	-	88	0	18	0	112	4	26	0	330	0	-	-
22, ...	124	1	68	2	40	0	65	0	629	0	-	-	-	-
23, ...	173	0	260	3	-	-	33	4	75	0	176	0	-	-
24, ...	227	0	106	2	6	1	37	1	-	-	86	0	-	-
25, ...	212	0	-	-	6	0	23	0	118	0	51	0	-	-
26, ...	58	0	272	0	41	2	36	0	153	0	47	0	-	-
27, ...	1,358	0	103	0	44	0	-	-	975	0	42	0	-	-
28, ...	-	-	468	1	85	1	93	1	154	0	68	0	-	-
29, ...	68	0	424	0	184	2	24	1	128	0	-	-	-	-
30, ...	-	-	393	0	-	-	92	0	27	0	54	0	-	-
31, ...	113	0	-	-	337	0	27	2	-	-	33	0	-	-
Average, .	212	-	168	-	206	-	87	-	301	-	70	-	91	-

Effluent of Filter No. 86.

[Parts per 100,000.]

1899.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	2,845,000	-	-	-	-	-	-	-	-	-	56.4	212
June, . . .	2,864,000	73	71	.15	.0004	.0053	.25	.034	.0000	.13	10.2	168
July, . . .	2,819,000	76	76	.10	.0003	.0052	.28	.041	.0000	.12	21.2	208
August, . .	2,812,000	74	72	.11	.0014	.0071	.28	.031	.0013	.16	33.3	87
September, .	3,060,000	67	61	.11	.0013	.0074	.35	.035	.0006	.13	2.0	301
October, . .	2,796,000	58	56	.13	.0002	.0063	.36	.045	.0000	.16	6.6	70
November, .	2,845,000	40	43	.23	.0003	.0091	.35	.032	.0000	.27	42.0	91
Average, .	2,863,000	66	63	.14	.0006	.0068	.31	.036	.0003	.16	24.5	162

Filters Nos. 122 and 126.

During the year preliminary studies upon the removal of color from water have been made with Filters Nos. 122 and 126. The first of these filters, No. 122, contained 5 feet in depth of a mixture of coarse sand and iron turnings and filings; and the second, No. 126, contained 4½ feet in depth of brown hematite, such as was used in the experiments upon the purification of sewage mentioned on page 474. Both filters were quite successful at times in removing the color of the canal water applied to them, but discussions in regard to the results of their operation will be postponed until their action and the conditions governing it are more thoroughly understood, and other investigations upon this subject have been made.

Effluent of Filter No. 122.

[Parts per 100,000.]

1899.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May, . . .	1,957,000	58	58	.28	.0165	.0087	.16	.003	.0001	.15	0.7	841
June, . . .	1,878,000	73	72	.12	.0102	.0106	.23	.000	.0000	.15	1.0	225
July, . . .	1,909,000	76	76	.15	.0177	.0114	.29	.001	.0000	.14	1.2	133
August, . .	1,627,000	74	71	.09	.0139	.0084	.29	.002	.0000	.13	2.0	150
September, .	2,122,000	67	65	.07	.0061	.0085	.33	.019	.0000	.08	1.6	798
October, . .	1,985,000	58	57	.07	.0130	.0072	.35	.002	.0000	.09	3.8	71
November, .	1,760,000	40	45	.07	.0162	.0085	.35	.002	.0000	.11	3.8	110
Average, .	1,891,000	64	63	.12	.0134	.0090	.29	.004	.0000	.12	2.0	333

Number of Bacteria and B. Coli Communis per Cubic Centimeter in the Effluent of Filter No. 122.

Day of Month.	1899. May. Bacteria.	May. B. Coli Communis.	June. Bacteria.	June. B. Coli Communis.	July. Bacteria.	July. B. Coli Communis.	August. Bacteria.	August. B. Coli Communis.	September. Bacteria.	September. B. Coli Communis.	October. Bacteria.	October. B. Coli Communis.	November. Bacteria.	November. B. Coli Communis.
1, . . .	-	-	[illegible]	0	80	12	222	2	-	-	-	-	[illegible]	1
2, . . .	20,200	0	174	6	-	-	275	6	-	-	126	0	582	1
3, . . .	19,200	6	[illegible]	0	519	5	172	5	-	-	[illegible]	0	275	1
4, . . .	6,400	6	-	-	-	-	126	8	-	-	32	0	445	6
5, . . .	5,100	0	1,224	6	105	0	[illegible]	1	[illegible]	2	60	0	-	-
6, . . .	11,400	6	[illegible]	6	208	6	-	-	[illegible]	2	20	0	116	0
7, . . .	-	-	1,000	0	600	9	72	2	1,206	0	95	1	116	0
8, . . .	7,200	0	[illegible]	0	621	3	62	2	540	12	-	-	345	1
9, . . .	4,000	0	1,515	0	-	-	80	6	1,672	15	53	0	167	0
10, . . .	3,500	2	1,061	6	108	0	78	6	-	-	104	0	100	1
11, . . .	1,000	0	-	-	840	6	95	6	238	0	126	0	158	1
12, . . .	800	0	1,400	0	1,060	0	93	3	108	0	45	0	-	-
13, . . .	800	0	108	0	264	3	-	-	1,060	0	85	0	64	0
14, . . .	-	-	2,120	8	434	18	20	-	1,582	0	-	-	45	0
15, . . .	1,400	0	2,408	1	446	6	25	0	2,044	12	-	-	3,740	12
16, . . .	2,800	6	2,158	3	-	-	-	-	2,519	0	108	0	-	-
17, . . .	1,000	5	-	-	206	12	-	-	-	-	32	0	142	0
18, . . .	507	0	-	-	161	0	68	0	240	0	74	0	176	1
19, . . .	400	0	182	0	802	10	122	0	125	6	100	0	-	-
20, . . .	700	2	165	0	406	0	-	-	108	1	115	0	53	0
21, . . .	-	-	840	0	208	0	108	5	66	1	65	0	-	-
22, . . .	236	0	1,228	8	286	6	102	0	233	0	-	-	-	-
23, . . .	1,140	0	3,767	12	-	-	124	2	526	0	178	0	332	0
24, . . .	661	0	1,329	13	23	0	20	1	-	-	62	0	1,200	1
25, . . .	316	0	-	-	37	0	-	-	118	1	57	0	-	-
26, . . .	218	0	366	0	204	12	-	-	103	0	66	0	-	-
27, . . .	566	0	476	0	426	0	-	-	163	0	275	1	1,618	0
28, . . .	-	-	436	1	190	2	450	15	106	0	144	0	861	0
29, . . .	424	0	3,026	4	80	0	66	7	125	0	-	-	883	1
30, . . .	-	-	5,804	14	-	-	-	-	-	-	94	0	-	-
31, . . .	663	0	-	-	406	2	-	-	-	-	75	0	-	-
Average, .	3,981	-	1,346	-	370	-	136	-	612	-	100	-	568	-

Effluent of Filter No. 126.

[Parts per 100,000.]

1899.	Quantity of Effluent. — Gallons per Acre Daily.	Temperature. Deg. F.		Color.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Per Cent. of Dissolved Oxygen.	Bacteria per Cubic Centimeter.
		Applied Water.	Effluent.		Free.	Albuminoid.		Nitrates.	Nitrites.			
May,	1,010,000	58	61	.30	.0036	.0066	.15	.001	.0000	.09	18.9	20,600
June,	976,000	73	74	.33	.0021	.0079	.22	.010	.0001	.07	12.7	1,050
July,	1,083,000	76	77	.09	.0045	.0058	.27	.038	.0001	.09	17.7	450
August,	2,063,000	74	73	.08	.0015	.0070	.33	.031	.0003	.10	10.0	488
September,	2,123,000	67	66	.09	.0011	.0080	.38	.028	.0030	.13	9.8	423
October,	2,271,000	58	56	.12	.0011	.0081	.35	.043	.0003	.14	13.5	118
November,	2,400,000	40	44	.17	.0019	.0094	.35	.036	.0000	.20	48.0	64
Average,	1,704,000	64	64	.24	.0023	.0075	.29	.026	.0005	.12	18.7	3,318

Summary of Bacterial Analyses, 1899.

Samples from —	Average Number of Bacteria.	Per Cent. Removed (Efficiency).	Number of Samples Tested for B. Coli Communis.	Number of Times B. Coli Communis was found.	Average Number of B. Coli Communis.	Per Cent. of Samples Containing B. Coli Communis.
Canal water,	5,700	-	297	287	40.00	96.63
Filter No. 86,	165	97.10	166	38	0.45	22.89

THE

OCCURRENCE OF IRON IN GROUND WATERS

AND

EXPERIMENTS UPON METHODS OF REMOVAL.

By HARRY W. CLARK, *Chemist of the Board.*

THE OCCURRENCE OF IRON IN GROUND WATERS AND EXPERIMENTS UPON METHODS OF REMOVAL.

By Harry W. Clark, *Chemist of the Board.*

The presence of iron in water drawn from the ground is a common occurrence. Of the forty or more public ground-water supplies of Massachusetts, not one is entirely free at all times from iron, but only a few contain iron in an amount sufficient to be objectionable.

The reason that some of our potable ground waters contain considerable iron is quite well known, but may be stated again as follows: as rain water percolates through the ground it comes in contact in many places with organic matter to such an extent that in many cases the dissolved oxygen, with which it is saturated when reaching the ground, is exhausted in oxidizing this organic matter, carbonic acid takes its place and a considerable amount of organic matter is also taken into solution. Nearly all soils and gravels contain iron in combination with silica and other mineral substances. Pure water has but little effect on this combined iron. Water as just described, however, containing organic matter in solution with free carbonic acid and no free oxygen, often exerts a decided action on many soils and rocks, whereby iron and other basic oxides are dissolved as bicarbonates. Ferrous bicarbonate, upon exposure of the water to the air, changes to ferric hydrate and precipitates. If the iron in the water, however, is caused by the oxidation of iron pyrites, it will occur in the form of ferrous sulphate and the hydrate will precipitate more slowly. These same phenomena also often occur when surface water, such as river water, polluted with organic matter, percolates through the ground to a well. This change, and the taking into solution of any considerable amount of iron, undoubtedly only takes place where there is an entire absence of oxygen. It does not necessarily follow, however, that ground water containing considerable iron, drawn or pumped from wells or filter galleries, must show an entire absence of free or dissolved oxygen, as some of the water entering may come through different soil strata than other portions, or may have been of a purer character originally, and hence its oxygen has not become exhausted during filtration through the ground.

In the following table are given the results of determinations of the free or dissolved oxygen and carbonic acid present in the water of many of these ground-water supplies, together with average sanitary analyses of these supplies. The determinations of oxygen and carbonic acid are not single determinations, but averages of a number made during the past two or three years.

An examination of the table makes clear that only three of the averages denote an entire absence of free oxygen in the water supply, although in a number of others the amount present is small. It is the supplies containing no oxygen that contain the greatest amount of iron in solution, although several of those low in oxygen contain an objectionable amount. Two analyses are given of Provincetown water; the first analysis represents the supply as formerly pumped from tubular wells, and contains no oxygen but a very large amount of carbonic acid, and the second analysis represents the present supply as pumped from an open basin in the ground excavated near the wells, and this water, while still containing a large amount of iron and carbonic acid in solution, has always when examined contained some free oxygen.

[Parts per 100,000.]

	Color.	Total Solids.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.	Carbonic Acid.	Oxygen Dissolved (Per Cent. of Saturation).
Attleborough,	0.02	4.15	.0000	.0020	0.34	.0100	.0000	.06	1.9	.0060	3.598	32.3
Brookline,	0.00	8.90	.0020	.0034	0.56	.0320	.0002	.13	4.7	.0050	2.297	17.5
Cohasset,	0.09	14.90	.0004	.0024	1.71	.0400	.0001	.05	6.3	.0660	4.634	9.7
Dedham,	0.00	10.30	.0010	.0028	0.91	.2400	.0000	.04	3.9	.0040	2.670	48.6
Easton,	0.01	4.60	.0000	.0008	0.44	.0500	.0000	.02	1.3	.0030	2.757	55.9
Fairhaven,	0.17	5.20	.0000	.0054	0.84	.0270	.0001	.22	1.6	.0100	2.175	37.8
Framingham,	0.05	9.20	.0026	.0040	0.90	.0410	.0001	.05	3.1	.0140	2.395	34.1
Grafton,	0.03	9.70	.0000	.0040	0.97	.1360	.0000	.06	3.0	.0200	1.912	86.0
Hyde Park (old supply),	0.07	11.65	.0142	.0041	1.62	.1010	.0006	.10	4.6	.0540	4.688	23.0
Hyde Park (new supply),	0.00	8.80	.0000	.0010	1.03	.2300	.0001	.02	2.9	.0020	3.446	73.7
Kingston,	0.02	4.30	.0000	.0002	0.78	.0080	.0000	.02	1.1	.0010	2.033	67.9
Lexington,	0.37	11.10	.0002	.0144	0.74	.1080	.0001	.56	4.4	.0100	2.033	75.4
Lowell (boulevard system),	0.12	4.45	.0100	.0038	0.27	.0200	.0001	.09	1.7	.0400	1.839	15.8
Lowell (Cook system),	0.05	8.80	.0000	.0048	0.48	.0360	.0000	.12	3.8	.0060	3.955	10.2
Lowell (hydraulic system),	0.16	8.40	.0072	.0042	0.36	.0070	.0000	.17	3.1	.0410	4.455	3.9

	Color.	Total Solids.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.	Carbonic Acid.	Oxygen Dissolved (Per Cent. of Saturation).
Lowell (Cook and hydraulic system).	0.09	8.75	.0033	.0051	0.44	.0200	.0001	.14	3.4	.0245	4.310	13.5
Malden, ...	0.03	29.30	.0002	.0016	2.71	.4200	.0000	.03	15.5	.0020	3.164	43.1
Marblehead, ...	0.30	15.65	.0278	.0029	1.66	.0005	.0000	.07	7.0	.3000	3.648	0.9
Methuen, ...	0.07	6.80	.0000	.0026	0.33	.0160	.0000	.18	3.0	.0030	1.175	7.7
Middleborough, ...	0.30	6.40	.0014	.0052	0.63	.0150	.0000	.14	2.6	.0870	4.333	24.0
Milford, ...	0.44	4.50	.0002	.0033	0.31	.0040	.0000	.65	1.0	.0040	1.557	39.2
Millbury, ...	0.02	4.70	.0000	.0008	0.23	.0120	.0000	.02	2.0	.0010	3.676	27.2
Newton, ...	0.05	5.85	.0003	.0025	0.45	.0390	.0000	.06	2.5	.0020	1.649	61.0
Norwood (tubular test wells), . .	0.00	8.45	.0000	.0012	0.61	.2240	.0000	.03	3.3	.0050	2.994	50.4
Provincetown (tubular wells), . .	1.71	9.50	.0116	.0115	2.28	.0045	.0000	.72	3.4	.3300	4.000	0.0
Provincetown (open reservoir), .	1.18	10.50	.0006	.0260	2.60	.0040	.0001	.78	2.5	.3600	2.485	10.0
Reading (before filtration), . .	0.85	9.70	.0120	.0178	0.39	.0050	.0000	.82	3.0	.2250	2.172	0.0
Reading (after filtration), . . .	0.30	17.30	.0038	.0108	0.46	.0050	.0005	.38	9.7	.0210	1.214	92.8
Revere, ...	0.01	14.70	.0002	.0004	1.26	.3400	.0004	.02	7.1	.0010	3.659	9.1
Sharon, ...	0.00	8.60	.0000	.0006	1.08	.2520	.0000	.02	2.9	.0030	2.130	93.4
Watertown, ...	0.95	8.75	.0448	.0104	0.55	.0015	.0001	.53	-	.6000	-	0.0
Webster, ...	0.00	3.60	.0000	.0010	0.23	.0140	.0000	.03	0.8	.0010	1.874	50.0
Wellesley, ...	0.03	6.70	.0006	.0021	0.58	.0520	.0000	.05	2.7	.0040	2.516	63.5

Experiments on Filtration.

Experiments upon the removal of iron from five supplies have been made during the past few years: namely, Provincetown (old supply), Provincetown (new supply), Watertown, Marblehead and Reading.

When iron occurs as ferrous carbonate in solution in a water containing little or no free oxygen and but a small amount of organic matter, the carbonic acid present is readily driven out by aeration or exposure to the air, the iron being oxidized by this aeration first to sesquioxide of iron which then precipitates as hydrate, and can be easily removed by filtration through sand. Several filter plants upon a somewhat large scale are in operation in this country where the iron, present in the ferrous condition and in a water containing little organic matter, is easily removed in this manner; the filters at Far Rockaway, Long Island, and Red Bank, New Jersey, being notable examples. At Asbury Park, New Jersey, iron is removed from a water supply by pressure filters, but it is evident from the investigation and report of Dr. T. M. Drown, made at the time these filters were installed, that simple sand filtration after aeration would be quite as effective in this instance also. There are no sand filters for the removal of iron from water in operation in this State, but the two experiments made by the Board at Watertown and Marblehead, here described, illustrate the ease and completeness of the removal of iron when present in the form and condition just stated.

Experimental Filtration at Watertown.

At Watertown, previous to the introduction of the metropolitan supply, a portion of the water pumped contained a considerable quantity of iron. The main supply of the town was from a filter gallery and a large circular well near the Charles River, but, in addition to this, tubular wells were sunk about 1,000 feet down the river from the main filter gallery; these wells being about 4 inches in diameter and from 25 to 30 feet deep. They were in a swampy locality, penetrating into gravel, but with a deep layer of heavy soil over the gravel, and the water when pumped from them had a very strong odor of carburetted hydrogen, contained no dissolved oxygen and was highly colored by the iron and organic matter present. In order to remove the odor from the water it was aerated in the following manner: as pumped from the wells it passed into an upright pipe about 5 feet high, from which it overflowed into a wooden basin about 4 feet square, with a perforated bottom; from this basin it fell into a similar basin slightly larger than the first, and from there flowed into the large filter gallery or well, previously mentioned, and was thus mixed with the main supply. With the large volume pumped, the water passed rapidly through this aerating device, foaming violently, and was freed to a considerable extent from the carburetted hydrogen and carbonic acid present in it as it came from the ground, and a considerable quantity of free oxygen was introduced.

During May, 1897, a small filter, consisting of an iron tank 20 inches in diameter and containing 20 inches in depth of sand of an effective size of 0.24 millimeter, was put into operation by the Board to receive a portion of the water that came from the lower wooden basin of the aerating plant. The filter was first started at the rate of 40,000,000 gallons per acre daily, but was operated during only a portion of the day; that is, when the pump was running, or generally for five or six hours only. During July the rate was 20,000,000 gallons per acre daily, and during August and the first part of September, 10,000,000 gallons per acre daily. Frequent samples of the water before and after filtration were taken during these months and the results in parts per 100,000 were as follows: —

Applied Water.

MONTH.	Color.	Iron.	Hardness.
June,	0.97	0.2000	3.8
July,	1.11	1.3000	3.7
August,	0.91	0.2920	3.7

Filtered Water.

MONTH.	Color.	Iron.	Hardness.
June,	0.33	0.0390	3.9
July,	0.29	0.0274	3.9
August,	0.26	0.0240	3.6
September,	0.29	0.0268	3.6

During all this period the filter was operated without any attention except the removal of iron from its surface during July. It will be seen from the figures given that the filter was nearly as effective when operating at the rate of 40,000,000 gallons per acre daily for six hours in a day as when operating at the rate of 10,000,000 gallons per acre daily for the same period. The hardness of the water was not changed by filtration.

Before the conclusion of this experiment by the Board the soil was removed by the Watertown Water Company from a piece of land near the large circular well previously mentioned, and the water from the tubular wells after aeration was pumped to this excavation and filtered into the large well with satisfactory results. Soon after, however, the metropolitan water supply was introduced and the local supply abandoned.

Experimental Filtration at Marblehead.

Marblehead has a ground-water supply, drawn from two large, circular wells. Considerable iron is present in the water as pumped to the town, and analyses and investigations have shown that this iron comes with the supply drawn from Well No. 2, so called. During the last week of January, 1898, a small sand filter was put in operation in the Marblehead pumping station. The filter consisted of a galvanized iron tank, 20 inches in diameter, and containing 14 inches in depth of coarse sand having an effective size of 0.40 millimeter. Above this filter were placed two wooden boxes with perforated bottoms, similar to those at Watertown, previously described. The upper box was 5½ feet above the level of the sand in the filter, and the lower box 2½ feet above this level. During February the water from Well No. 2 ran directly into the upper box, from which it dropped to the lower, and from this passed to the filter-bed. The rate of filtration was placed at 15,000,000 gallons per acre daily at the beginning of each month, and at the end of each month the rate had been reduced to 7,000,000 gallons per acre daily; caused by the clogging of the surface of the filter with iron oxide, no change having been made in the position of the gate at the outlet of the filter. The following table gives the average amount of color and iron and the average hardness of the unfiltered and filtered water during the period of experiment: —

Applied Water.

[Parts per 100,000.]

Month.	Color.	Iron.	Hardness.
February,	1.10	.2400	8.0
March,	-	.2950	8.1
April,	-	.2700	7.8

Effluent.

Month.	Color.	Iron.	Hardness.
February,	.03	.0025	8.0
March,	.02	.0049	8.1
April,	.02	.0040	7.8

At the end of the first month's operation at this rate the surface of the filter was scraped and the sand clogged with the iron oxide was removed to the depth of ¹ inch. Iron had penetrated to some slight extent below this depth, owing, without doubt, to the coarseness of the sand in the filter. The rate was again placed at the beginning of March at 15,000,000 gallons per acre daily, and the filter continued in operation during the month. During this month the applied water, instead of being aerated by passing through both boxes above the filter, was run directly into the lower box, and from this dropped to the filter's surface. At the end of March the filter was again scraped and started at the same rate as before, but during the third month of operation — April — the water was applied directly to the filter, without any aeration. Operating the filter in this way, that is, applying the water directly to its surface without aeration, the iron, instead of all remaining upon or near the surface of the sand, penetrated to some extent to a depth of 10 inches.

Difference of Results at Watertown and Marblehead due to Organic Matter.

There was more organic matter in the Watertown water than in the Marblehead water (see table, page 538), and the water as drawn from the ground at Watertown was much more highly colored than the water when first pumped from the well at Marblehead, and it will be noticed by a comparison of the results that the iron and color were more completely removed by filtration at Marblehead than at Watertown; the effect of organic matter in holding iron in solution being indicated by the Watertown results. When air was drawn through the Watertown water, the iron would not oxidize and precipitate in less than two or three days' aeration; while with the Marblehead water, the iron began to precipitate in a few hours after being taken from the well, even without any greater aeration than exposure to the air. In both cases, however, better results were obtained in subsequent filtration by aerating in the manner described as used with the experimental filters — which required but a few seconds — than by drawing air through the water for a much longer period. The reason for this is not clear, but the foaming of the water and the friction when passing through the aerator and the impact of the water upon the sand must have caused the difference.

Experimental Filtration at Provincetown.

Provincetown is situated at the extreme end of Cape Cod, where the land has been formed of sand drifted by ocean currents or blown by the wind. Buried under the sand at various depths are found layers of soil and decaying organic matter that were evidently at one time the surface of the ground, but have been covered by the shifting sands; and this phenomenon and the covering of surface soil and even fairly large trees can still be observed going on at the present time.

A public water supply was introduced in 1893, after tests in 1892, and was taken from a system of six tubular wells, 5 inches in diameter and about 28 feet deep. This water from the beginning of its use contained considerable iron, and this amount increased each year that the water supply of the town was drawn from these wells, as shown by the following table: —

Average Amount of Iron in Provincetown Water (by Years).

[Parts per 100,000.]

Source.	Year.	Iron.	Source.	Year.	Iron.
Wells,	1893	.1840	Wells,	1896	.5162
Wells,	1894	.2212	Wells,	1897	.6083
Wells,	1895	.3764	Reservoir,	1898	.2289

Referring to the table on page 538 it will be seen that this is one of the few supplies containing much organic matter as shown by the determinations of albuminoid ammonia and oxygen consumed. The water also contains a large amount of organic coloring matter.

Beginning in 1896 and covering a period of several years, many experiments were made on methods of removing the iron from this water. Experiments similar to those just described as made at Watertown and Marblehead were first undertaken. The water was aerated by several methods and for long periods and filtered through a sand filter 4½ feet in depth. The experiments were continued long enough to show that this method of purification could not be applied successfully to this water. At the rate of 1,000,000 gallons per acre daily only about 30 per cent. of the iron was removed, and at the rate of 500,000 gallons per acre daily the percentage was not changed. Reducing the rate to 100,000 gallons per acre daily about 80 per cent. of the iron was removed by the filter. The iron in the unfiltered water during these experiments averaged .4760 part per 100,000; and with the best purification obtained at the lowest rate, the average amount still remaining in the effluent of the filter was .0990 part per 100,000, this being much more than enough to render the water turbid and to eventually precipitate.

Experiments with and examinations of the water seemed to show that the ferric oxide after the change from the ferrous condition was held in solution by the organic matter, and hence simple aeration and sand filtration were not successful in removing the iron, as was the case in the Watertown and Marblehead experiments.

Filtration through Coke.

Coke Filter No. 1.

The Provincetown water was next applied at the rate of 1,000,000 gallons per acre daily to a small filter containing 4 feet in depth of coke breeze. The filter remained in operation three months, and the result was that a clear, colorless water was obtained, containing only .0165 part of iron per 100,000 and with but a slight increase of hardness. In regard to the action of the coke by which a large amount of iron was removed from the water, the following theory was evolved, and subsequent experience with this water and other lines of filtration at the experiment station have seemed to show its correctness; namely, that the carbonic acid and oxygen present in the water dissolved the metallic iron of the coke, taking a small amount into solution as bicarbonate, and this was further oxidized in the filter, and its precipitation as hydrate removed from the water the organic matter present, and this allowed the iron primarily present in the water to precipitate also. When this filter ceased to be operated an examination of it showed that nearly all the iron removed from the water was held in the upper 6 inches of coke.

Coke Filter No. 2.

In December, 1896, a coke filter was put into operation at Provincetown. This filter was $\frac{1}{800}$ of an acre in area and contained $3\frac{1}{2}$ feet in depth of coke breeze. It was so located in Provincetown that it received the water that had passed through the main pipe and storage tank of the system. It was operated at the rate of 500,000 gallons per acre daily and continued in operation for eight months. The coke for this filter was obtained from a different gas plant than the coke used in the small filter at Lawrence, and subsequent analysis showed that it contained a somewhat greater percentage of lime and a smaller percentage of iron than the Lawrence coke. The following table shows the work of the filter during this period: —

Water applied to the Filter.

[Parts per 100,000.]

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.
Iron,	0.5300	0.4100	0.5500	0.4300	0.5000	0.6000	0.7000	0.8800
Hardness,	1.8000	1.8000	1.8000	1.5000	1.7000	2.3000	1.7000	3.1000

Effluent from the Filter.

[Parts per 100,000.]

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.
Iron, . . .	0.0610	0.0960	0.0650	0.0560	0.0490	0.0560	0.1270	0.4600
Hardness, . .	6.0000	5.8000	6.1000	7.0560	6.5000	9.0000	6.2000	5.0000

The filter, as will be seen, was not as successful as the small filter at the experiment station, but for several months removed a large percentage of the iron from the water. In July, however, poorer work was done and in August only 50 per cent. of the iron was removed. In explanation it can be said that three factors entered in to produce this result: (1) the iron in the applied water increased very greatly during the last months of operation of the filter; (2) the volume of dissolved gases present in the water decreased, so that there was not enough carbonic acid to successfully attack the iron in the coke and cause the actions to take place which have been described; and (3) exhaustion or oxidation of the metallic iron in the coke.

Early in March, 1897, a second filter was put into operation, and was located in the pumping station at Provincetown. This filter was 20 inches in diameter and contained 4½ feet in depth of coke breeze. As it was placed within the pumping station, it received the water just as it was pumped from the wells and before the escape of any of the dissolved gases, and was operated at the rate of 1,000,000 gallons per acre daily. The filter was kept in operation for six months, with the following results, the water applied to it containing practically the same amount of iron as given in the previous table: —

Effluent of Coke Filter No. 2.

[Parts per 100,000.]

	March.	April.	May.	June.	July.	Aug.
Iron, ...	0.0380	0.0180	0.0240	0.0560	0.0550	0.4200
Hardness, ...	8.5000	9.0000	9.2000	9.0000	9.9000	7.5000

The filter was successful for five months, when it ceased to remove the iron from the applied water. Both of the coke filters, moreover, increased the hardness of the water to an objectionable extent.

With both of these coke filters the lime present in the coke may have exerted an influence in removing the iron, but it was by no means exhausted when the filters failed to work successfully.

At this time, experiments were made at Provincetown upon passing the water rapidly through a filter or tower of coarse coke for aeration and partial iron removal, as is quite common abroad, and then much more slowly through a filter of sand. A small percentage of the iron was removed from the water by the coke filter, but it passed through the sand filter without further change at even as low a rate as 250,000 gallons per acre daily.

Filtration through Iron followed by Filtration through Sand.

As it was believed that the metallic iron in the coke was the cause of the results obtained upon the removal of iron from the water when passed through coke filters, experiments with iron were made and it was found that, by shaking the water with iron filings, precipitation of the iron would occur; that is, iron was taken into solution, which acted as a coagulant and precipitant. Following this, two filters were put into operation in the pumping station at Provincetown: a preliminary filter of iron filings and a secondary sand filter. These filters were 20 inches in diameter, the first one containing 20 inches in depth of iron filings and turnings, and the second containing 20 inches in depth of sand. They were put into operation in November, 1897, and continued until the end of March, 1898, a period of five months, at a rate of between 5,000,000 and 10,000,000 gallons per acre daily. During this period they were successful in removing a large percentage of the iron without appreciably increasing the hardness of the water, as shown by the following table, showing the results of four months of operation: —

[Parts per 100,000.]

	Applied Water.	Effluent.		Applied Water.	Effluent.
Iron, ...	0.7500	0.0526	Hardness, ...	2.0000	2.1000

The experiment was entirely successful except that the iron filings rusted together, so that at the end of the period water passed through them with difficulty; and, as this rusting progressed, the water passed through fewer channels in the iron filter and hence the period of contact of water and iron was shortened. From the results of this experiment it was considered probable that if a water was brought into contact with metallic iron in a revolving cylinder, similar to the so-called "Anderson process of water purification," the gases in the water would attack this metallic iron, as in the filter of iron filings, and enough be taken into solution to cause a precipitation and removal by sand filtration.

At this time, however, the water supply of the town was changed from the tubular wells to a large open well or reservoir excavated near the wells, and beginning April 1, 1898, water was pumped from this new reservoir in connection with the driven-well supply, and after April 23 the entire supply of the town was drawn from this new reservoir. This changed the character of the water considerably. The water obtained from the new supply contained for several months much less iron than that from the driven wells, but the amount present gradually increased. Owing to exposure to the air, however, in the open reservoir, it lost so much of its carbonic acid gas that the removal of organic matter and iron, by the precipitation of iron taken into solution during the necessarily limited period of contact of water and iron in the cylinder, and subsequent sand filtration could not be successfully carried out. The experiments and investigations were discontinued for a time with the introduction of the reservoir water; but as the iron in it after a few months began to increase in quantity regularly, just as the iron in the driven-well water had increased after its introduction, experiments were finally again begun to find a method of so treating this new supply that the iron could be removed from it efficiently and economically.

Contact with Iron Strips, followed by Sand Filtration.

As the iron filings and turnings in the filter previously described had rusted together, and become useless on this account, and also had prevented the free flow of water and adequate contact with the iron, an apparatus was constructed, containing strips of iron, through which the water could be passed comparatively slowly, but faster than ordinary sand filtration. By this means rusting together could be prevented and the time of contact prolonged so that sufficient action could take place for enough iron to be taken from the strips to act as a precipitant. This new method was entirely successful and many satisfactory results were obtained in laboratory experiments; and the water, when treated in this contact filter and subsequently filtered through sand, was rendered practically colorless and free from iron. The following experiment is illustrative of many that were made, covering a considerable period: —

Provincetown water, having a color of 1.20, iron contents .6800 part per 100,000 parts and a hardness of 2.2 parts, was passed through the iron contact filter, being in contact with the iron for an average period of one-half hour, and then through a shallow sand filter at a rate of 10,000,000 gallons per acre daily. The effluent of the filter had a color of .04, contained .0140 part of iron and had a hardness of 2.1; 98 per cent. of the iron being removed and the hardness slightly decreased.

Removal of Iron by Potassium Permanganate.

It was determined to try the use of permanganate as an oxidizing agent for changing the Provincetown water to a condition that would allow the iron to be removed by filtration, as this body could not increase the hardness of the water and the products of its decomposition could be removed by filtration. Its use in water purification for the oxidation of organic matter has often been mentioned. Prof. W. R. Nichols, for instance, in his book upon "Water Supply, Chemical and Sanitary," published in 1883, mentions the use of potassium permanganate as an agent for the oxidation of the organic matter present in a water, stating, what is of course true, that the permanganate in destroying the organic matter is itself decomposed, and an oxide or hydrate of manganese separates as a finely divided solid that can be removed by filtration. The use of permanganate as an oxidizing agent in the removal of iron from waters we believe, however, to be new.

Theoretically, 1,000 pounds of $KMnO_4$ per 1,000,000 gallons of water should oxidize the iron, in a water containing 12.80 parts per 100,000 of iron, as FeO to Fe_2O_3. As the Provincetown water rarely contains over 1 part, and the average amount in the water from this open reservoir during 1898 was .23 of a part, it should not theoretically take more than 18 pounds of permanganate per 1,000,000 gallons of water to oxidize the iron present. Considerable permanganate is, however, when this water is treated with it, consumed in oxidizing the organic matter present, and this is perhaps its principal function. Hence, our experiments indicated that it was necessary to add at different times from 50 to 75 pounds per 1,000,000 gallons of

Provincetown water. Many experiments were made upon the removal of iron in this way, and with uniform success. It was necessary, after the treatment of the water with permanganate, that a period of time for oxidation should elapse before the water could be filtered.

The following experiment is illustrative of many that were made at the laboratory with this process. The Provincetown water used contained .5360 part per 100,000 of iron, and the amount of permanganate used equalled 75 pounds per 1,000,000 gallons of water.

Experiment Number.	Time of Aeration (Hours).	Iron present after Filtration (Parts per 100,000).	Per Cent. of Iron Removed.
1,	3	.0270	95
2,	4	.0090	98
3,	5	.0290	95
4,	6	.0325	95
5,	7	.0100	98
6,	7½	.0105	98

With three hours' aeration of the water — that is, simple exposure to the air — a sufficient percentage of iron was removed, when the water was subsequently filtered, to render it clear, colorless and with not enough iron present to precipitate. This method of purifying the water also decreased in many instances the hardness and never caused an increase. The cost of the method might be prohibitive upon a large scale, but in the case of Provincetown, not using during any season of the year more than 200,000 gallons of water per day and during a large portion of the year much less, the cost of the chemical would not be large.

Experiments on the Removal of Iron by the Use of Lime.

It was known before any of these investigations were begun that, if a sufficient amount of lime were added to the Provincetown water and the water subsequently aerated, a precipitation of the iron would generally ensue, but with the well water the hardness was increased four or five times, according to the iron and organic matter present to be removed, and the amount of lime necessary to secure their removal. The water could, of course, be softened subsequently by the use of sodium carbonate. Many experiments along this line were made and it was found that after the water from the tubular wells, the first supply at Provincetown, had stood for some time after pumping, an amount of lime that would increase the hardness to not more than 7 or 8 parts would remove the iron. This amount of lime, however, would not remove the iron when applied to the water just as it came from the wells. With the water from the open reservoir, the lime treatment was more successful, because of the smaller amount of iron present in this water than in the driven-well water and because of the aeration received in the well before pumping; but in the case of this water, also, the hardness has to be increased considerably.

In the experiments made by the Board at Reading, Mass., in 1894, it was found that the Reading water containing iron could generally be freed from it if it was first passed through a filter of marble chips ($CaCO_3$), followed by sand filtration. By this method, however, the hardness of the water was increased very greatly by the lime taken into solution above that necessary to absorb the carbonic acid and precipitate the iron, or remaining finely divided in suspension in the water. In later experiments, however, the feasibility of removing the iron from the Provincetown and Reading supplies by treating the water as in the well-known softening process — that is, by adding only enough milk of lime ($Ca(OH)_2$) to combine with the carbonic acid present, forming $CaCO_3$, which would precipitate and carry down the iron with it and not increase the hardness by leaving lime in solution — has been investigated.

The following experiment is illustrative of the removal of iron by this means and is a sample of a number made: Provincetown water, having a color of 1.68 parts per 100,000, containing .5280 part iron and having a hardness of 3.1 parts, was treated as follows: portion No. 1, with enough lime water to combine with 2 parts CO_2 per 100,000 parts of water and allowed to stand three hours and then filtered through sand; portion No. 2, with enough lime to combine with 3 parts CO_2; portion No. 3, with enough lime to combine with 4 parts CO_2; and portion No. 4, with enough lime to combine with 5 parts CO_2. The results were as follows: —

[Parts per 100,000.]

Portion Number.	Iron.	Hardness.	Color.	Portion Number.	Iron.	Hardness.	Color.
1, ...	.0120	4.2	.05	3, ...	.0230	4.6	.07
2, ...	.0210	4.9	.07	4, ...	.0110	4.0	.07

Experiments with Reading Water.

Reading water has already been referred to. The supply is obtained from a filter-gallery near the bank of the Ipswich River. The gallery is constructed beneath a meadow which is subject to being overflowed to a depth of 5 or 6 feet at times of high water in the river. The gallery is located 22 feet beneath the level of the river. The iron is removed from the water at the present time by means of a mechanical filter, being first treated with milk of lime, aeration and aluminum sulphate, thus increasing the hardness to an objectionable degree. Investigations by the Board a number of years ago showed that the iron was present in part at least as ferrous sulphate. The amount of iron present in the water and its degree of hardnesss before and after treatment by the mechanical filter during 1898 and 1899 are shown by the following table: —

[Parts per 100,000.]

1898.	Iron.	Hardness.	1899.	Iron.	Hardness.
Water from filter gallery, .	.2250	3.0	Water from filter gallery, .	.1721	2.4
Water after filtration, . .	.0132	10.0	Water after filtration, . .	.0064	8.4

Reference to the table on page 538 will show that this water contains more coloring matter and more organic matter than any of the other waters with the exception of the Provincetown and Watertown supplies, and that free oxygen is absent from it. Experiments upon the filtration of this water made at different times showed conclusively that the removal of the iron by aeration and sand filtration could not be successful with a reasonable degree of aeration or rate of filtration. Experiments made during the past year, however, have indicated that the iron could be successfully removed by two methods already discussed in the experiments with Provincetown water; namely, treatment with iron followed by sand filtration, or treatment, after a preliminary period of storage permitting aeration, with enough lime to absorb the carbonic acid, followed by a period of precipitation and subsequent sand filtration. The first process tends to decrease the hardness, while the second increases it slightly.

The following experiments are only two of many made and are illustrative of the results of these methods when treating Reading water:

the water, containing as an average .2760 part per 100,000 of iron, .83 color and 3.1 parts of hardness, was treated first in the iron contact filter, followed by rapid sand filtration. The time of contact with the iron, as the water passed through the iron filter, was twelve minutes and the water after filtration through sand contained .0055 part of iron, — a removal of 98 per cent., — an average color of .06 and an average hardness of 3 parts per 100,000.

Another portion of the water, containing an average of .2380 part of iron per 100,000, with an average color of .56 and an average degree of hardness of 3.2, was treated with enough milk of lime ($Ca(OH)_2$) to combine with 2 parts of CO_2 per 100,000 and then allowed to stand exposed to the air for two hours and afterwards filtered at a high rate, giving the following average result: iron .0090 part per 100,000, — a removal of 96 per cent., — color .08, and hardness 4.7 parts per 100,000.

These experiments upon the treatment of Provincetown water with potassium permanganate and Reading water with lime have only been carried on upon a laboratory scale, and for this reason do not definitely prove that these waters could be purified on a practical basis by these methods, but simply indicate that they might be so purified. All of our experiments and their results are of value, however, as showing that different iron-bearing waters cannot be freed from this iron in the same manner, but that each class may require a different treatment for its satisfactory purification.

THE

PURIFICATION OF THE SEWAGE

OF

CITIES AND TOWNS IN MASSACHUSETTS.

THE

PURIFICATION OF THE SEWAGE

OF

CITIES AND TOWNS IN MASSACHUSETTS.

THE

Purification of the Sewage of Cities and Towns in Massachusetts.

There are at the present time seventeen cities and towns in Massachusetts, having an aggregate population by the 1895 census of 137,589, in which purification of the sewage is effected by filtration through gravel or sand, and the sewage of many large institutions is also disposed of by this method.

In the annual report for the year 1898 a description was given of many of the sewage purification works in Massachusetts, and the results of frequent analyses of sewage and effluent from the towns in which the sewage is purified by intermittent filtration were presented. During the year 1899 the examinations of sewage and effluent from these towns have been continued and examinations of sewage and effluent from works which have been more recently constructed have been begun. The results of these examinations are presented in the tables which follow.

The results of analyses of samples of water from underdrains beneath the sewers at Brockton, Framingham, Medford and Newton are also given.

Sewage Disposal at Brockton.

Chemical Examination of Sewage from Brockton.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
		Total Residue.			Loss on Ignition.				Albuminoid.							
		Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.
	1889.															
25913	Jan. 11	37.00	30.40	6.60	17.60	11.40	6.20	2.7500	.5800	.3300	.2500	5.55	.0020	.0220	6.80	5.25
26181	Feb. 8	36.60	29.40	7.20	18.40	12.20	6.20	3.0500	.8200	.3800	.4400	5.33	.0000	.0000	5.64	4.10
26414	Mar. 8	27.60	23.50	4.10	11.60	8.20	3.40	1.6000	.3100	.2300	.0800	3.95	.1260	.0260	4.08	3.17
26736	Apr. 12	36.00	29.40	6.60	17.80	12.20	5.60	2.7500	.5300	.3500	.1800	5.15	.0000	.0000	5.92	4.16
27057	May 10	50.60	34.20	16.40	20.00	13.20	6.80	2.8400	.5400	.4000	.1400	6.05	.0000	.0000	7.20	3.83
27428	June 14	68.20	60.00	8.20	28.60	21.00	7.60	5.3600	.8400	.5000	.3400	16.20	.0000	.0000	11.00	8.08
27728	July 12	54.80	45.00	9.80	23.00	13.20	9.80	3.3300	.5300	.3800	.1500	11.85	.0000	.0000	16.10	4.44
28101	Aug. 9	53.60	42.80	10.80	21.00	12.50	8.50	3.7000	.5500	.3200	.2300	13.05	.0000	.0000	7.20	5.16
28586	Sept. 13	63.20	47.40	15.80	32.40	18.00	14.40	4.1600	.8000	.4100	.3900	11.30	.0000	.0000	8.80	6.20
28951	Oct. 11	48.00	35.20	12.80	25.20	14.00	11.20	2.8800	.7400	.4600	.2800	6.03	.0000	.0000	7.40	5.20
29309	Nov. 9	39.60	31.20	8.40	18.00	10.40	7.60	3.5400	.5600	.5000	.0600	6.40	.0010	.0000	4.70	3.16
29651	Dec. 13	64.00	49.60	14.40	32.40	20.40	12.00	6.1600	.9600	.7000	.2600	8.70	-	.0000	12.00	8.20
Av...	....	48.27	38.18	10.09	22.17	13.89	8.28	3.5100	.6466	.4133	.2333	8.30	.0117	.0040	8.07	5.04

The samples were collected as the sewage flowed out upon the filter-beds, and were composed of several equal portions collected at intervals during the time that the pumps were in operation.

Chemical Examination of the Sewage pumped from the Bottom of the Sewage Reservoir at Brockton.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation. Total Residue. Total.	Residue on Evaporation. Total Residue. Dissolved.	Residue on Evaporation. Total Residue. Suspended.	Residue on Evaporation. Loss on Ignition. Total.	Residue on Evaporation. Loss on Ignition. Dissolved.	Residue on Evaporation. Loss on Ignition. Suspended.
	1899.						
25912	Jan. 11	234.00	37.00	197.00	183.60	12.60	171.00
26180	Feb. 8	181.20	38.20	143.00	143.60	18.40	125.20
26413	Mar. 8	200.00	30.00	170.00	144.00	12.80	131.20
26735	Apr. 12	181.20	40.00	141.20	100.40	19.00	81.40
27056	May 10	394.80	41.60	353.20	188.80	17.80	171.00
27427	June 14	115.60	59.70	56.30	69.40	19.70	49.70
27727	July 12	244.80	43.80	201.00	140.80	15.80	125.00
28100	Aug. 9	360.80	58.80	302.00	258.00	22.20	235.80
28585	Sept. 13	396.40	58.80	337.60	305.20	26.80	278.40
28950	Oct. 11	299.60	52.50	247.10	222.00	26.30	195.70
29306	Nov. 9	266.80	42.60	224.20	206.80	19.60	187.20
29650	Dec. 13	280.80	50.60	230.20	229.20	21.00	208.20
Av....	....	263.20	46.08	217.12	182.65	19.28	163.37

Chemical Examination of the Sewage pumped from the Bottom of the Sewage Reservoir at Brockton — Concluded.

[Parts per 100,000.]

Number.	Ammonia. Free.	Ammonia. Albuminoid. Total	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed. Unfiltered.	Oxygen Consumed. Filtered.
25912	3.2000	3.9000	0.4750	3.4250	7.59	.0000	.0000	29.12	3.68
26180	3.6850	4.2000	0.5750	3.6250	6.30	.0000	.0000	28.40	4.56
26413	1.5200	3.0000	0.3200	2.6800	3.63	.0000	.0000	26.40	2.46
26735	4.2000	4.1000	0.5500	3.5500	6.25	.0000	.0000	30.00	4.72
27056	4.4000	4.7500	0.4600	4.2900	6.60	.0000	.0000	45.76	6.00
27427	7.5600	1.3200	0.5600	0.7600	15.90	.0000	.0000	19.10	7.60
27727	3.5200	3.6500	0.3500	3.3000	10.35	.0000	.0000	36.60	5.92
28100	6.5000	4.2000	0.6000	3.6000	12.55	.0000	.0000	41.20	7.20
28585	5.8600	4.4600	0.6800	3.7800	11.45	.0000	.0000	64.80	6.40
28950	4.8000	5.3000	0.5400	4.7600	7.70	.0000	.0000	46.20	7.20
29306	5.2500	4.2500	0.5000	3.7500	6.26	-	-	39.00	5.10
29650	6.6500	4.5000	0.6400	3.8600	8.85	-	.0000	33.00	7.80
Av...	4.7204	3.9692	0.5209	3.4483	8.62	.0000	.0000	36.63	5.72

The samples were collected as the sewage flowed out upon the filter-beds and represent the heavy sewage which settled to the bottom of the reservoir, mixed with a small amount of the supernatant sewage. Each sample was composed of several equal portions collected at intervals during the time that the heavy sewage was flowing upon the beds.

Chemical Examination of Effluent from an Underdrain at the Brockton Sewage Disposal Works.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25914	Jan. 11	None.	None.	.01	21.50	.1424	.0096	4.15	1.0800	.0018	.13	5.7	.0020
26182	Feb. 8	V. slight.	V. slight.	.06	19.90	.3200	.0185	3.95	1.0000	.0080	.25	4.3	.0080
26415	Mar. 8	V. slight.	V. slight.	.03	19.30	.4400	.0158	3.86	0.9200	.0100	.23	4.2	.0110
26737	Apr. 12	None.	V. slight.	.01	22.70	.1760	.0090	4.45	1.3600	.0082	.14	5.4	.0010
27058	May 10	None.	None.	.00	29.80	.1440	.0076	5.48	2.0800	.0026	.14	8.6	.0020
27429	June 14	None.	None.	.02	34.70	.1600	.0134	6.92	1.5800	.0100	.18	6.0	.0020
27729	July 12	None.	None.	.00	46.00	.0296	.0030	9.15	0.6800	.0018	.15	9.3	.0020
28102	Aug. 9	None.	None.	.08	54.80	.0432	.0084	12.70	2.7200	.0009	.20	10.2	.0020
28587	Sept. 13	None.	None.	.02	48.90	.0208	.0108	11.21	3.1500	.0000	.18	9.6	.0130
28952	Oct. 11	None.	None.	.01	38.30	.0144	.0098	8.24	1.6250	.0003	.13	7.1	.0010
29310	Nov. 9	None.	V. slight.	.02	34.10	.0104	.0068	7.85	1.6000	.0001	.13	6.3	.0020
29652	Dec. 13	None.	V. slight.	.03	34.50	.0848	.0128	6.99	1.3500	.0080	.16	6.0	.0020
Av...	....	....	....	.02	33.71	.1321	.0105	7.08	1.6371	.0039	.16	6.9	.0040

The samples were collected from the underdrain on Pearl Street, which receives, in addition to the effluent from several of the filter-beds, ground water from the territory in the vicinity of the filtration area.

Chemical Examination of Water from Underdrains beneath the Sewers at Brockton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
27730	July 12	Decided, milky.	Cons., iron.	.09	12.70	.0710	.0110	1.85	.2000	.0005	.16	5.0	.1850
29811	Nov. 9	Decided.	Heavy, iron.	.12	14.10	.0752	.0024	2.02	.0750	.0005	.19	4.7	.2400

Averages by Years.

-	1897	-	-	.42	14.75	.3400	.0194	2.03	.1625	.0087	.28	5.5	.0950
-	1898	-	-	.18	13.20	.3460	.0163	2.53	.3588	.0063	.65	6.6	.0780
-	1899	-	-	.10	13.40	.0731	.0067	1.93	.1375	.0005	.17	4.8	.2125

NOTE to analyses of 1899: Odor of the first sample, faintly musty and oily, and of the second, faintly unpleasant. —— The samples were collected from an underdrain at its outlet into Salisbury Plain River at Factory Village.

Sewage Disposal at Framingham.

Chemical Examination of Sewage from Framingham.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.					
		Total Residue.			Loss on Ignition.		
		Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.
	1899.						
25915	Jan. 11	34.00	29.60	4.40	15.00	11.60	3.40
26191	Feb. 9	35.80	28.50	7.30	16.20	9.10	7.10
26431	Mar. 8	28.40	24.50	3.90	11.40	7.70	3.70
26744	Apr. 12	31.60	27.80	3.80	10.20	6.50	3.70
27070	May 10	81.40	67.40	14.00	28.40	17.50	10.90
27442	June 14	473.00	37.50	435.50	387.00	13.00	374.00
27750	July 12	46.60	36.70	9.90	16.60	8.80	7.80
28111	Aug. 9	48.20	36.60	11.60	16.80	9.30	7.50
28592	Sept. 13	41.40	34.50	6.90	17.20	11.80	5.40
28994	Oct. 11	334.00	45.00	289.00	256.00	20.50	235.50
29268	Nov. 7	37.40	32.80	4.60	15.40	10.80	4.60
29666	Dec. 14	45.40	36.60	8.80	21.40	14.10	7.30
Av.......	....	103.10	36.46	66.64	67.63	11.72	55.91

Chemical Examination of Sewage from Framingham — Concluded.

[Parts per 100,000.]

Number.	Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
	Free.	Albuminoid.				Nitrates.	Nitrites.	Unfiltered.	Filtered.
		Total.	Dissolved.	Suspended.					
25915	1.4800	0.4800	.2800	0.2000	4.78	.0370	.0700	4.00	2.88
26191	2.3500	0.5300	.3800	0.1500	5.48	.0440	.0380	3.36	1.99
26431	1.6500	0.3900	.2300	0.1600	3.80	.0570	.0400	2.30	1.65
26744	1.2500	0.3900	.2400	0.1500	5.85	.0070	.1600	2.56	1.86
27070	3.0300	0.6500	.4200	0.2300	6.50	.0060	.0000	9.68	8.40
27442	3.5600	3.4800	.3800	3.1000	7.71	.0020	.0000	28.00	3.08
27750	2.9100	0.5000	.3700	0.1300	8.41	.0000	.0000	4.10	2.64
28111	3.2900	0.4200	.3600	0.0600	9.38	.0050	.0000	3.50	2.60
28592	2.4200	0.5700	.3000	0.2700	8.05	.0010	.0000	3.50	2.32
28994	3.8500	3.6500	.8200	2.8300	6.15	.0000	.0000	48.00	4.00
29268	3.0500	0.4900	.3500	0.1400	5.85	.0030	.0002	3.70	2.34
29666	2.8500	0.6900	.4600	0.2300	5.05	.0060	.0000	4.75	3.85
Av...	2.6408	1.0200	.3825	0.6375	6.42	.0140	.0257	9.79	3.13

The samples were collected as the sewage flowed out upon the filter-beds.

Chemical Examination of Effluent from the East Underdrain of the Framingham Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25916	Jan. 11	Slight.	V. slight.	.11	24.00	.3300	.0260	4.95	0.7500	.0017	.30	7.0	.0070
26192	Feb. 9	V. slight.	V. slight.	.06	21.50	.8000	.0190	4.93	0.3350	.0020	.23	5.3	.0070
26432	Mar. 8	Decided.	Slight.	.06	22.30	.5200	.0280	4.41	0.2050	.0052	.28	4.6	.0550
26745	Apr. 12	Slight.	Slight.	.28	22.50	.6400	.0290	4.68	0.5400	.0036	.31	6.0	.0100
27071	May 10	V. slight.	V. slight.	.03	25.50	.3280	.0106	4.97	0.8600	.0024	.10	5.8	.0100
27443	June 14	V. slight.	Slight.	.08	34.50	.3080	.0120	5.85	1.6600	.0030	.19	7.0	.0050
27751	July 12	V. slight.	V slight.	.04	44.00	.1680	.0125	6.72	2.9000	.0060	.26	8.0	.0030
28112	Aug. 9	None.	V. slight.	.05	43.50	.0588	.0124	7.55	3.2000	.0060	.15	9.1	.0080
28593	Sept. 13	None.	Slight.	.01	44.90	.1072	.0092	8.59	2.6500	.0100	.19	8.1	.0040
28995	Oct. 11	Slight.	Heavy.	.15	29.00	.2160	.0230	7.45	0.5100	.0024	.34	5.3	.1450
29269	Nov. 7	V. slight.	Cons.	.11	38.90	.1120	.0125	7.88	1.2500	.0100	.28	7.0	.0320
29667	Dec. 14	None.	None.	.03	36.50	.1400	.0120	7.02	1.9500	.0024	.12	7.6	.0020
Av...	....	....	....	.08	32.26	.3107	.0172	6.25	1.4008	.0045	.23	6.7	.0240

The samples were collected from the underdrain at its outlet.

Chemical Examination of Effluent from the West Underdrain of the Framingham Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25917	Jan. 11	None.	V. slight.	.02	23.00	.1392	.0064	5.01	0.8300	.0018	.12	5.4	.0090
26193	Feb. 9	None.	V. slight.	.02	22.60	.1400	.0085	4.35	0.9000	.0013	.18	5.4	.0080
26433	Mar. 8	Slight.	Slight.	.08	13.00	.1200	.0148	2.53	0.3250	.0022	.28	3.0	.0050
26746	Apr 12	None.	V. slight.	.10	15.00	.0796	.0128	3.15	0.2900	.0004	.27	3.3	.0080
27074	May 10	V. slight.	Slight.	.09	26.50	.1828	.0132	5.55	0.8200	.0014	.17	6.9	.0200
27444	June 14	V. slight.	V. slight.	.02	31.30	.2840	.0220	5.98	1.4400	.0044	.21	7.9	.0040
27752	July 12	None.	V. slight.	.00	40.80	.1700	.0095	6.57	2.5000	.0025	.19	8.7	.0020
28113	Aug. 9	None.	V. slight.	.04	35.80	.1360	.0080	6.75	1.7600	.0048	.22	9.1	.0050
28594	Sept. 13	V. slight.	V. slight.	.04	38.90	.1072	.0152	8.70	1.8200	.0160	.15	8.1	.0030
28996	Oct. 11	None.	V. slight.	.00	38.00	.1360	.0125	8.50	1.7000	.0040	.19	6.3	.0040
29270	Nov. 7	V. slight.	V. slight.	.16	25.10	.0540	.0140	4.59	0.8750	.0080	.29	5.9	.0280
29668	Dec. 14	None.	V. slight.	.00	28.20	.0640	.0066	6.01	1.5500	.0040	.17	6.0	.0050
Av...	....	....	....	.05	28.18	.1302	.0120	5.64	1.2342	.0042	.20	6.3	.0080

The samples were collected from the underdrain at its outlet.

Chemical Examination of Water from Bannister Brook below the Framingham Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
	1899.														
27757	July 12	V. slight.	V. slight.	.06	30.30	8.50	.2920	.0114	.0106	.0008	5.02	1.4000	.0140	.19	6.4
28117	Aug. 9	None.	V. slight.	.06	27.35	7.65	.0078	.0090	.0078	.0012	5.11	2.8000	.0028	.20	4.9
28598	Sept. 13	V. slight.	Slight.	.04	27.50	9.00	.0158	.0116	.0110	.0006	5.38	1.0600	.0032	.15	5.3
28999	Oct. 11	V. slight.	V. slight.	.07	24.15	6.60	.0412	.0156	.0132	.0024	4.85	0.8100	.0036	.22	5.7
29273	Nov. 7	Slight.	Slight.	.07	29.45	5.85	.3600	.0170	.0090	.0080	6.71	0.6500	.0014	.20	4.9
Av...	....	... .	....	.06	27.75	7.52	.1434	.0129	.0103	.0026	5.41	1.3480	.0050	.19	5.4

Odor in July and November, distinctly musty; in October, faintly disagreeable; at other times none, becoming faintly musty or unpleasant on heating. —— The samples were collected from the brook, at the first road crossing below the sewage field. The brook receives the effluent from both the Natick and the Framingham sewage disposal works.

Chemical Examination of Water from a Spring near Bannister Brook which receives Effluent from the Framingham Filter-beds.

[Parts per 100,000]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25918	Jan. 11	None.	V. slight.	.02	17.30	.0008	.0148	3.65	.6400	.0000	.04	4.4	.0060
26194	Feb. 9	None.	None.	.00	18.40	.0002	.0014	3.79	.7800	.0000	.04	5.3	.0040
26436	Mar. 8	None.	V. slight.	.00	18.80	.0000	.0012	3.95	.5300	.0000	.04	4.4	.0020
26747	Apr. 12	None.	None	.00	16.50	.0004	.0014	3.50	.6000	.0000	.03	4.4	.0020
27075	May 10	None.	None.	.00	17.00	.0002	.0016	3.33	.5300	.0000	.02	4.2	.0080
27445	June 14	None.	None.	.00	18.20	.0008	.0018	3.47	.6100	.0000	.05	4.6	.0030
27754	July 12	None.	None.	.00	19.60	.0000	.0018	3.71	.8800	.0000	.03	4.3	.0010
28115	Aug. 9	None.	None.	.02	20.20	.0002	.0022	3.82	.9500	.0000	.01	4.2	.0020
28596	Sept. 13	None.	None.	.02	18.90	.0000	.0020	4.13	.8400	.0001	.05	4.3	.0050
28998	Oct. 11	None.	None.	.01	21.00	.0030	.0022	4.00	.8800	.0000	.05	4.3	.0030
29272	Nov. 7	None.	None.	.00	19.10	.0026	.0028	4.02	.6500	.0000	.03	4.3	.0060
29670	Dec. 14	None.	None.	.03	18.80	.0000	.0022	4.01	.7600	.0000	.02	4.3	.0010
Av...	....	....	....	.01	18.65	.0007	.0029	3.78	.7208	.0000	.03	4.4	.0033

Odor, none.

Chemical Examination of Water from the Underdrain beneath the Sewers at Framingham.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25920	Jan. 11	Slight.	Slight.	.06	19.50	.0568	.0068	2.10	.5900	.0016	.10	7.9	.0110
26196	Feb. 9	Slight.	Slight.	.05	20.20	.0656	.0056	2.01	.5200	.0004	.11	8.6	.0130
26434	Mar. 8	V.slight.	V.slight.	.05	19.70	.0624	.0044	2.03	.2650	.0016	.08	7.1	.0130
26748	Apr. 12	Decided.	Slight.	.10	19.60	.1065	.0155	2.20	.4200	.0060	.12	7.4	.0090
27072	May 10	Slight.	Slight.	.12	20.00	.1520	.0320	2.35	.4100	.0120	.20	8.1	.0200
27469	June 19	Slight.	Slight.	.11	11.30	.0088	.0288	0.63	.0020	.0000	.23	4.6	.0100
27753	July 12	Decided, green.	Cons., green.	.22	12.20	.0008	.0312	0.47	.0020	.0000	.18	5.9	.0220
29271	Nov. 7	Slight.	V.slight.	.69	9.60	.0156	.0196	0.83	.0460	.0008	.93	3.3	.0270

Averages by Years.

Number.	Date of Collection.	Turbidity.	Sediment.	Color.	Residue on Evaporation.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
-	1890	-	-	.01	19.71	.0823	.0073	3.51	.5836	.0026	-	8.4	-
-	1891	-	-	.01	20.44	.1029	.0045	3.51	.5833	.0019	-	8.0	-
-	1892	-	-	.01	19.32	.0805	.0042	3.99	.6667	.0018	-	8.0	-
-	1893	-	-	.02	20.75	.0829	.0039	3.84	.6282	.0014	.06	7.4	-
-	1894	-	-	.00	22.24	.0620	.0033	3.61	.5315	.0028	.08	7.1	-
-	1895	-	-	.03	20.92	.0502	.0086	2.29	.4995	.0023	.09	7.7	.0366
-	1896	-	-	.09	19.99	.0462	.0200	2.07	.3575	.0048	.17	7.2	.0419
-	1897	-	-	.16	16.72	.0218	.0101	1.75	.3169	.0012	.17	6.7	.0132
-	1898	-	-	.08	19.72	.0640	.0141	2.14	.4479	.0020	.12	7.7	.0164
-	1899	-	-	.17	16.51	.0586	.0180	1.58	.2819	.0028	.24	6.6	.0156

Note to analyses of 1899: Odor, generally musty and occasionally disagreeable. —— The samples were collected from the underdrain at the point where it discharges into a storage reservoir. The water is usually pumped from this reservoir to filter-beds, but during the months of July and August the underdrain water was mixed with the sewage and pumped to the sewage filter-beds.

Chemical Examination of Effluent from the Filter-beds on which the Water from the Underdrain beneath the Sewers at Framingham is discharged.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25919	Jan. 11	Slight.	Slight.	.36	10.80	.0110	.0114	1.01	.1460	.0004	.50	3.9	.0060
26195	Feb. 9	Decided.	Cons., earthy.	.40	10.40	.0144	.0244	0.79	.1450	.0001	.82	3.5	.0080
26435	Mar. 8	Decided, milky.	Cons., earthy.	.50	7.50	.0060	.0208	0.65	.0350	.0002	.71	2.3	.0090
26749	Apr. 12	V.slight.	Slight.	.38	8.30	.0084	.0160	0.73	.0900	.0003	.51	2.3	.0080
27073	May 10	V.slight.	Slight.	.36	14.20	.0020	.0116	1.55	.1050	.0000	.41	5.0	.0100
28114	Aug. 9	None.	V.slight.	.03	17.90	.0016	.0056	2.01	.4730	.0004	.18	6.4	.0020
28596	Sept. 13	V.slight.	V.slight.	.06	16.50	.0020	.0092	2.13	.5100	.0013	.15	5.3	.0050
28997	Oct. 11	Slight.	V.slight.	.37	12.00	.0048	.0128	1.08	.1300	.0005	.43	4.3	.0110
29699	Dec. 14	Decided.	Slight.	.30	9.30	.0162	.0136	0.84	.1100	.0005	.43	3.9	.0120
Av...	....	....	....	.31	11.88	.0076	.0139	1.20	.1938	.0004	.45	4.1	.0079

The samples were collected from the underdrain at its outlet.

Sewage Disposal at Gardner.

Chemical Examination of Sewage from Gardner.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation. Total Residue. Total.	Dissolved.	Suspended.	Loss on Ignition. Total.	Dissolved.	Suspended.	Ammonia. Free.	Albuminoid. Total.	Dissolved.	Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed. Unfiltered.	Filtered.
	1899.															
25928	Jan. 11	150.00	30.20	119.80	129.00	11.00	118.00	1.5500	0.7100	.4100	0.3000	7.25	.0470	.0120	9.04	3.97
26215	Feb. 15	46.80	25.50	21.30	32.40	13.40	19.00	4.4500	1.1500	.5900	0.5600	3.27	.0080	.0000	7.20	3.68
26416	Mar. 8	33.00	19.10	13.90	21.00	8.60	12.40	2.7500	0.7500	.3000	0.4500	2.79	.0040	.0000	4.72	2.21
27128	May 17	41.60	19.80	21.80	25.80	8.00	17.80	2.7600	0.8200	.3300	0.4900	3.62	.0000	.0000	4.50	2.24
27430	June 14	34.60	20.70	13.90	24.00	10.50	13.50	2.8000	2.8100	.3700	2.4400	2.80	.0020	.0000	5.60	3.06
27740	July 12	53.20	30.00	23.20	27.00	10.80	16.20	4.2200	0.9400	.4200	0.5200	7.75	.0020	.0000	7.00	2.72
28103	Aug. 9	80.20	31.70	48.50	57.80	13.50	44.30	4.3900	1.3800	.4600	0.9200	4.40	.0080	.0000	8.00	3.36
28275	Aug. 18	36.10	22.85	13.25	19.10	6.20	12.90	3.6100	0.7400	.4400	0.3000	4.80	.0050	.0000	5.06	2.66
28599	Sept. 13	32.80	22.30	10.50	16.40	10.20	6.20	2.2900	0.4400	.2560	0.1840	3.51	.0010	.0000	3.20	1.80
28966	Oct. 11	42.40	27.00	15.40	29.00	14.10	14.90	3.2600	0.8800	.4400	0.4400	3.30	.0010	.0000	5.80	3.29
29303	Nov. 8	30.80	21.70	9.10	15.40	8.70	6.70	1.3900	0.5400	.3200	0.2200	3.91	.0020	.0000	4.30	2.48
29656	Dec. 13	35.80	21.40	14.40	21.60	9.40	12.20	2.8200	0.6600	.3400	0.3200	3.40	.0020	.0000	5.20	3.15
Av.*	....	50.83	24.09	26.74	34.55	10.41	24.14	2.9800	0.9782	.3842	0.5940	4.20	.0069	.0011	5.73	2.87

The sewage was collected as it flowed upon the beds.

Chemical Examination of Effluent from Main Underdrain of the Gardner Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Sediment.	Color.	Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
25929	Jan. 11	Decided, iron.	Slight, iron.	0.90	14.60	0.7600	.0600	2.52	0.2640	.0280	0.74	3.5	.1900
26216	Feb. 15	Decided, iron.	Cons., iron.	1.00	18.00	0.3160	.0680	3.22	0.0800	.0180	0.91	4.2	.8000
26417	Mar. 8	Decided, iron.	Cons., iron.	0.13	16.00	1.5600	.1200	2.51	0.0900	.0140	1.26	2.3	.6000
26740	Apr. 12	Decided, iron.	Heavy, iron.	-	19.00	1.8000	.1480	2.61	0.0450	.0130	1.54	3.4	.3400
27129	May 17	Decided, iron.	Heavy, iron.	0.60	34.40	0.5840	.0720	2.10	2.2000	.1200	0.60	9.9	.1900
27431	June 14	Decided, iron.	Cons., iron.	0.51	21.70	0.7400	.0930	2.68	1.3000	.0200	1.00	5.0	.2400
27741	July 12	Decided.	Cons.	0.33	22.60	0.3280	.0420	3.28	1.1000	.0150	0.56	5.3	.0650
28104	Aug. 9	Slight, milky.	V. slight.	0.20	19.10	0.4600	.0460	2.75	0.8500	.0040	0.50	5.1	.0280
28276	Aug. 18	Slight, milky.	Cons., iron.	0.08	19.20	0.3280	.0400	3.32	0.5300	.0052	0.48	5.0	.1100
28600	Sept. 13	Decided, iron.	Cons., iron.	0.30	19.10	0.3720	.0710	3.79	0.3050	.0080	0.73	4.7	.0650
28967	Oct. 11	Decided.	Heavy, floc.	0.17	20.30	0.5360	.0680	2.55	3.0500	.1160	0.65	4.2	.0250
29304	Nov. 8	Decided.	Cons., floc.	0.16	17.50	0.5040	.0490	2.95	0.6800	.0720	0.68	3.8	.0680
29656	Dec. 13	Decided.	Cons.	1.20	16.60	1.2960	.1360	3.19	0.0650	.0480	1.15	3.3	.4100
Av.*	....	....	....	0.49	19.91	0.8075	.0825	2.87	0.8191	.0392	0.86	4.5	.2568

The samples were collected from the main underdrain at the point where it discharges into Pond Brook.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from Pond Brook above the Gardner Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27742	July 12	Decided.	Cons.	.35	15.55	4.80	.0260	.0235	.0220	.0015	3.83	.0380	.0018	.38	5.3
28105	Aug. 9	V. slight, milky.	V. slight.	.11	19.45	8.25	.0058	.0120	.0112	.0008	4.75	.0150	.0004	.21	6.3
28601	Sept. 13	Slight.	Cons.	.13	15.30	4.25	.0408	.0336	.0276	.0060	3.73	.0800	.0030	.30	3.9
Av...	....	....	....	.19	16.76	5.77	.0242	.0230	.0203	.0028	4.10	.0443	.0017	.29	5.2

Odor, vegetable or musty. —— The samples were collected from the brook above the point where it is crossed by the main sewer leading to the filter-beds.

Chemical Examination of Water from Pond Brook below the Gardner Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27743	July 12	Decided.	Slight.	.22	16.25	4.35	.0780	.0240	.0230	.0010	3.70	.2120	.0056	.39	4.4
28106	Aug. 9	V. slight, milky.	V. slight.	.09	17.85	5.60	.0480	.0168	.0140	.0028	4.85	.1600	.0012	.29	5.9
28602	Sept. 13	V. slight.	V. slight.	.19	14.70	3.60	.0028	.0188	.0152	.0036	3.67	.0200	.0008	.31	4.6
Av...	....	....	....	.17	16.27	4.52	.0429	.0199	.0174	.0025	3.91	.1307	.0024	.33	4.9

Odor, faintly musty, becoming stronger on heating. —— The samples were collected from the brook below the point where the effluent from the filter-beds enters it.

Sewage Disposal at Leicester.

Chemical Examination of Sewage from Leicester.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
		Total Residue.			Loss on Ignition.			Free.	Albuminoid.							
		Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.		Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.
	1899.															
26183	Feb. 8	102.80	90.80	12.00	70.00	60.00	10.00	4.2500	0.9000	.6200	.2800	5.40	.0000	.0000	41.92	32.00
26752	Apr. 12	48.00	46.60	1.40	26.00	25.00	1.00	2.2500	0.4600	.3600	.1000	3.20	.0000	.0100	14.80	13.12
27425	June 14	39.00	34.60	4.40	19.00	16.00	3.00	3.1200	0.5600	.3500	.2100	5.12	.0000	.0000	8.48	7.28
28118	Aug. 9	81.60	45.20	36.40	48.80	19.50	29.30	4.4000	1.1200	.3500	.7700	5.75	.0000	.0000	15.60	9.80
29002	Oct. 11	86.60	68.00	18.60	48.00	30.40	17.60	3.9000	1.1800	.5000	.6800	7.50	-	.0000	21.80	18.70
29657	Dec. 13	90.20	76.20	14.00	40.80	31.20	9.60	3.3200	0.7400	.5200	.2200	6.75	-	.0000	27.00	22.50
Av..	....	74.70	60.23	14.47	42.10	30.35	11.75	3.5400	0.8266	.4500	.3766	5.62	.0000	.0016	21.60	17.23

The sewage was collected as it entered the settling tank.

Chemical Examination of Effluent from the Underdrain of the Leicester Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.
	1899.												
[illegible]	Feb. 6	Decided.	Cons.	–	46.76	2.[illegible]	.[illegible]	5.02	0.[illegible]	.[illegible]	12.28	7.1	.0[illegible]
[illegible]	Apr. 12	Slight.	None.	.[illegible]	20.[illegible]	0.2540	.0[illegible]	2.30	0.[illegible]	.[illegible]	0.[illegible]	5.1	.[illegible]
[illegible]	June 14	Decided, iron.	Heavy, iron.	.05	44.[illegible]	0.5400	.0470	[illegible]	0.7400	.1200	1.17	8.7	.[illegible]
28119	Aug. 9	Decided, milky	Cons., brown floc.	.55	58.20	0.2540	.0400	[illegible]	1.9000	.[illegible]	0.76	9.6	.1200
[illegible]	Oct. 11	Decided.	Cons.	.24	58.50	0.4200	.0236	6.00	1.5000	.[illegible]	4.32	9.6	.[illegible]
[illegible]	Dec. 12	Decided.	Cons.	–	50.[illegible]	0.[illegible]	.0750	6.05	0.1200	.0400	7.04	9.6	.0[illegible]
Av...	....	....	....	.26	45.62	0.3516	.0943	6.17	0.[illegible]	.0420	4.42	8.3	.2[illegible]

The samples were collected from the underdrain at the point where it discharges into the brook.

Chemical Examination of Water from the Brook below the Leicester Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. 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.
	1899.														
27765	July 12	Slight.	Slight.	.22	3.70	1.20	.0014	.0194	.0180	.0014	.25	.0400	.0001	.47	1.1
28120	Aug. 9	V. slight.	Slight.	.23	2.40	0.90	.0022	.0216	.0174	.0042	.24	.0040	.0000	.40	0.6
29600	Sept. 12	Slight.	Slight.	.14	3.75	1.35	.0010	.0224	.0196	.0028	.28	.0200	.0005	.41	0.8
Av...	....	....	....	.20	3.28	1.15	.0015	.0211	.0183	.0028	.29	.0213	.0002	.43	0.8

Odor, faintly musty or unpleasant.—The samples were collected from the brook below the point where the effluent from the filter-beds enters the stream.

Sewage Disposal at Leicester Poor Farm.

Chemical Examination of Effluent from the Underdrain of the Filter-beds at the Leicester Poor Farm.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25977	Jan. 17	V. slight.	Slight.	.06	12.50	.2144	.0196	1.45	0.1000	.0024	.28	3.3	.0020
26330	Feb. 23	Decided.	Cons.	.16	11.50	.4480	.0376	1.31	0.1550	.0016	.49	2.9	.0080
26488	Mar. 14	V. slight.	Slight.	.08	10.00	.1952	.0192	1.10	0.0450	.0025	.24	2.5	.0040
26927	Apr. 25	V. slight.	Heavy, earthy.	.02	14.20	.0406	.0228	1.79	0.2650	.0036	.38	3.3	.0220
27123	May 16	V. slight.	Cons.	.01	13.80	.0044	.0158	1.65	0.6500	.0002	.29	3.4	.0040
27518	June 20	V. slight.	Slight.	.01	19.90	.0006	.0094	1.40	1.4000	.0000	.15	3.9	.0050
27822	July 18	V. slight.	Slight, earthy.	.00	17.90	.0000	.0090	1.33	0.9000	.0001	.23	5.0	.0040
28265	Aug. 17	None.	V. slight.	.01	16.20	.0002	.0072	1.45	0.9300	.0001	.16	3.8	.0030
28680	Sept. 19	Slight.	Cons., earthy.	.04	19.30	.0040	.0268	2.25	1.2400	.0004	.36	3.5	.0080
29095	Oct. 21	V. slight.	Cons., earthy.	.03	23.80	.0038	.0198	2.70	1.3200	.0004	.30	3.9	.0040
29397	Nov. 14	V. slight.	Cons., earthy.	.00	24.90	.0154	.0066	2.15	1.8800	.0064	.18	5.0	.0050
29706	Dec. 19	V. slight.	Slight, earthy.	.04	22.25	.0470	.0168	2.35	1.0400	.0032	.21	4.3	.0100
Av.	....	....	....	.04	17.19	.0811	.0177	1.74	0.8271	.0017	.27	3.7	.0066

The samples were collected from the underdrain at its outlet.

Sewage Disposal at Marlborough.

Chemical Examination of Sewage from Marlborough.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
		Total Residue.			Loss on Ignition			Free.	Albuminoid.				Nitrates.	Nitrites.	Unfiltered.	Filtered.
		Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.		Total.	Dissolved.	Suspended.					
	1899.															
25923	Jan. 11	20.40	19.50	0.90	8.00	7.20	0.80	0.2560	0.0880	.0560	0.0320	2.72	.4400	.0220	0.54	0.46
26188	Feb. 9	50.00	32.30	17.70	27.80	12.20	15.60	3.9500	0.8000	.4700	0.3300	6.28	.0040	.0000	7.44	3.58
26439	Mar. 9	21.10	19.40	1.70	6.80	5.80	1.00	0.6500	0.1400	.0920	0.0480	2.99	.4400	.0280	0.99	0.60
26741	Apr. 12	26.40	22.20	4.20	11.70	3.00	8.70	1.2500	0.3600	.2200	0.1400	3.28	.1500	.0960	2.16	1.28
27083	May 11	45.00	30.10	14.90	21.60	10.10	11.50	4.3000	0.7700	.4200	0.3500	5.40	.0000	.0000	4.96	2.75
27448	June 14	84.00	58.70	25.30	47.00	24.30	22.70	6.7600	1.4800	.6900	0.7900	11.90	.0000	.0000	10.40	5.24
27760	July 12	80.80	48.00	32.80	46.00	19.00	27.00	8.0000	1.5400	.5100	1.0300	7.89	.0020	.0000	9.10	5.30
28186	Aug. 10	79.60	39.00	40.60	52.20	13.30	38.90	6.6000	0.8400	.5500	0.2900	7.35	.0000	.0000	8.20	4.72
28605	Sept. 13	50.20	33.90	16.30	25.20	13.20	12.00	4.6400	0.9300	.3120	0.6180	5.35	.0010	.0000	5.20	2.30
28963	Oct. 11	32.40	24.00	8.40	14.40	6.50	7.90	1.1600	0.3700	.2000	0.1700	3.95	.0020	.0160	3.40	1.52
29306	Nov. 8	77.60	50.60	27.00	41.00	18.60	22.40	6.1000	1.3200	.5900	0.7300	10.12	-	.0000	10.80	5.20
29661	Dec. 13	56.40	31.80	24.60	29.80	10.20	19.60	4.4800	1.0300	.5100	0.5200	5.60	.0000	.0000	7.35	3.25
Av.	....	52.00	34.13	17.87	27.62	12.36	15.26	4.0122	0.8057	.3850	0.4207	6.07	.0945	.0135	5.88	3.07

The samples were collected from the settling tanks and represent the sewage after a portion of the suspended matter has been separated from it.

Chemical Examination of Effluent from the Underdrains of the Marlborough Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25924	Jan. 11	Decided.	Cons.	.12	17.90	0.6200	.0140	3.42	0.3520	.0026	0.26	5.6	.0350
25925	Jan. 11	Decided.	Cons.	.17	18.50	0.5000	.0140	3.59	0.4000	.0075	0.23	5.1	.0370
26189	Feb. 9	V. slight.	None.	.07	21.20	0.4100	.0160	3.69	0.5400	.0260	0.20	6.7	.0230
26190	Feb. 9	Slight.	V. slight.	.09	21.70	0.3600	.0340	4.11	0.5200	.0360	0.39	7.1	.0130
26440	Mar. 9	Slight.	V. slight.	.15	14.20	0.4000	.0135	2.70	0.1500	.0240	0.26	4.4	.0130
26479	Mar. 14	Decided.	Slight.	.26	15.30	1.0700	.0445	2.95	0.2200	.0130	0.44	4.6	.1300
26742	Apr. 12	Slight.	Cons.	.09	18.30	0.4640	.0260	3.03	0.2250	.0200	0.32	5.4	.0230
26743	Apr. 12	Decided.	Cons.	.28	15.90	0.6720	.0420	3.07	0.1000	.0120	0.46	4.9	.0800
27084	May 11	Slight.	Slight.	.08	21.90	0.4800	.0490	3.32	0.4000	.0096	0.35	6.7	.0080
27085	May 11	Decided, iron.	Heavy, iron.	.19	27.00	0.5600	.0330	4.68	0.6100	.0068	0.39	7.3	.2300
27449	June 14	V. slight.	V. slight.	.10	37.80	0.4200	.0245	6.17	2.5000	.0036	0.33	9.1	.0070
27450	June 14	V. slight.	Slight, floc.	.11	31.80	0.6200	.0280	5.21	1.6600	.0180	0.35	9.3	.0010
27761	July 12	Decided.	Cons.	.31	39.10	1.2960	.0660	8.26	0.8200	.0320	0.80	9.6	.0600
27762	July 12	Slight.	Cons.	.15	36.20	0.9760	.0520	6.45	2.0000	.0240	0.53	8.9	.0060
28187	Aug. 10	None.	Slight.	.07	48.30	0.6400	.0230	6.70	1.6400	.0040	0.30	12.6	.0430
28188	Aug. 10	V. slight.	Slight, b'wn, floc.	.34	42.00	1.3000	.1030	7.68	0.7000	.0400	1.22	7.7	.2920
28606	Sept. 13	Slight.	Slight.	.11	46.00	0.7000	.0380	8.37	1.4500	.0120	0.33	9.1	.0350
28607	Sept. 13	V. slight.	Cons., iron.	.12	45.70	0.8000	.0320	7.41	2.0000	.0015	0.31	9.1	.0700
28954	Oct. 11	Decided.	Cons.	.45	34.00	2.2000	.1620	9.03	0.2650	.0800	1.76	8.9	.0110
28955	Oct. 11	V. slight.	V. slight.	.04	47.70	0.5440	.0160	7.70	2.0200	.0100	0.30	9.4	.0050
29306	Nov. 8	Decided.	Cons., iron.	.46	42.50	1.2640	.0760	6.70	0.9000	.0350	0.86	9.0	.2800
29307	Nov. 8	Decided.	Cons.	.10	40.20	0.7920	.0200	6.75	0.6100	.0200	0.38	8.1	.1100
29662	Dec. 13	Decided.	Cons.	.33	34.20	1.0560	.1240	6.50	0.8200	.0240	0.81	7.1	.0440
29663	Dec. 13	Decided.	Cons.	.34	31.20	1.7600	.1020	6.60	0.7200	.0720	0.78	5.4	.0680
Av.*.	....	....	....	.18	31.21	0.8502	.0480	5.61	0.9009	.0224	0.51	7.3	.0682

The samples were collected from the two main effluent underdrains at their outlets.

* Where more than one sample was collected in a month, the mean analysis for that month has been used in making the average.

Chemical Examination of Water from the Brook into which the Effluent from the Marlborough Sewage Filter-beds is discharged.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
								Albuminoid.							
		Turbidity.	Sediment.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Sus-pended.		Nitrates.	Nitrites.		
	1899.														
27763	July 12	V. slight.	Cons.	.12	18.55	5.50	.6560	.0360	.0300	.0060	5.72	1.3800	.0280	.48	7.4
28189	Aug. 10	None.	Cons., b'wn, floc.	.16	32.20	15.60	.5800	.0270	.0250	.0020	5.81	1.5800	.0360	.43	8.1
28608	Sept. 13	V. slight.	V. slight.	.11	36.60	11.80	.6080	.0380	.0360	.0020	7.23	1.1000	.0800	.45	7.4
Av...	....	....	....	.13	29.12	10.97	.6147	.0336	.0303	.0033	6.25	1.3533	.0480	.45	7.6

Odor, musty. —— The samples were collected from the brook below the point where the effluent from the filter-beds enters the stream.

Sewage Disposal at Medfield.

Chemical Examination of Sewage from Medfield.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
		Total Residue.			Loss on Ignition.				Albuminoid.							
		Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.	Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.
	1899.															
25921	Jan. 11	45.20	43.00	2.20	27.00	25.20	1.80	0.4600	1.2800	1.1800	.1000	2.55	.0000	.0360	7.60	6.88
26437	Mar. 8	48.60	45.00	3.60	16.00	13.40	2.60	1.0000	0.7100	0.6200	.0900	5.41	.0000	.0068	6.88	6.24
27076	May 10	51.60	41.00	10.60	23.80	15.00	8.80	1.5400	1.0600	0.9400	.1200	-	.0000	.0000	8.16	6.40
27748	July 12	165.20	145.30	19.90	49.00	34.20	14.80	1.4200	1.2300	0.7800	.4500	10.02	.0000	.0000	11.00	9.08
28590	Sept. 13	73.60	63.70	9.90	17.20	9.10	8.10	1.4920	0.5200	0.3400	.1800	29.45	.0010	.0000	3.50	2.28
29299	Nov. 8	111.00	79.80	31.20	44.40	18.90	25.50	1.0600	0.5500	0.4300	.1200	5.50	-	.0004	11.60	3.80
Av..	....	82.53	69.63	12.90	29.57	19.30	10.27	1.1620	0.8917	0.7150	.1767	10.59	.0002	.0072	8.12	5.79

The samples were collected as the sewage flowed upon the filter-beds.

Chemical Examination of Water from a Spring below the Filtration Area of the Medfield Sewerage System.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25922	Jan. 11	V. slight.	V. slight.	0.05	4.60	.0016	.0028	0.35	.1120	.0005	0.10	1.7	.0030
26438	Mar. 8	Slight.	Slight.	0.08	5.20	.0006	.0052	0.46	.0920	.0003	0.15	1.6	.0050
27077	May 10	V. slight.	Slight.	0.17	3.70	.0014	.0112	0.28	.0250	.0001	0.19	1.7	.0110
27749	July 12	Decided.	Heavy, earthy.	1.00	8.90	.1030	.0750	0.79	.0030	.0000	1.16	2.6	.1500
28501	Sept. 13	V. slight.	Cons.	0.15	15.80	.0264	.0196	1.68	.0800	.0006	0.37	4.3	.0150
29300	Nov. 8	Decided.	V. heavy, earthy.	0.75	8.20	.0168	.0456	1.12	.0010	.0002	16.60	3.3	.1060
Av...	....	....	....	0.37	7.73	.0250	.0266	0.78	.0522	.0003	3.09	2.5	.0487

The samples were collected from a spring which is located north of the filter-beds and a little over 260 feet from the edge of the nearest bed. The ground where the filter-beds are located slopes in the direction of this spring.

Medford.

Chemical Examination of Water from Underdrains beneath the Sewers, Medford.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26430	Mar. 7	Slight.	Cons., earthy.	.02	29.00	.0504	.0076	6.69	.4750	.0024	.12	7.1	.0150
27731	July 12	None.	V. slight.	.00	17.90	.0372	.0056	2.52	.5200	.0008	.06	4.6	.0040
29295	Nov. 8	None.	None.	.00	24.60	.0704	.0056	6.40	.3400	.0008	.11	4.6	.0010

Averages by Years.

-	1897	-	-	.02	27.30	.0584	.0067	5.91	.6933	.0008	.08	7.4	.0160
-	1898	-	-	.03	23.60	.0347	.0051	3.78	.8333	.0004	.09	6.3	.0090
-	1899	-	-	.01	23.83	.0527	.0063	5.20	.4450	.0012	.09	5.4	.0067

NOTE to analyses of 1899: Odor of the first two samples, very faintly musty; of the last, none.—— The samples were collected from the underdrain in Boston Avenue, near the Mystic River.

SEWAGE DISPOSAL AT NATICK.

Chemical Examination of Sewage from Natick.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
		Total Residue.			Loss on Ignition.				Albuminoid.							
		Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.	Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.
	1899.															
25930	Jan. 11	22.40	21.90	0.50	6.60	6.40	0.20	0.3320	.0840	.0360	.0480	2.95	.4900	.0650	0.54	0.41
26185	Feb. 8	23.20	21.50	1.70	8.20	6.60	1.60	0.7000	.2200	.1300	.0900	3.45	.4300	.0950	1.03	0.76
26420	Mar. 8	22.40	20.30	2.10	8.00	7.80	0.20	0.3080	.0960	.0600	.0360	2.71	.2750	.0600	0.58	0.49
26750	Apr. 12	21.60	21.10	0.50	6.60	6.60	0.00	0.2680	.1100	.0520	.0580	2.68	.5600	.0560	1.44	1.25
27078	May 10	24.50	22.80	1.70	6.20	4.80	1.40	0.8320	.3240	.1180	.2060	4.50	.0000	.0880	1.44	1.38
27440	June 14	30.00	27.20	2.80	9.60	7.00	2.60	1.2900	.2800	.2000	.0800	5.10	.0100	.0000	2.84	2.22
27746	July 12	40.00	35.90	4.10	12.60	9.10	3.50	1.6500	.3200	.2400	.0800	8.60	.0030	.0000	4.00	2.68
28123	Aug. 9	49.40	39.10	10.30	16.60	7.00	9.60	2.1300	.4000	.2300	.1700	12.20	.0000	.0000	3.72	2.30
28588	Sept. 13	46.40	37.90	8.50	21.20	13.70	7.50	2.7080	.4700	.2360	.2340	7.86	.0010	.0000	4.40	3.00
29000	Oct. 11	62.40	42.80	19.60	32.00	15.60	16.40	3.0300	.5700	.3900	.1800	8.05	.0000	.0000	6.04	4.30
29301	Nov. 8	39.00	33.40	5.60	17.00	12.00	5.00	2.6200	.4000	.3000	.1000	5.15	–	.0000	4.90	3.36
29659	Dec. 13	38.00	32.70	5.30	16.40	12.00	4.40	2.3300	.4600	.3100	.1500	5.10	.0000	.0000	4.25	3.25
Av..	....	34.94	29.72	5.22	13.42	9.05	4.37	1.5165	.3112	.1918	.1194	5.70	.1608	.0303	2.93	2.12

The samples were collected as the sewage flowed upon the filter-beds.

Chemical Examination of Effluent from the Underdrain of the Natick Filter-beds.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
25931	Jan. 11	None.	V. slight.	.02	20.00	.0200	.0054	2.65	0.8300	.0022	.10	6.6	.0010
26200	Feb. 11	V. slight.	None.	.02	18.30	.1100	.0065	3.08	0.5300	.0048	.14	6.6	.0020
26421	Mar. 8	V. slight.	V. slight, floc.	.02	16.50	.0656	.0068	2.18	0.4350	.0016	.10	5.1	.0050
26751	Apr. 12	V. slight.	Slight.	.02	15.50	.0628	.0080	2.30	0.4300	.0028	.11	5.7	.0030
27079	May 10	V. slight.	Slight.	.10	23.20	.0588	.0201	3.49	0.3900	.0200	.27	7.9	.0180
27441	June 14	V. slight.	V. slight.	.05	25.30	.1040	.0290	5.00	0.9600	.0120	.35	6.1	.0040
27747	July 12	V. slight.	Slight.	.02	30.90	.0050	.0104	5.39	1.5200	.0016	.16	7.4	.0020
28124	Aug. 9	Slight.	Cons.	.07	27.40	.1860	.0560	6.73	0.3750	.0056	.40	5.3	.0010
28589	Sept. 13	Decided.	Cons.	.10	32.20	.2680	.0665	7.25	0.8100	.0100	.60	6.7	.0020
29001	Oct. 11	V. slight.	Cons., iron.	.02	33.00	.0232	.0142	5.30	1.6400	.0020	.17	7.3	.0100
29302	Nov. 8	Decided.	Cons.	.16	33.30	.2120	.3180	5.23	1.3000	.0036	.59	7.9	.0120
29660	Dec. 13	Decided.	Cons.	.30	31.50	.3960	.0980	4.75	0.9800	.0048	.72	7.4	.0060
Av...	....	....	....	.07	25.59	.1259	.0582	4.45	0.8500	.0059	.31	6.7	.0055

The samples were collected from the underdrain at the point where it discharges into Bannister Brook.

NEWTON.

Chemical Examination of Water from the Main Underdrain of the Hyde Brook Division of the Newton Sewerage System.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26442	Mar. 8	V. slight.	Slight.	.01	19.00	.0094	.0050	2.15	.4800	.0004	.07	8.6	.0010
29313	Nov. 9	V. slight.	Slight.	.08	22.80	.0166	.0088	2.18	.5000	.0036	.09	8.4	.0100

Averages by Years.

-	1892	-	-	.00	27.08	.0126	.0029	3.18	1.1666	.0015	-	10.1	.0052
-	1893	-	-	.03	25.43	.0140	.0087	2.48	0.9550	.0018	.06	9.4	.0099
-	1894	-	-	.03	26.27	.0105	.0084	2.67	0.9933	.0012	.05	9.2	.0083
-	1895	-	-	.02	25.73	.0072	.0032	2.44	0.5583	.0005	.05	9.7	.0157
-	1896	-	-	.03	24.30	.0202	.0101	2.32	0.7333	.0017	.20	8.5	.0797
-	1897	-	-	.01	23.67	.0067	.0061	2.18	0.6033	.0027	.04	8.9	.0007
-	1898	-	-	.04	20.90	.0161	.0074	2.39	0.5500	.0018	.07	9.7	.0057
-	1899	-	-	.02	20.90	.0130	.0069	2.16	0.4900	.0020	.08	8.5	.0055

NOTE to analyses of 1899: Odor of the first sample, very faintly musty, disappearing on heating; of the last, none, becoming very faintly unpleasant on heating. —— The samples were collected from the underdrain at its outlet.

Chemical Examination of Water from the Main Underdrain of the Cheesecake Brook Division of the Newton Sewerage System.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
26441	Mar. 8	Slight.	Cons., earthy.	.09	15.50	.0062	.0078	1.30	.3100	.0003	.16	5.7	.0200
27775	July 14	V. slight.	Slight.	.06	14.20	.0058	.0040	1.25	.2890	.0003	.06	6.0	.0020
29312	Nov. 9	V. slight.	Cons., earthy.	.05	14.70	.0040	.0030	1.51	.2100	.0003	.09	6.0	.0390

Averages by Years.

-	1894	-	-	.04	20.53	.0265	.0040	2.05	.5567	.0030	.06	7.9	.0340
-	1895	-	-	.03	19.30	.0125	.0038	1.50	.3167	.0004	.03	7.6	.0267
-	1896	-	-	.08	17.03	.0065	.0074	1.40	.3333	.0004	.16	6.8	.0533
-	1897	-	-	.03	16.08	.0061	.0041	1.32	.2600	.0008	.05	6.4	.0377
-	1898	-	-	.07	15.77	.0047	.0043	1.43	.3683	.0002	.06	6.6	.0137
-	1899	-	-	.07	14.80	.0053	.0049	1.85	.2697	.0008	.10	5.9	.0203

NOTE to analyses of 1899: Odor, none. —— The samples were collected from the underdrain at its outlet.

Chemical Examination of Water from the Main Underdrain beneath the Laundry Brook Valley Sewer, Newton.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albu-minoid.		Nitrates.	Nitrites.			
	1899.												
26443	Mar. 8	V. slight.	Cons.	.05	19.60	.0150	.0024	2.10	.6900	.0004	.05	7.3	.0120
27726	July 12	V. slight.	Slight.	.02	16.20	.0108	.0028	1.50	.4450	.0008	.02	6.4	.0100
29814	Nov. 9	None.	Slight.	.03	15.90	.0094	.0022	1.60	.3600	.0004	.05	6.0	.0120

Averages by Years.

-	1894	-	-	.04	17.23	.0103	.0019	1.68	.3767	.0005	.05	6.8	.0447
-	1895	-	-	.03	21.70	.0105	.0067	2.09	.6217	.0006	.04	8.5	.0550
-	1896	-	-	.02	18.40	.0118	.0017	1.88	.4600	.0005	.07	7.0	.0330
-	1897	-	-	.02	16.93	.0095	.0037	1.48	.2938	.0008	.08	6.7	.0163
-	1898	-	-	.07	19.17	.0195	.0040	2.00	.5400	.0009	.06	7.9	.0227
-	1899	-	-	.03	17.23	.0117	.0025	1.73	.4988	.0004	.04	6.6	.0113

NOTE to analyses of 1899: Odor, none. —— The samples were collected from the underdrain at its outlet.

Sewage Disposal at Spencer.

Chemical Examination of Sewage from Spencer.

[Parts per 100,000.]

Number.	Date of Collection.	Residue on Evaporation.						Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	
		Total Residue.			Loss on Ignition.				Albuminoid.							
		Total.	Dis-solved.	Sus-pended.	Total.	Dis-solved.	Sus-pended.	Free.	Total.	Dis-solved.	Sus-pended.		Nitrates.	Nitrites.	Unfiltered.	Filtered.
	1899.															
25926	Jan. 10	23.20	17.60	5.60	12.20	6.60	5.60	1.0800	0.3600	.1700	.1900	2.58	.1740	.0260	3.33	2.21
26304	Feb. 20	18.20	11.30	6.90	10.20	3.60	6.60	0.6400	0.3440	.0960	.2480	2.03	.0250	.0260	2.56	1.18
26525	Mar. 14	22.00	14.80	7.20	10.60	4.30	6.30	1.9520	0.4960	.1800	.3160	2.60	.0020	.0000	2.18	1.04
26765	Apr. 11	16.00	11.80	4.20	7.50	3.50	4.00	1.1600	0.4400	.1320	.3080	1.90	.0000	.0000	2.08	0.35
27081	May 11	16.00	10.00	6.00	7.00	3.00	4.00	0.8600	0.2800	.0800	.2000	1.90	.0000	.0000	1.38	0.88
27579	June 24	30.00	18.60	11.40	16.20	5.50	10.70	1.6500	0.3400	.1700	.1700	4.01	.0020	.0000	3.00	1.76
27858	July 22	23.40	18.50	4.90	10.40	7.10	3.30	3.6400	0.3200	.1700	.1500	3.70	.0000	.0000	1.64	0.97
28273	Aug. 18	29.00	21.75	7.25	9.50	5.40	4.10	1.0200	0.4000	.2200	.1800	4.95	.0030	.0000	2.48	1.40
28685	Sept. 19	26.80	14.70	12.10	13.00	7.00	6.00	0.8300	0.4200	.2040	.2160	2.57	.0020	.0000	3.08	1.82
29109	Oct. 23	78.00	21.00	57.00	59.00	8.50	50.50	3.2000	1.1550	.4200	.7350	3.25	.0050	.0012	8.40	2.64
29355	Nov. 10	27.00	16.00	11.00	13.20	5.90	7.30	1.9100	0.4900	.2500	.2400	2.98	.0020	.0000	3.30	2.00
29616	Dec. 11	42.20	25.70	16.50	28.40	12.90	15.50	1.5500	0.6100	.2400	.3700	4.46	.0020	.0000	6.08	4.26
Av.	....	29.31	16.81	12.50	16.43	6.11	10.32	1.6202	0.4712	.1943	.2769	3.08	.0181	.0044	3.29	1.71

The samples were collected as the sewage flowed upon the filter-beds.

Chemical Examination of Effluent from the Sewage Filtration Area at Spencer.

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.			Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.	Iron.
		Turbidity.	Sediment.	Color.		Free.	Albuminoid.		Nitrates.	Nitrites.			
	1899.												
25927	Jan. 10	V. slight.	V. slight.	.01	15.60	.0256	.0058	2.42	0.8200	.0005	.00	4.0	.0010
26305	Feb. 20	None.	V. slight.	.00	12.00	.0680	.0060	2.01	0.2000	.0008	.10	3.3	.0010
26526	Mar. 14	None.	Slight.	.01	10.10	.1632	.0096	1.76	0.2750	.0010	.11	3.6	.0000
26766	Apr. 11	None.	V. slight.	.00	12.50	.4320	.0980	1.80	0.6800	.0009	.10	4.4	.0080
27082	May 9	V. slight.	V. slight.	.00	14.30	.0454	.0078	2.22	0.7100	.0012	.09	3.9	.0020
27580	June 24	V. slight.	V. slight.	.04	19.40	.0320	.0184	2.98	1.2000	.0048	.24	3.9	.0010
27869	July 22	None.	None.	.00	19.30	.0520	.0080	2.95	1.1800	.0024	.12	4.9	.0010
28274	Aug. 18	None.	None.	.00	22.40	.0454	.0060	2.85	0.4400	.0015	.13	5.3	.0010
28686	Sept. 19	None.	V. slight.	.00	18.20	.0408	.0100	3.10	0.9600	.0018	.10	4.3	.0020
29110	Oct. 23	None.	None.	.08	15.70	.0324	.0068	2.62	0.2850	.0001	.10	3.5	.0010
29356	Nov. 10	V. slight.	None.	.07	14.10	.1880	.0070	2.48	0.7300	.0006	.11	3.1	.0030
29617	Dec. 11	None.	V. slight.	.02	16.70	.0704	.0044	2.61	0.9500	.0010	.11	3.9	.0000
Av...	....	....	....	.02	15.86	.1018	.0156	2.48	0.7025	.0014	.12	4.0	.0013

The samples were collected from the underdrain beneath bed J.

FOOD AND DRUG INSPECTION.

FOOD AND DRUG INSPECTION.

The following report comprises the operations of the Board during the year ended Sept. 30, 1899, under the provisions of the food and drug acts.

The Board is required to print an annual report to the Legislature of "the number of prosecutions made under the food and drug acts, and an itemized account of all money expended in carrying out the provisions thereof."

This report was presented to the Legislature March 2, 1900, and is also embodied in the following detailed report of observations for the year.

The general supervision of the work has, as in previous years, in compliance with the regulations of the Board, been under the charge of the secretary. This has included the collection of samples, their examination by the analysts, the prosecution of offenders, and other essential work under these statutes, including the necessary correspondence with various classes of parties who are especially amenable to the action of these statutes.

The following persons comprised the force employed by the Board during the year in this department of work: —

ALBERT E. LEACH,	*Analyst.*
C. A. GOESSMANN,	*Analyst.*
HERMANN C. LYTHGOE,	*Assistant Analyst.*
JOHN F. MCCAFFREY,	*Inspector.*
JOHN H. TERRY,	*Inspector.*
HORACE F. DAVIS,	*Inspector.*
THOMAS O. ALLEN,	*Inspector.*

The number of samples of food and drugs examined during the year is show in the following summary; and the following pages contain a complete summary of the work done since and including 1883 :—

Number of samples of milk examined,	6,186
Number of samples above standard,	4,506
Number of samples below standard,	1,680
Percentage of adulteration or deficiency,	27.2
Number of samples of other kinds of food examined (not milk),	3,069
Number of samples above standard,	2,615
Number of samples below standard,	454
Percentage of adulteration,	14.8
Number of samples of drugs examined,	547
Number of samples of good quality,	303
Number of samples adulterated (as defined by the statutes),	244
Percentage of adulteration,	44.6
Total number of food and drugs examined,	9,802
Total number found to be of good quality,	7,424
Total number not conforming to the statutes,	2,378
Percentage of adulteration,	24.3

STATISTICAL SUMMARY.

FOOD AND DRUG INSPECTION (1883-99).

Summary.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Number of samples of milk examined,	218	1,123	2,219	2,085	3,081	2,825	3,219	3,236	2,726
Number of samples above standard,	35	347	1,297	1,323	1,900	1,705	1,971	1,858	1,629
Number of samples below standard,	183	776	922	762	1,181	1,120	1,248	1,378	1,097
Percentage of adulteration,	83.9	69.1	41.7	36.5	38.3	39.6	38.7	42.6	40.2
Number of samples of other kinds of food examined (not milk),	477	839	1,552	1,353	1,789	2,079	1,635	2,349	2,144
Number of samples of good quality,	328	432	883	863	1,263	1,680	1,242	1,913	1,577
Number of samples adulterated, as defined by the statutes,	149	407	669	490	526	399	393	436	567
Percentage of adulteration,	31.2	48.5	43.1	36.2	29.4	19.2	24.0	18.6	26.4
Number of samples of drugs examined,	603	682	1,007	888	550	862	600	400	424
Number of samples of good quality,	357	431	571	463	400	634	503	325	352
Number of samples adulterated, as defined by the statutes,	246	251	436	425	150	228	97	75	72
Percentage of adulteration,	40.8	36.8	43.3	47.8	27.3	26.4	16.2	18.7	17.0
Total examinations of food and drugs,	1,298	2,644	4,778	4,326	5,420	5,766	5,454	5,985	5,294
Total examinations of good quality,	720	1,210	2,751	2,649	3,563	4,019	3,716	4,096	3,558
Total examinations not conforming to the statutes,	578	1,434	2,027	1,677	1,857	1,747	1,738	1,889	1,736
Percentage of adulteration,	44.5	54.2	42.7	38.7	34.3	30.3	31.9	31.5	32.8
Expense of collection, examination and prosecution,	$2,931 56	$5,529 60	$8,557 43	$8,025 34	$8,803 62	$8,915 41	$10,356 28	$10,013 04	$10,019 41
Expense of collection, examination and prosecution, per sample,	2 26	2 09	1 79	1 85	1 62	1 54	1 89	1 67	1 89

FOOD AND DRUG INSPECTION (1883–99) — *Concluded.*

SUMMARY.	YEARS. 1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	TOTALS.
Number of samples of milk examined,	3,271	3,073	3,551	3,794	4,484	6,046	6,247	6,186	57,384
Number of samples above standard,	1,757	1,545	1,794	1,905	2,904	4,150	4,307	4,506	34,933
Number of samples below standard,	1,514	1,528	1,757	1,889	1,580	1,896	1,940	1,680	22,451
Percentage of adulteration,	46.3	49.7	49.5	49.8	35.2	31.3	31.1	27.2	39.1
Number of samples of other kinds of food examined (not milk),	2,441	3,009	2,836	2,971	3,368	3,944	3,738	3,069	39,598
Number of samples of good quality,	2,042	2,637	2,566	2,379	2,978	3,438	3,238	2,615	32,074
Number of samples adulterated, as defined by the statutes,	399	372	270	592	390	506	500	454	7,519
Percentage of adulteration,	16.3	12.3	9.5	19.9	11.6	12.8	13.4	14.8	19.0
Number of samples of drugs examined,	487	327	487	544	505	690	812	547	10,415
Number of samples of good quality,	312	228	324	212	251	442	531	303	6,639
Number of samples adulterated, as defined by the statutes,	175	99	163	332	254	248	281	244	3,776
Percentage of adulteration,	35.9	30.3	33.5	61.0	50.3	35.9	34.6	44.6	36.3
Total examinations of food and drugs,	6,199	6,409	6,874	7,309	8,357	10,680	10,797	9,802	107,392
Total examinations of good quality,	4,111	4,410	4,684	4,496	6,133	8,030	8,076	7,424	73,646
Total examinations not conforming to the statutes,	2,088	1,999	2,190	2,813	2,224	2,650	2,721	2,378	33,746
Percentage of adulteration,	33.7	31.2	31.9	38.5	26.6	24.8	25.2	24.3	31.4
Expense of collection, examination and prosecution,	$11,180 30	$10,454 11	$10,364 64	$11,375 89	$10,921 61	$12,076 43	$11,062 68	$11,251 83	$161,839 18
Expense of collection, examination and prosecution, per sample,	1 80	1 63	1 52	1 56	1 23	1 13	1 02	1 15	1 51

The following table has been prepared for the purpose of comparing the results of inspection during the earlier years of work under the food and drug acts with those of the later years of the period. Two periods were purposely selected, in order that the amount of work performed in these periods might be compared. The entire number of samples collected and examined in the three years 1883, 1884 and 1885 was less than the number now examined in a single year.

	1883-91.			1892-98.		
	Total.	Adulterated.	Per Cent.	Total.	Adulterated.	Per Cent.
Milk,	20,782	8,667	41.8	30,466	12,104	39.7
Condensed milk,	20	2	10.0	227	19	8.4
Butter,	1,195	338	28.0	2,368	75	3.2
Cheese,	130	1	0.8	343	0	0.0
Vinegar,	1,146	652	57.0	604	275	45.5
Lard,	173	74	43.0	277	52	18.8
Olive oil,	318	206	66.0	211	51	24.1
Spices and condiments,	5,280	1,411	26.7	9,622	1,263	13.1
Coffee,	296	97	33.0	792	148	18.7
Tea,	352	5	1.0	624	26	4.1
Wheat flour,	22	0	0.0	145	5	3.5
Cream of tartar,	1,877	376	20.0	2,609	89	3.4
Molasses,	1,165	212	18.0	1,229	93	7.6
Syrups,	39	13	33.0	83	43	52.0
Maple syrup,	210	89	42.0	273	46	16.8
Maple sugar,	118	44	37.0	247	43	17.4
Honey,	266	118	44.0	450	91	20.2
Confectionery,	285	52	18.0	497	12	2.4
Canned foods,	203	133	66.0	320	111	34.7
Jellies and jams,	61	12	20.0	51	35	68.6
Spirits, wine, beer and cider,	17	7	41.0	175	114	65.1
Drugs,	6,016	1,980	33.0	3,852	1,552	40.3

The following observations may be made in regard to this table. It is not complete. Only the principal articles of food examined are here presented for comparison. There is a large class of miscellaneous articles which do not appear in the table, comprised of a greater variety of different kinds of food which have been collected at different times and for various purposes, often on account of some temporary adulteration, such as occasionally appears and as quickly disappears after it has once been exposed by one or more prosecutions of offenders.

These different varieties of articles cannot fairly be compared with reference to periods of time, since examinations of this character were often confined to a single year or portion of a year.

Of the twenty-two classes of articles shown in the table, with few exceptions, the greater number were examined in the later period of time.

These different classes are here commented upon separately.

Milk and Milk Products. — The statutes require that three-fifths of the appropriation for food and drug inspection shall be expended in enforcing the laws relating to these articles; hence the majority of the articles procured for examination were of this class.

Milk as a food differs from other classes of food so far as adulteration is concerned, since, while it may have been produced under perfectly natural conditions, it may yet be below the standard fixed by statute and hence is deemed to be adulterated. Observations once made by the Board upon the subject of "milk of known purity" showed that if a thousand samples of milk were obtained from as many animals and were submitted to analysis, a considerable number would prove to be below any standard which has been adopted. Hence the 41.8 per cent. of the early and the 39.7 per cent. of the later period do not represent so much actual and intentional adulteration. The work of the first two years, 1883 and 1884, showed an excessive percentage of adulteration, but after inspection and analysis had once been established the amount of actual adulteration has been reduced to a small amount, which does not appear in the published percentages. It is, however, undoubtedly true that continuous and persistent work in this direction is necessary in order to protect the consumers from the frauds that are sure to be practised in the absence of such inspection.

It is worthy of note here that the stringent standard of 1880 (13 per cent. of solids throughout the year) has been modified by several successive amendments. At first a standard of 12 per cent. was made permissible for two months of the year, then for five months and finally for six months, so that the 13 per cent. standard is now in force only for the months from October to March inclusive, and for the remaining months it is 12 per cent.

During the sixteen years comprised in this table very great improvement has taken place in the matter of local inspection. At the beginning of the period there was no local inspection worthy of note in the State. Now nearly every city and some of the larger towns have milk inspectors, regularly appointed, some of whom are equipped with efficient laboratories for the examination of milk. In consequence of this fact a large share of the work of milk inspection has been transferred from the State to local inspectors, and the work of the State Board has therefore been devoted in a greater ratio to the inspection of the milk obtained at the dairies of producers, since the law does not give the local inspector authority to examine milk outside the boundaries of his own city.

Condensed Milk. — This valuable article of food is largely used, in consequence of its less perishable character, and because it contains the nutritious constituents of the milk in portable and compact form. Special attention has been given to this article in recent years, and several prosecutions have been made for violation of the statute. The principal form of adulteration noticed consisted in a deficiency of fat.

Butter. — The whole number of examinations of butter in the sixteen years was 3,563, of which about one-third was examined in the first period and the remaining two-thirds in the last period. There was a very marked improvement, comparing the two periods, the percentage of adulteration falling from 28 per cent. to 3.2 per cent., a fact which was undoubtedly due in some measure to the enactment of several laws since 1883 for the prevention of adulteration of this valuable article of food. A considerable portion of the samples recorded in the first column was obtained during the investigation ordered by the Legislature of 1887. This order was as follows: —

Ordered, That the State Board of Health be requested and required to make a special investigation and report to the next General Court upon the manufacture and sale of oleomargarine and butterine, especially with reference to their healthfulness as articles of food, and as to the question whether they are sold in compliance with existing laws.

The results of this investigation were reported upon in full in the nineteenth annual report of the Board for 1887.

Cheese. — So far as has been shown by the samples of cheese collected and examined, this article would appear to be more free from adulteration in Massachusetts than any other article named in the list. (See statement in analyst's report on page 626, giving reason for this fact.)

Vinegar. — The percentage of samples of vinegar which did not conform to the standard in the first period was 57 and in the latter 45.5. The standard of vinegar was fixed by statute in 1884 (chapter 307), but by a law of 1885, after an investigation of the subject by a legislative committee, the acidity percentage, which had been 5 per cent., was lowered to 4½, and has not been changed since that date. A considerable portion of the samples obtained in the first period were procured with reference to and as an aid to this investigation. The standard of solid residue for cider vinegar, 2 per cent., has not been changed.

Lard. — With reference to this article special legislation was also enacted by the Legislature of 1887, and investigations were made by the Board relative to the quality of lard offered for sale in the market. Samples were prepared by the Board containing known quantities of different ingredients commonly used for the purpose of cheapening this product, and were entrusted to different chemists with the object of securing precision in the methods of analysis. The percentage of adulteration was reduced more than one-half, comparing the two periods.

Olive Oil. — This article is quite generally adulterated by the substitution of some cheaper oil, usually cotton-seed. Comparing the two periods, however, the adulteration has been reduced to but little more than one-third of its former magnitude. In this instance, as well as in many others, experience shows that a case of actual adulteration cannot usually be maintained in court unless the article sold is of a different character from that which is called for by the purchaser or consumer. Hence, if the buyer uses such indefinite terms as "Sweet Oil" or "Salad Oil" in purchasing of a vendor, no complaint can be maintained if the article does not prove to be pure olive oil, or unless it be fraudulently labelled. Instances of extremely adroit methods of evading the law by the use of misleading labels are quite common in connection with the sale of this article.

Spices and Condiments. — Spices are more liable to adulteration than any other class of food, except milk. The percentage of adulteration found to exist in 1883, 1884 and 1885 was, respectively, 65, 50 and 48 per cent. and for the period 1883–91 it was 26.7 per cent.; but it has fallen to an average of only 13.1 per cent. in the period 1892–98.

The forms and ingredients of adulteration are very numerous and consist mostly of powdered substances of very cheap and worthless character.

A singular instance of spice adulteration occurred during last year, that of the substitution of wild mace for mace, the former being the cheaper product. The courts decided this to be a violation of the statutes. (See report of 1898, p. 685.)

Coffee and Tea. — While adulterated coffee is one of the most common forms of falsification found in our markets, adulterated tea is comparatively rare.

At the beginning of operations under the food acts in 1883, the markets were still flooded with the cheap imitations of coffee which became so common soon after the civil war. They were mostly put up in packages containing one pound in each package, the mixture containing variable percentages of chicory, roasted peas, beans, wheat, rye and other cereals. They were usually sold at a much lower price than pure coffee. There is now a considerable demand for coffee substitutes, and many brands of roasted cereals find a ready sale and are mostly labelled honestly.

At the present time the adulterations of coffee are chiefly those which consist of a mixture, the chief ingredients of which are usually pure coffee in the proportion of 60 to 80 per cent., the remainder consisting either of chicory or cereals or both, the whole being sold either in bulk or in packages of two to five pounds or more. These are usually labelled as blended or mixed coffee, or often as pure coffee, but quite as often they bear a misleading label, which, after considerable study, appears to indicate a mixture.

The general result of analyses of coffee shows a reduction from 33 per cent. to 18.7 per cent., comparing the two periods.

Several years ago an artificial coffee berry was invented, having a very close resemblance to the genuine roasted berry. It was undoubtedly believed by the manufacturers that this imitation could be used successfully by mixing it with roasted, unground coffee berries in certain proportions. The false berries, however, being made of roasted starch or of similar material, lacked the most important characteristic of genuine coffee, the taste or flavor. Hence as an adulteration they proved a failure, especially in states where food inspection is practised.

The examination of *teas* shows a remarkable freedom from adulteration, the whole number of samples collected being 976, with only

31 adulterated samples. The ratio of adulteration in the later period was greater than that of the first, but this fact has little significance, since the absolute numbers in each case were quite small.

Wheat Flour. — The entire number of samples of wheat flour examined in both periods was only 167, of which 5 were adulterated, or 3.5 per cent., the adulterant being in each case the flour or meal of Indian corn. The sensational statements of the public press published during the past year relative to flour adulteration do not appear to be confirmed so far as examinations made in Massachusetts are concerned.

Cream of Tartar. — The early inspections made by the Board showed an excessive adulteration of cream of tartar, the substances in use for this purpose being very numerous. Phosphate and sulphate of lime, corn-starch and alum were the chief substitutes. But a few prosecutions and careful inspection of the markets had a marked effect in clearing the State of very much of the impure material which had hitherto been sold as cream of tartar.

It appears by the report of 1884, p. 138, that out of a total of 232 samples collected, 77, or 33.2 per cent., were found to be below an assumed standard of 90 per cent. of pure cream of tartar. Only 1 sample contained more than 98.1 per cent. of pure cream of tartar and only 23 contained over 95 per cent. On the other hand, in the reports of 1897 and 1898, it appears that only 29 samples out of 799 which were examined, or but little more than 3½ per cent., were adulterated. The whole number of samples examined in the first period, 1883–91, was 1,877, with a ratio of adulteration of 20 per cent., and in the later period, 1892–98, 2,609, with a ratio of only 3.4 per cent.

Baking Powders. — The whole number of samples examined was 178. They were found free from ingredients whose use would be harmful under the ordinary conditions in which baking powders are used. It would be difficult to define adulteration of baking powders, since no standard of this class of preparations exists other than that which has been arbitrarily proposed in accordance with the claims of rival manufacturers. Popular notions, derived from the well-paid advertisements of baking-powder manufacturers, are exaggerated.

Molasses. — The ratio of adulteration of molasses was reduced from 18 per cent. in 1883–91 to 7.6 per cent. in the later period, 1892–98. The action of the Board in regard to the adulteration of molasses with salts of tin had a decided effect in suppressing this form of adulteration, and the principal adulterant now in use with the view of cheapening the product is glucose.

Syrups. — Only 122 samples of syrups (sold under this name without further specification) were examined, and the figures relating to this article have little significance in consequence of the indefinite character of the word "syrup." No complaints were entered in court in which this word "syrup" was employed, since the term is generic, not specific. (Several complaints have been entered in England for adulteration of so-called "golden syrup," and convictions were secured in these cases.)

With maple syrup, however, the case is quite different. The difference in price between maple syrup and common syrup is an incentive to adulteration, and, as a consequence, glucose has formed the chief adulterant of this article. Wholesale dealers or manufacturers were, as a rule, the parties against whom complaints were entered, and as a result the ratio of adulteration has been diminished more than one-half, comparing the two periods, the actual figures being 42 per cent. for the first period and 16.8 for the second period.

In the case of maple sugar the adulterants are usually some of the different forms of cane sugar, with which maple sugar is almost identical in composition. Hence the cheaper forms are employed as adulterants. The ratio of adulteration of this article also was diminished more than one-half, or from 37 per cent. to 17.4 per cent., comparing the two periods.

Honey. — The whole number of samples of this article examined was 716, of which 266 were examined in the first period and 450 in the later. The ratio of adulteration was diminished from 44 per cent. to 20.2 per cent., or more than one-half. The methods of deception practised were many and in some cases ingenious. The use of beeswax made up in sheets and stamped in such a manner as to facilitate the deposit made by the bee is not considered an adulterant, since it is made of beeswax and is used to assist the bee and save time in comb manufacture.

The chief adulterant of honey is glucose. Liquid honey put up in jars, tumblers, etc., is more liable to adulteration than that which is sold in the comb.

Confectionery. — The term "confectionery" embraces a variety of substances, among which different varieties of sugar are the most prominent. Starch, chocolate, fruit, nuts, flavoring substances and coloring matters are also used, so that a standard of purity would be difficult to define. Under the statutes, chapter 171, Acts of 1886, confectionery is deemed to be an article of food and hence amenable to the laws relating to adulteration; but the lack of any definite standard of this article makes it difficult to consider any ingredient as an adulterant unless it is an actively harmful substance, and this is practically the position taken by the American Confectioners' Association.

At the beginning of operations under the food acts, in 1883, occasional instances of the use of poisonous colors in confectionery occurred, but a few prosecutions put an end to the practice, and for the past few years no cases have been found. The whole number of samples examined in the two periods was 782; and the ratio of adulteration was reduced from 18 per cent. to 2.4 per cent.

Canned Food. — The use of air-tight receptacles, either of glass or metal, for the preservation of certain articles of food has several decided advantages.

1. The preservation of perishable food products for long periods of time.

2. The possibility of furnishing certain foods throughout the year which, in the fresh state, are limited to certain seasons.

3. Convenience of transportation, without loss or injury, from places of abundance to those of scarcity or even of famine. Also for use at sea upon long voyages, and for the use of armies in the field.

There are also certain disadvantages in connection with the canning of food, especially of meat. These are summarized by Dr. J. Brown in the Journal of the Sanitary Institute as follows:* —

The poison is probably due to one of the ptomaines, which are of bacteriological origin, and may have been produced: —

1. Before the meat was canned.
2. After canning.
3. After being opened.

In the first, the toxic properties are probably rendered inert by the steaming process. In the second, the can is usually in the condition technically known as "blown," and third, after being opened, foods are rapidly acted upon by bacteria which form toxines, some of which are more dangerous than mineral poisons.

* Vol. 19, 1898, p. 61.

Another source of danger is the character of the metal in which the food is preserved, and also of the solder used in sealing the cans. Corrosion of the inner plated surface of the can often occurs, the metal being dissolved by the acid contents of the can. The metals thus dissolved are chiefly tin and lead, each of which is harmful. The twenty-sixth report of the Board (p. 740) contains a plate which shows the effect of corrosion upon the inner plating of a can which contained blueberries.

The German law forbids the importation of canned foods where the tin used in plating contains more than 1 per cent. of lead, or more than 10 per cent. in the solder.

The paper referred to (Dr. Brown's) contains a list of twenty-five instances in which about 100 persons in all were poisoned by the use of canned meats, fish and fruits. All these cases occurred in England.

The ratio of adulteration of this class of food in this State was reduced from 66 per cent. to 34.7, comparing the two periods.

It is only just to this industry to state that the excessive percentage of the early period is accounted for by the fact that very many of the samples examined in the early period were those of imported French vegetables, colored with copper sulphate, and those reported in the later period as adulterated contained variable quantities of tin or lead in the contents of the cans.

A law was enacted in 1897 providing that canned foods should be marked so as to indicate their quality or grade, and should bear the name and address of the parties who packed them. The same law also provided that all canned articles prepared from dried products should be plainly marked with the word "soaked." A scarcity in the pea crop in 1899 forced into the market a considerable quantity of these goods illegally marked. A few prosecutions, however, produced a marked improvement in this direction.

Jellies and Jams. — Within the past few years adulteration has found in this class of goods a fruitful field of operation. Not many years ago the principal constituents of such articles were chiefly fruit, sugar and water, but the tendency to cheapen the product has led to the introduction of glucose instead of cane sugar, of cheaper instead of the more expensive fruits, and of aniline dyes to imitate the color of genuine fruits. This industry has largely increased within a few years and accounts for the higher percentage of adulteration in the second period as compared with the first. The law of 1897 (chapter 344) applies with special force to this class of food, since it requires that they shall be "distinctly labelled as mixtures or compounds, with the name and per cent. of each ingredient." Inspection, however, has shown that, while such labels have been quite generally affixed to the packages, it is quite common to find the percentage of the cheaper ingredients considerably in excess of the statement printed on the label.

Drugs. — An examination of the figures relating to the inspection of drugs shows an increase of adulteration, when the later period is compared with the earlier. The difference, however, is more apparent than real, since a careful retrospect of the work of the board in this direction shows that in the earlier years of operation a much greater variety of articles was examined than at present, and many of these were not subject to adulteration. In the examinations conducted in 1885, for example, 125 different sorts of drugs were examined, and in several instances all the samples of a particular kind were found to conform to the standard. In the examinations made in 1883, all the samples of alcohol, ether, tartaric acid, calomel, borax, several salts of iron, antimony, silver, morphia and magnesia conformed to the pharmacopœial standard.

In the analysis of 192 samples of powdered officinal drugs made in that year only 39 specimens, or 23 per cent., were found to be below the standard requirement. These included 26 different kinds of powdered drugs, and among these every specimen out of 15 sorts proved to be pure. Hence, in later years, it has been the practice to examine chiefly those articles which are known to be subject to adulteration, and in the work of 1897 and 1898 about 50 different articles only were selected for examination; the resulting percentage of adulteration of the whole number was, therefore, considerably greater than that of the earlier period.

The number of samples of drugs examined in the sixteen years was 13,400. The ratio of adulteration in the first period was 33 per cent. and that of the later period was 40.3 per cent. The reasons for this apparent increase have been explained.

The principal articles liable to adulteration appear to be the following: spirits of nitrous ether, tincture of opium, the pharmacopœial wines and liquors, distilled water, compound spirits of ether, tincture of iodine, olive oil, extract of liquorice, chlorinated lime, fluid extract of ginger, precipitated sulphur, powdered jalap, ipecac and saffron.

NOTICES.

Cities and Towns to which Notices were sent on Account of Adulterated Milk in 1899.

Attleborough,	2	Natick,	1
Barre,	1	New Bedford,	2
Beverly,	3	Newton,	5
Boston,	8	North Adams,	1
Cambridge,	5	North Easton,	1
Canton,	1	Peabody,	1
Chelsea,	4	Quincy,	4
Dedham,	2	Revere,	3
Everett,	1	Salem,	3
Fall River,	3	Somerset,	1
Fitchburg,	3	Somerville,	11
Gloucester,	5	Stoughton,	2
Grafton,	1	Sudbury,	1
Haverhill,	3	Waltham,	3
Hyde Park,	3	Watertown,	3
Malden,	1	Westford,	1
Manchester,	1	Winthrop,	2
Marlborough,	3	Woburn,	3
Medford,	1		
Milford,	1	Total,	103
Nantucket,	3		

Cities and Towns to which Notices were sent on Account of Adulterated Articles of Food other than Milk.

Allston,	1	Lawrence,	2
Boston,	24	New Bedford,	3
Brookline,	1	Newton,	2
Cambridge,	12	Salisbury,	1
Chicopee Falls,	1	Spencer,	1
Clinton,	1	Springfield,	2
Dedham,	1	Somerville,	1
Fall River,	11		
Fitchburg,	2	Total,	68
Franklin,	2		

Cities and Towns to which Notices were sent on Account of Adulterated Drugs.

Boston,	6	Spencer,	1
Chicopee,	1		
Fitchburg,	1	Total,	10
Mansfield,	1		

Prosecutions.

The following condensed summary is presented in accordance with the custom which has been followed in the reports of the past seven years.

The following table presents the same figures, with the addition of the data relating to the prosecutions conducted during the year ended Sept. 30, 1899 : —

Number of Complaints entered in Court.

Year.	Food (not including Milk).	Drugs.	Milk.	Total.	Convictions.	Fines Imposed.
1883,	-	5	4	9	8	-*
1884,	2	1	45	48	44	-*
1885,†	50	1	68	119	103	-*
1886,‡	10	-	10	20	19	-*
1887,	30	-	34	64	60	-*
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	96	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
Totals,	516	41	825	1,382	1,273	$32,238 44

* No record kept. † To May 1, 1886. ‡ Four months only.

Ratio of convictions to complaints, 92 per cent.

Note.— All complaints entered before May 1, 1886, were under the direction of the Board of Health, Lunacy and Charity, and all after that date were under the direction of the State Board of Health.

The number of prosecutions made against offenders during the year was 47, and the number of convictions 45.

Several causes have contributed to the reduction in the number of complaints entered in court, among which the following may be named : —

1. The action of the statutes. The reduction of standards. Since the beginning of the operations of the Board under the

food and drug acts, in 1883, several statutes have been enacted, providing certain changes in the standards of articles of food. These were the reduction of the standard of vinegar from 5 per cent. to 4½ per cent. by the provisions of chapter 150 of the Acts of 1885, and the reduction of the standard of milk from 13 to 12 in certain months by chapters 318 of the Acts of 1886, 398 of 1896, and 223 of 1899.

By the provisions of chapter 425, Acts of 1894, limitations and restrictions were placed upon the inspectors with reference to the manner of taking samples at dairies or in the possession of producers. By chapter 169 of the Acts of 1899 it was further provided that "analysis of the sample shall, within ten days of the procurement thereof, be sent to the person from whom the sample was obtained." By chapter 300 of the present year (1900) additional measures are provided by which the amount of the fine for selling milk "not of good standard quality is in certain cases placed at the discretion of the court."

2. The food and drug statutes were enacted for the protection of the community, not only for the consumers, who constitute the entire population, but for the producers, manufacturers, wholesalers and retailers, who supply the consumers either directly or indirectly. The effect of a thoroughly enforced system of inspection is to protect all. In the course of such inspection it is only practicable to secure the best results by obtaining the different samples of food and drugs in the same manner as they are obtained by the consumers, and for this purpose an inspector must be unknown to the vendor in a majority of cases, otherwise he is liable to obtain only such articles as the vendor knows to be absolutely pure. Fortunately, fair dealing and honesty are characteristic of the majority of dealers; but the law is intended for the protection of the community against the minor portion, which is constantly endeavoring to devise new forms of fraud and deception. Hence the fact, that a corps of inspectors constantly moving about among the retailers for the purpose of securing compliance with the statutes becomes yearly more and more known as inspectors, and the difficulty of obtaining samples of food which are adulterated or below the standard increases.

3. Growth of local inspection. For nearly forty years a law has existed providing for the inspection of certain articles of food in cities and towns. The law required the appointment of inspectors in every city but made such appointment permissive in the towns.

This law was practically inoperative, however, during the first twenty years of its existence as a statute. Nothing worthy of the name of inspection had been done in any city. Inspectors had been appointed, licenses were issued to milkmen, and occasional samples of milk were examined by means of the unreliable lactometer; but thorough milk analysis was not conducted until the work of the State Board of Health in 1883 and 1884 showed the need of a better state of affairs.

Efficient inspection of milk requires the employment of a chemist and the possession of a well-equipped laboratory for the proper performance of his work. Such inspection has been thoroughly carried out for fifteen years or more in Boston, and was followed by its introduction in Cambridge, Lowell, Malden and other cities, and in some of the large towns. For this reason the inspection of milk, as conducted at first by the State Board of Health in the cities and towns, has been diminished, but has given place to another line of work, which has been necessitated by the fact that the work of a local inspector is limited by the boundaries of his city or town, while the milk furnished to the people of such places is mostly produced outside of the limits of the cities or towns, and, contrary to the popular notion, a very large share of the milk adulteration is conducted before the milk reaches the city limits. Hence the State authority is called upon to ascertain the source of adulteration, since no authority is given to the local inspector to act beyond his own jurisdiction.

4. Another cause contributing to the decrease in the number of prosecutions consists in the constant endeavor of the Board to reach the guilty party in each case of adulteration. A system of notification or warning, described in previous reports, has been devised for the purpose of giving the retailer information as to the quality of articles obtained from him, and found to be below the standard of purity. In the majority of instances the only safeguard which the retailer possesses with reference to the goods which he sells is the established character or reputation of the wholesaler from whom he obtains them.

A considerable proportion of the food supply of Massachusetts, including many important and staple articles, is produced outside the State, since Massachusetts is a manufacturing and not a food-producing State. Hence in many instances it has been found impossible to convict the responsible food producer or manufacturer, his place of business being outside the limits of the State. It was, therefore, found expedient to publish his name or that of the firm in the bulletins of the Board, a method which has usually been productive of good results.

5. The existence of an actual improvement in the condition of the markets with reference to food adulteration. The figures already presented on page 581 show very clearly that the operations of the Board have secured a decidedly improved condition in the majority of articles of the food supply which were liable to adulteration.

During the first years of work under the food and drug acts convictions were easily obtained because adulteration had, up to 1883, been untrammelled by legislation; but after several years the effect of well-enforced statutes became generally known, adulteration was largely held in check, and prosecutions naturally diminished in number.

The following report was sent to the Legislature March 2, 1900: —

OFFICE OF THE STATE BOARD OF HEALTH,
STATE HOUSE, BOSTON, March 2, 1900.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The following summary is made in compliance with the provisions of chapter 289, section 2, of the Acts of 1884, requiring the State Board of Health to "report annually to the Legislature the number of prosecutions made under chapter 263 of the Acts of 1882, and an itemized account of all money expended in carrying out the provisions thereof."

The whole number of prosecutions made by authority of the Board against offenders, under the provisions of the food and drug acts, for the year ending Sept. 30, 1899, was 47.

The cities and towns in which the articles were sold, and in respect to which complaints were entered in court, the character of the articles found to be adulterated, or fraudulently sold, the dates of the trials, and their results, are presented in the following table: —

MILK AND MILK PRODUCTS.

For Fraudulent Sales of Milk.

PLACE.	DATE.	RESULT.
Cambridge,	May 22, 1899,	Convicted.
Somerville,	May 22, 1899,	"
Somerville,	May 22, 1899,	"
Somerville,	Sept. 28, 1899,	"

For Fraudulent Sales of Milk — Concluded.

Place.	Date.	Result.
Chelsea,	Oct. 29, 1898,	Convicted.
Gloucester,	Jan. 27, 1899,	"
Gloucester,	Aug. 2, 1899,	"
Taunton,	Jan. 31, 1899,	"
Medford,	March 24, 1899,	"
Woburn,	Sept. 7, 1899,	Discharged.
Ashland,	Oct. 29, 1898,	Convicted.
Ashby,	Oct. 24, 1898,	"
Marblehead,	Jan. 27, 1899,	"
Marblehead,	Aug. 11, 1899,	"
Dedham,	Aug. 13, 1899,	"
Swampscott,	Aug. 30, 1899,	"
Southborough,	June 14, 1899,	"
Rockport,	July 31, 1899,	"
Rockport,	July 31, 1899,	"
Weston,	Aug. 3, 1899,	"
Manchester,	Aug. 5, 1899,	"
Littleton,	Aug. 18, 1899,	"
Littleton,	Aug. 18, 1899,	"
Dover,	Aug. 25, 1899,	"
Hopkinton,	Sept. 12, 1899,	"
Grafton,	Sept. 12, 1899,	"

Butter.

Chicopee,*	May 11, 1899,	Convicted.

Molasses.

Fall River,	Dec. 20, 1898,	Convicted.
Boston,	May 16, 1899,	"
Boston,	May 23, 1899,	Discharged.
Boston,	Sept. 20, 1899,	Convicted.
Boston,	Sept. 21, 1899,	"
New Bedford,	Aug. 10, 1899,	"

Pepper.

North Adams,	Feb. 23, 1899,	Convicted.
Chelsea,	Feb. 8, 1899,	"
Boston,	March 11, 1899,	"

Cloves.

North Adams,	Feb. 23, 1899,	Convicted.

Allspice.

North Adams,	Feb. 23, 1899,	Convicted.

* The complaints against this man contained six charges, two each for selling oleo colored as butter, for not marking package and for selling as butter under Acts of 1891.

Mustard.

Place.	Date.	Result.
Boston,	March 11, 1899,	Convicted.

Coffee.

Fall River,	Dec. 6, 1898,	Convicted.
Chelsea,	Dec. 31, 1898,	"

Maple Syrup.

Fall River,	Dec. 20, 1898,	Convicted.
Boston,	March 14, 1899,	"

Maple Sugar.

Malden,	March 24, 1899,	Convicted.
Watertown,	March 28, 1899,	"

DRUGS.

Tincture of Opium.

Boston,	April 12, 1899,	Convicted.
Boston,	April 12, 1899,	"

Complaints entered in court under the provisions of acts relating to

	Cases.
Milk,	26
Butter,	1
Other articles of food,	18
Drugs,	2
Total,	47

SUMMARY.

The whole number of complaints entered by the State Board of Health during the year ending Sept. 30, 1899, in the courts of the Commonwealth, against parties for violation of the statutes relating to food and drug inspection, was 47. In 45, or 95.7 per cent. of these, the parties were convicted; 2 were discharged.

Of the whole number, 27 were for violation of the statutes relating to the adulteration of milk and milk products, and of this number 26 resulted in conviction. The greater number of these were for violation of the statutes providing that milk offered for sale shall be of good standard quality. In 3 of the foregoing cases the complaints were for sales of milk containing coloring matter.

Attention is respectfully called to the provisions of section 23 of chapter 397 of the Acts of 1896, by which the people are now deprived of the legal protection which they enjoyed under the poison act of 1888 against the harmful action of poisonous patent medicines.

All of the parties except one against whom complaints were entered in the courts for fraudulent sales of other kinds of food were convicted. The articles of food and drugs with reference to which these complaints were made were as follows: —

Molasses, 6 cases; pepper, 3 cases; coffee, 2 cases; cloves, allspice and mustard, 1 each; maple syrup, 2 cases; maple sugar, 2 cases; tincture of opium, 2 cases.

Since there still appears to be considerable doubt on the part of retailers and others with reference to the provisions of the act of 1897 relative to food adulteration, the act is herewith published for general information: —

[Acts of 1897, Chapter 344.]

An Act relative to the Adulteration of Food.

Section 1. No person shall within this Commonwealth manufacture for sale, offer for sale, or sell any article of food which is adulterated within the meaning of this act.

Section 2. The term "food" as used herein, shall include all articles used in food or drink by man, whether simple, mixed or compound.

Section 3. An article shall be deemed to be adulterated within the meaning of this act in the case of food: — 1. If any substance or substances have been mixed with it, so as to lower or depreciate or injuriously affect its quality, strength or purity. 2. If any inferior or cheaper substance or substances have been substituted wholly or in part for it. 3. If any valuable or necessary constituents or ingredient have been wholly or in part taken from it. 4. If it is in imitation of or is sold under the name of another article. 5. If it consists wholly or in part of a diseased, decomposed, putrid, tainted or rotten animal or vegetable substance or article, whether manufactured or not, or, in the case of milk, if it is produced from a diseased animal. 6. If it is colored, coated, polished or powdered in such a manner as to conceal its damaged or inferior condition, or if by any means it is made to appear better, or of greater value, than it really is. 7. If it contains any added substance or ingredient which is poisonous or injurious to health: *provided*, that the provisions of this act shall not apply to mixtures or compounds recognized as ordinary articles or ingredients of articles of food, if every package sold or offered for sale is distinctly labelled as a mixture or compound, with the name and per cent. of each ingredient therein, and if such mixtures or compounds are not injurious to health.

SECTION 4. No person shall offer for sale any canned articles of food after the first day of January in the year eighteen hundred and ninety-eight, except goods packed prior to the passage of this act, unless such articles bear a mark to indicate the grade or quality thereof, together with the name and address of the person, firm or corporation which packed the same, or of the dealer who sells the same.

SECTION 5. All canned articles of food prepared from dried products which have been soaked before canning shall be plainly marked by an adhesive label, having on its face the word "soaked," in letters not less in size than two line pica, of legible type; and all cans, jugs and other packages containing maple syrup or molasses shall be plainly marked by an adhesive label, having on its face the name and address of the person, firm or corporation which made or prepared the same, together with the name and quality of the ingredients of the goods, in letters of the size and description above-specified.

SECTION 6. Any person, firm or corporation falsely stamping or labelling any cans, jars or other packages, containing fruit, or food of any kind, or knowingly permitting such false stamping or labelling, and any person, firm or corporation violating any of the provisions of this act, shall be deemed guilty of a misdemeanor, and shall be punished by a fine of not less than ten dollars nor more than one hundred dollars in the case of vendors, and in the case of manufacturers and those falsely or fraudulently stamping or labelling such cans, jars or other packages, by a fine of not less than one hundred dollars nor more than five hundred dollars.

SECTION 7. All acts and parts of acts inconsistent herewith are hereby repealed.

Frequent inquiry having been made relative to the meaning of the term "two-line Pica" of legible type, as employed in this statute, the following line is presented as a sample: —

TWO LINE PICA.

The following statute, as amended in 1899 (by chapter 223 of the Acts of that year), presents the standard of milk in Massachusetts at the date of publishing this report: —

[ACTS OF 1899, CHAPTER 223.]

In all prosecutions under this chapter, if the milk is shown upon analysis to contain less than thirteen per cent. of milk solids, or to contain less than nine and three-tenths per cent. of milk solids exclusive of fat, or to contain less than three and seven-tenths per cent. of fat, it shall be deemed for the purposes of this act to be not of good standard quality, except during the months of April, May, June, July, August and September, when milk containing less than twelve per cent. of milk solids, or less than nine per cent. of milk solids exclusive of fat, or less than three per cent. of fat, shall be deemed to be not of good standard quality.

The whole number of samples of food and drugs examined in this department since the beginning of work in 1883 was 107,393, and the number of complaints entered in court was 1,382. The average cost per sample for collection, analysis and other work has been reduced from $2.26 in 1883 to $1.14 in 1899.

The following list presents the total solids in each of the samples of milk upon which complaints were founded, so far as records of the same were kept: —

8.75	10.30	11.33
8.98	10.67	11.35
9.13	10.72	11.46
9.49	10.98	11.58
9.76	11.26	11.63
10.13	11.26	11.72
10.22	11.30	11.80

The total number of samples of food and drugs examined during the year was as follows: —

Milk,	6,186
Other articles of food,	3,069
Drugs,	547
Total,	9,802
Total expenses of collection, examination and prosecution,	$11,251 83
Average expense per sample collected,	1 14

Fines.

The amount of fines paid into the treasuries of counties, cities and towns under the provisions of the general and special laws relative to the inspection of food and drugs was as follows: —

Fines paid for Violation of the Food and Drug Acts upon Cases entered for the Year ending Sept. 30, 1899.

Under the provisions of the laws relating to milk and milk products,	$995 46
Under the provisions of the laws relating to other articles of food,	397 20
Under the provisions of the laws relating to drugs,	40 00
Total,	$1,432 66

The total amount of fines imposed since the beginning of the enforcement of the general food acts to Sept. 30, 1899, was $33,238.44.

EXPENDITURES

Under the Provisions of the Food and Drug Acts during the Year ending Sept. 30, 1899.

	For the Enforcement of the Statutes relating to Food and Drug Inspection.	
	Relative to Milk and Milk Products.	Relative to Other Kinds of Food and Drugs.
Salaries of analysts,	$2,300 00	$1,575 48
Salaries of inspectors,	2,500 00	1,550 00
Travelling expenses and purchase of samples,	1,203 50	600 00
Apparatus and chemicals,	672 50	449 22
Printing,	16 97	4 70
Special investigation,	-	50 00
Extra services for inspection,	27 00	161 00
Services (cleaning laboratory),	73 20	48 80
Express,	1 25	30
Telegram,	-	42
Case for samples,	7 50	-
Sundry laboratory supplies,	5 00	4 99
	$6,806 92	$4,444 91
		6,806 92
Total,	. . .	$11,251 83

REPORT OF THE ANALYST.

REPORT OF THE ANALYST.

Dr. S. W. Abbott, *Secretary of State Board of Health.*

Dear Sir: — I herewith submit my report on the analysis of food and drugs for the year ending Sept. 30, 1899.

So many inquiries have been received as to the analytical methods employed in the laboratory that it has been thought best to briefly outline, or at least indicate in many cases under the proper headings, the principal methods employed, especially where experience has shown a particular line of procedure to be best adapted to the case in hand. It has been found to be a matter of some comment that such a large number of samples as our statistics show (nearly 10,000) are examined by the comparatively small working force employed. This is rendered possible by the fact that in most cases only those samples found to be adulterated are examined in detail, so that for economy in time it becomes necessary to employ quick processes for separating the good from the poor, attention being chiefly paid to the adulterated samples.

When it is remembered that only about 25 per cent. of the samples of food and drugs brought in for examination are actually adulterated, it will be seen that the task is not an extraordinary one. It is, moreover, an obvious advantage to restrict the number of those handling the samples for analysis in order to avoid unnecessary complication in cases of prosecutions in the courts.

Milk.

Methods. — All the samples of milk brought in by the collectors are examined for total solids, and those standing below 12 per cent. are further tested for fat. For the total solids 5 grammes of each sample are evaporated in a platinum dish for at least two hours in direct contact with the live steam of a boiling water bath. The fat is obtained by the well-known Babcock process.

Tests for artificial coloring matter were given in full in the analyst's report of last year,* but the following is a summarized method of procedure: —

Summary of Scheme for Color Analysis.†

[Curdle 150 cubic centimeters of milk in casserole with heat and acetic acid. Gather curd in one mass. Pour off whey, or strain if curd is finely divided. Macerate curd with ether in corked flask. Pour off ether.]

<table>
<tr><th>Ether Extract.</th><th colspan="2">Extracted Curd.</th></tr>
<tr><td rowspan="2">Evaporate off ether, treat residue with sodium hydroxide and pour on wetted filter. After the solution has passed through, wash off fat and dry filter, which if colored orange indicates presence of annatto.
(Confirm by stannous chloride.)</td><td colspan="2">(1) If colorless. — Indicates presence of no foreign color other than in ether extract.
(2) If orange or brownish. — Indicates presence of aniline orange or caramel. Shake curd in test tube with concentrated hydrochloric acid.</td></tr>
<tr><td>If solution gradually turns blue; indicative of caramel.
(Confirm by testing for caramel in whey of original milk.)</td><td>If orange curd immediately turns pink, indicative of aniline orange.</td></tr>
</table>

For preservatives, formaldehyde is best tested for by heating about 10 cubic centimeters of the milk with an equal quantity of concentrated hydrochloric acid and a drop of ferric chloride. A violet coloration is produced if formaldehyde be present, delicate to one part formaldehyde in 100,000.

Boracic acid is tested for by soaking turmeric paper in a solution of the milk ash, acidified slightly with hydrochloric acid. On drying the turmeric paper, a cherry red color indicates the presence of boracic acid.

The presence of carbonate of soda is shown by an effervescence on treating the ash with acid, and may further be tested for by the well-known rosolic acid test.

Another month, viz., September, has been added to those in which the 12 per cent. standard prevails, so that under the present law the legal standard for milk solids is 13 per cent. from October to March inclusive, and 12 per cent. from April to September inclusive. Another drop in the percentage of adulteration of milk for the year is shown, viz., from 31.1 per cent., the ratio of adulteration in 1898, to 27.2 per cent. for the year herein reported.

The accompanying diagram shows the variation in percentage of adulterated samples of milk examined during the seventeen years in which the milk laws have been enforced in Massachusetts, beginning with 1883.

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* Thirtieth annual report State Board of Health, p. 697.

† Leach. Jour. Am. Chem. Soc., Vol. XXII., p. 207.

There are many reasons for the variations in this curve aside from the actual variation in the quality of the milk. The falling off in the percentage of adulteration during the last three years, for example, may not be due to any actual improvement in the quality of

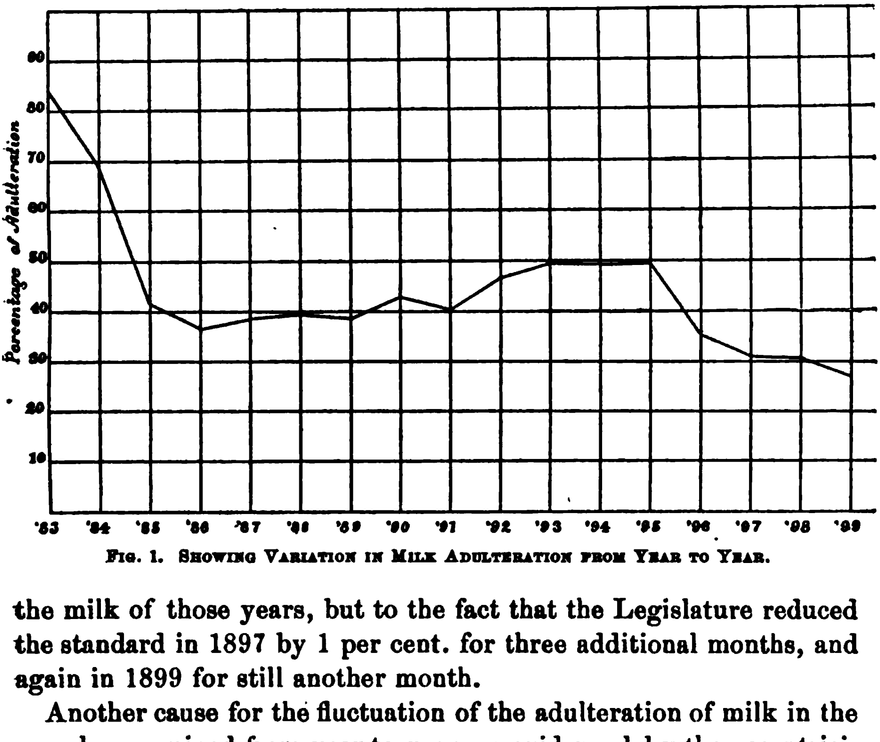

FIG. 1. SHOWING VARIATION IN MILK ADULTERATION FROM YEAR TO YEAR.

the milk of those years, but to the fact that the Legislature reduced the standard in 1897 by 1 per cent. for three additional months, and again in 1899 for still another month.

Another cause for the fluctuation of the adulteration of milk in the samples examined from year to year, as evidenced by the eccentricities of the line in the diagram, is that in some years a large number of samples of milk of known purity have been taken, which would, of course, bring down the ratio of adulteration perceptibly. This is noticeable in 1886. On the other hand, as in 1893, 1894 and 1895, an unusually large number of samples were brought in from suspected producers, thus causing the percentage of adulteration to increase. It is true, however, that the quality of the milk actually produced has deteriorated somewhat during the last decade by the increase in the number of Holstein cows. Indeed, at the present time the Holstein is by far the most common cow to be found in the producer's herd in Massachusetts. That the Holstein is the favorite is by no means strange, for it would seem to be true that no other breed of cow can, with moderate feeding, be made to give so large a quantity of milk. For this reason it is true that the average Holstein herd is apt to give milk somewhat below the standard in total solids. The best authorities, however, claim that by proper attention to the feeding the quality of the Holstein milk can be sufficiently improved to bring it well above the standard, but as this result is accomplished at the expense of the quantity, it is not an experiment that the average producer cares to try.

The following tables show the number and quality of milk samples collected from various localities throughout the State:—

Milk from Cities.

CITIES.	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Skimmed Samples.	Number of Colored Samples.	Number of Preserved Samples.
Boston, . . .	431	329	102	23.6	10.78	6	-	-
Brockton, . .	163	108	55	33.7	10.05	-	-	-
Cambridge, . .	401	286	115	28.7	9.67	1	1	3
Chelsea, . .	265	178	87	32.8	10.85	-	-	-
Everett, . . .	87	50	37	42.5	11.21	-	-	7
Fall River, . .	240	174	66	27.5	9.98	-	-	4
Fitchburg, . .	104	72	32	30.8	10.85	6	-	-
Gloucester, . .	195	143	52	26.7	9.49	-	-	-
Haverhill, . .	148	110	38	25.7	10.03	-	-	-
Lawrence, . .	138	110	28	20.3	11.83	5	-	2
Lowell, . . .	15	6	9	60.0	11.06	-	-	-
Malden, . . .	172	117	55	31.9	10.60	-	-	-
Marlborough, .	40	34	6	15.0	11.30	2	-	-
Medford, . .	208	166	42	20.2	8.75	-	-	3
New Bedford, .	30	22	8	26.7	9.45	-	-	-
Newburyport, .	52	43	9	17.3	12.17	1	-	-
Newton, . .	190	157	33	16.8	11.70	2	-	4
North Adams, .	52	38	14	26.9	10.03	2	-	2
Quincy, . . .	104	75	29	27.9	11.04	3	-	-
Salem, . . .	147	118	29	19.7	9.40	-	2	4
Somerville, . .	576	342	234	40.6	9.55	-	18	35
Springfield, . .	15	13	2	13.3	11.26	-	-	1
Taunton, . .	66	56	10	15.1	11.58	3	-	-
Waltham, . .	115	81	34	29.5	10.50	-	-	-
Woburn, . .	122	79	43	35.2	10.96	-	-	-
Worcester, . .	100	68	32	32.0	12.00	-	-	-
Totals, . .	4,176	2,975	1,201	28.7	8.75	31	21	65

Milk from Towns.

TOWNS.	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Skimmed Samples.	Number of Colored Samples.	Number of Preserved Samples.
Amesbury, . .	11	10	1	9.1	11.43	-	-	-
Amherst, . .	20	12	8	40.0	11.68	-	-	-
Attleborough, .	76	64	12	15.8	9.59	-	-	1
Beverly, . .	59	38	21	35.6	11.20	-	-	3
Brookline, . .	158	132	26	16.5	11.90	1	-	3
Canton, . . .	40	33	7	17.5	11.12	-	-	-
Clinton, . . .	17	12	5	29.4	12.64	4	-	-
Cottage City, .	19	19	-	0.0	12.15	-	-	-
Dedham, . .	99	74	25	25.2	10.30	-	-	1
Easton, . . .	7	6	1	14.3	11.76	-	-	-
Framingham, .	27	24	3	11.1	12.04	-	-	-
Hyde Park, . .	123	90	33	26.8	10.12	-	-	3
Hull, . . .	19	17	2	10.5	11.42	-	-	-
Manchester, . .	27	22	5	18.5	10.67	-	-	-
Marblehead, . .	15	11	4	26.7	10.22	-	-	-
Milford, . .	45	42	3	6.7	11.99	1	-	-
Nantucket, . .	28	23	5	17.9	11.05	-	-	-
Natick, . . .	64	58	6	9.1	11.60	-	-	-
Peabody, . .	9	2	7	77.8	11.12	-	-	-
Plymouth, . .	18	18	-	0.0	12.40	-	-	-
Provincetown, .	9	9	-	0.0	12.58	-	-	-
Revere, . . .	101	72	29	28.7	10.59	-	-	-
Rockland, . .	14	13	1	7.1	11.98	-	-	-
Rockport, . .	15	9	6	12.0	9.13	-	2	-
Salisbury, . .	16	15	1	6.2	11.73	-	-	-
Stoneham, . .	57	50	7	12.3	12.66	13	-	-
Stoughton, . .	83	59	24	28.9	9.45	-	-	-
Swampscott, .	10	9	1	10.0	11.60	-	-	
Wareham, . .	20	18	2	10.0	10.53	-	-	2
Watertown, . .	82	61	21	25.6	10.27	1	-	-
Westborough, .	32	29	3	9.4	11.63	3	-	-
Whitman, . .	18	17	1	5.6	11.15	-	-	-
Winchester, . .	59	49	10	16.9	12.13	-	-	-
Winthrop, . .	106	77	29	27.3	11.17	-	-	-
Totals, . .	1,503	1,194	309	20.5	9.13	23	2	13

Milk from Suspected Producers.

Locality.	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Samples.
Ashland,	18	18	-	-	12.20
Barre,	48	32	16	33.3	6.50
Beverly,	16	16	-	-	12.35
Dedham,	25	9	16	64.0	10.20
Dover,	18	14	4	22.2	9.76
Framingham,	18	-	18	100.0	9.60
Grafton,	6	-	6	100.0	8.96
Holliston,	7	-	7	-	12.25
Hopkinton,	17	11	6	35.2	11.30
Lexington,	17	6	11	64.7	11.30
Littleton,	27	15	12	44.4	10.72
Norwood,	5	5	-	-	-
Sharon,	5	5	-	-	-
Somerset,	25	25	-	-	11.70
Southborough,	30	19	11	36.7	11.65
Sudbury,	18	9	9	50.0	11.88
Waltham,	20	19	1	5.0	11.75
Wenham,	18	14	4	22.2	11.83
Westborough,	7	7	-	-	12.15
Westford,	7	3	4	57.1	11.48
Weston,	23	16	7	30.5	9.60
Westwood,	9	9	-	-	13.48
Woburn,	14	11	3	21.4	10.92
Totals,	398	263	135	34.0	6.50

Summary of Milk Statistics.

	Total Samples Collected.	Above Standard.	Below Standard.	Per Cent. below Standard.	Total Solids in Lowest Sample.	Number of Skimmed Samples.	Number of Colored Samples.	Number of Preserved Samples.
Cities,	4,176	2,975	1,201	28.7	8.75	31	21	55
Towns,	1,503	1,194	309	20.5	9.13	23	2	13
Suspected producers,	398	263	135	34.0	6.50	-	-	-
Miscellaneous,	14	3	11	78.6	9.96	-	-	3
Totals,	6,091	4,435	1,656	27.2	6.50	54	23	71

In the foregoing tables only those samples of milk that are actually below the legal standard have been classed as adulterated, to conform to the custom of past years. As a matter of fact, however, milk is quite often found above the standard both in solids and fat, but which is actually adulterated by reason of the addition of foreign matter, such as artificial color, preservatives, etc. Such milk has not heretofore been included in the adulterated series. As a rule, milk containing artificial coloring matter is usually below the standard as well, by reason of watering, though there are exceptions to this. On the contrary, milk containing preservatives is more often found to be above the standard. As many as 49 samples examined during the year were found to be adulterated by reason of the addition of foreign substances, and yet were above the legal standard of solids. Among these were several samples which, through unclean methods of handling, contained notable quantities of excreta and stable dirt, which constitute the very worst form of milk adulteration.

Twenty-three samples of milk were found to be artificially colored, the color found being in all cases annatto. These were collected in Cambridge, Rockport, Salem and Somerville.

Preservatives in Milk.

Seventy-one samples of milk, or 11.6 per cent. of the entire number collected, were found to contain a preservative. Of these, 13 contained boracic acid, 55 were found with formaldehyde and 3 contained carbonate of soda. Samples of milk found to be thus preserved were collected in Cambridge, Everett, Fall River, Lawrence, Medford, North Adams, Newton, Salem, Somerville, Attleborough, Brookline, Beverly, Dedham, Hyde Park and Wareham.

This year all samples of milk collected during June, July, August and September were examined for preservatives.

In the analyst's report for 1897 (p. 559) is given a table showing the result of experiments with milk containing formaldehyde in different proportions, the milk samples being kept on ice during the term of the experiment. Further tests were made this year as to the keeping qualities of various commonly used antiseptics, present in varying strength, the milk being kept not on ice, but at the temperature of the laboratory, which was about 20 degrees Centigrade. The preservatives were added about five hours after milking. The following table shows the result:—

Action of Various Preservatives on Milk.

Preservative.	First Day.		Second Day.		Third Day.			Fourth Day.			Fifth Day.		
	Acidity.	Condition.	Acidity.	Condition.	Acidity.	Condition.	When Curdled.	Acidity.	Condition.	When Curdled.	Acidity.	Condition.	When Curdled.
Blank,	0.78	Sweet.	0.96	Sweet.	3.95	Sour.	1½ days.	-	-	-	-	-	-
Sodium carbonate:													
1:1,000,	-	Sweet.	0.75	Sweet.	4.05	Sour.	1½ days.	-	-	-	-	-	-
1: 500,	-	Sweet.	0.75	Sweet.	4.05	Sour.	1½ days.	-	-	-	-	-	-
1: 250,	-	Sweet.	0.75	Sweet.	4.05	Sour.	2 days.	-	-	-	-	-	-
Boracic acid 75 per cent., borax 25 per cent.:													
1:2,000,	-	Sweet.	0.96	Sweet.	4.04	Sour.	1½ days.	-	-	-	-	-	-
1:1,500,	-	Sweet.	1.05	Sweet.	1.64	Sweet.	-	4.28	Sour.	2½ days.	-	-	-
1:1,000,	-	Sweet.	1.19	Sweet.	1.44	Sweet.	-	4.31	Sour.	3 days.	-	-	-
1: 500,	-	Sweet.	1.50	Sweet.	1.52	Sweet.	-	2.18	Sweet.	-	3.80	Sour.	4 days.
Boracic acid 25 per cent., borax 75 per cent.:													
1:2,000,	-	Sweet.	1.00	Sweet.	2.77	Sweet.	-	4.18	Sour.	2½ days.	-	-	-
1:1,500,	-	Sweet.	1.00	Sweet.	1.95	Sweet.	-	4.21	Sour.	2½ days.	-	-	-
1:1,000,	-	Sweet.	1.04	Sweet.	1.27	Sweet.	-	4.25	Sour.	3 days.	-	-	-
1: 500,	-	Sweet.	1.12	Sweet.	1.40	Sweet.	-	1.71	Sweet.	-	4.20	Sour.	4 days.
Formaldehyde:													
1:50,000,	0.78	Sweet.	0.80	Sweet.	1.09	Sweet.	-	3.92	Sour.	2½ days.	-	-	-
1:20,000,	0.78	Sweet.	0.79	Sweet.	0.81	Sweet.	-	1.26	Sweet.	-	4.15	Sour.	4 days
1:10,000,	0.78	Sweet.	0.78	Sweet.	0.80	Sweet.	-	0.91	Sweet.	-	0.96	Sweet.	-
1: 5,000,	0.78	Sweet.	0.78	Sweet.	0.79	Sweet.	-	0.87	Sweet.	-	0.89	Sweet.	-

Action of Various Preservatives on Milk — Concluded.

Preservative.	Sixth Day.		Seventh Day.			Eighth Day.		Ninth Day.		Tenth Day.		Eleventh Day.		
	Acidity.	Condition.	Acidity.	Condition.	When Curdled.	Acidity.	Condition.	Acidity.	Condition.	Acidity.	Condition.	Acidity.	Condition.	When Curdled.
Blank,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium carbonate:														
1:1,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1: 500,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1: 250,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boracic acid 75 per cent., borax 25 per cent.:														
1:2,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:1,500,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:1,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1: 500,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boracic acid 25 per cent., borax 75 per cent.:														
1:2,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:1,500,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:1,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1: 500,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Formaldehyde:														
1:50,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:20,000,	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1:10,000,	1.29	Sweet.	4.10	Sour.	5½ days.	-	-	-	-	-	-	-	-	-
1: 5,000,	0.92	Sweet.	0.93	Sweet.	-	0.94	Sweet.	0.96	Sweet.	1.10	Sweet.	1.32	Sour.	10½ days.

The samples were titrated for acidity each morning, the acidity being expressed by the number of cubic centimeters of decinormal sodium hydroxide necessary to neutralize 5 cubic centimeters of the milk.

The proportions of preservatives used in the above table were intended to cover a very wide range, from the very weakest that could possibly aid in preserving the milk up to a strength limited only by being perceptible to the taste. A sample of milk treated with 1 part of formaldehyde in 2,500 parts of milk kept for fifty-five days before curdling.

Various so-called "boric mixtures" are found on the market for the use of milkmen, being mixtures of boracic acid and borax in varying proportions. In the above table two of such mixtures were employed, in one of which the boracic acid predominated, and in the other the borax. A mixture of 25 per cent. boracic acid and 75 per cent. borax was found on the whole a better preservative than the one mixed in reversed order. Carbonate of soda was shown to have little or no value as a milk preservative.

In the case of formaldehyde the antiseptic power increases in a marked degree as the strength of this preservative is increased. In the strength of 1 part to 10,000, for instance, the milk kept sweet five and one-half days. In the strength of 1 part to 5,000 the milk did not curdle for ten and one-half days, while 1 part of formaldehyde to 2,500 of milk kept the milk from curdling for fifty-five days, the acidity up to that time being nearly normal.

Formaldehyde is thus shown to be decidedly the best of all milk preservatives. Whether or not it is harmful remains an open question. It should be borne in mind, however, that the use of preservatives or *any* foreign substance in milk is illegal.

Milk dealers are still led to believe by artful dealers in preservative preparations that the latter cannot be detected in milk. The manufacturer of a largely used preservative, known as "Freezine" (which is a weak solution of formaldehyde), issues an attractive pamphlet in which he makes the following remarkable claims: —

"It is not an adulterant. . . . It immediately evaporates, so that no trace of it can be found, as soon as it has rendered all the bacteria inert. . . . No chemical analysis can prove its presence in the milk quantitatively or otherwise."

Its use in milk is also claimed by the manufacturer to be beneficial to the health of infants, many of whom have been saved from sick-

ness and even death, they allege, by a liberal use of "Freezine" in the milk!

Table showing General Quality of Milk sold during December and June† in Various Cities and Towns.*

	December.								June.							
	Number of Samples.	Total Solids.			Fat.			Solids not Fat (Average Per Cent).	Number of Samples.	Total Solids.			Fat.			Solids not Fat (Average Per Cent).
		Highest Per Cent.	Lowest Per Cent.	Average Per Cent.	Highest Per Cent.	Lowest Per Cent.	Average Per Cent.			Highest Per Cent.	Lowest Per Cent.	Average Per Cent.	Highest Per Cent.	Lowest Per Cent.	Average Per Cent.	
Cities.																
Boston,	52	14.15	12.82	13.44	5.40	4.00	4.53	8.41	32	16.63	12.02	12.67	7.80	3.35	4.02	8.65
Brockton,	-	-	-	-	-	-	-	-	14	15.40	10.86	12.96	6.45	3.00	4.26	8.70
Cambridge,	18	14.60	12.02	13.27	6.10	3.65	4.44	8.83	46	13.84	10.88	12.61	4.85	2.70	3.90	8.71
Chelsea,	31	14.36	11.67	13.18	6.15	2.90	4.44	8.74	17	13.49	11.75	12.48	4.85	3.00	3.78	8.75
Everett,	15	15.01	11.21	13.11	6.60	3.05	4.54	8.57	15	13.75	11.32	12.77	4.90	2.50	4.15	8.62
Fall River,	29	15.90	11.40	13.19	6.20	3.80	4.69	8.50	16	16.80	11.14	12.83	8.40	3.20	4.44	8.39
Fitchburg,	17	14.87	12.13	13.38	5.90	3.60	4.51	8.77	-	-	-	-	-	-	-	-
Gloucester,	-	-	-	-	-	-	-	-	28	16.25	10.75	12.69	7.50	2.20	3.83	8.76
Lawrence,	15	13.90	11.44	13.28	5.00	2.50	4.31	8.87	-	-	-	-	-	-	-	-
Lowell,	14	15.79	11.05	12.73	6.90	3.65	4.31	8.42	-	-	-	-	-	-	-	-
Malden,	15	14.43	11.63	13.13	5.40	3.40	4.19	8.94	13	13.10	10.83	12.22	4.55	2.30	3.73	8.49
Marlborough,	-	-	-	-	-	-	-	-	16	14.29	11.30	12.76	5.40	3.00	3.99	8.77
Medford,	15	15.03	10.93	13.10	6.00	2.40	4.08	9.02	13	14.06	11.47	12.92	5.40	3.25	4.25	8.67
Newburyport,	19	15.19	12.69	13.40	6.40	4.05	4.59	8.81	-	-	-	-	-	-	-	-
Newton,	11	13.99	11.10	13.21	4.90	2.60	4.19	9.02	-	-	-	-	-	-	-	-
North Adams,	47	15.60	12.10	13.45	6.00	3.40	4.57	8.89	-	-	-	-	-	-	-	-
Quincy,	13	13.90	10.88	12.78	5.10	2.40	4.07	8.71	21	14.64	11.70	13.08	5.50	3.40	4.23	8.85
Salem,	8	15.00	12.70	13.44	5.75	3.75	4.56	8.88	-	-	-	-	-	-	-	-
Somerville,	26	16.86	11.72	13.29	8.50	2.40	4.47	8.82	37	16.90	10.80	12.34	8.80	2.10	3.90	8.44
Springfield,	-	-	-	-	-	-	-	-	15	13.77	11.26	12.81	4.90	3.20	4.23	8.58
Taunton,	17	16.44	11.89	13.40	6.45	3.40	4.76	8.64	-	-	-	-	-	-	-	-
Waltham,	-	-	-	-	-	-	-	-	16	13.50	11.13	12.54	4.60	2.90	3.81	8.73
Woburn,	28	15.86	11.29	13.00	6.70	2.80	4.23	8.77	12	14.08	11.60	12.34	5.90	3.80	3.93	8.41
Worcester,	18	14.30	12.00	13.12	5.10	3.70	4.23	8.89	-	-	-	-	-	-	-	-
Summary,	403	16.86	10.88	13.21	8.50	2.40	4.37	8.74	311	16.90	10.75	12.67	8.80	2.10	4.03	8.54
Towns.																
Beverly,	4	14.05	13.74	13.89	4.80	4.40	4.62	9.27	-	-	-	-	-	-	-	-
Brookline,	-	-	-	-	-	-	-	-	17	15.71	12.10	12.92	7.10	3.40	4.21	8.71
Dedham,	10	14.40	12.20	13.49	5.40	3.50	4.43	9.06	-	-	-	-	-	-	-	-
Framingham,	15	14.86	12.04	13.51	5.70	3.30	4.50	9.01	-	-	-	-	-	-	-	-
Hull,	-	-	-	-	-	-	-	-	4	13.18	12.30	12.81	4.30	3.80	4.01	8.80
Hyde Park,	14	13.77	12.20	13.22	4.80	3.60	4.13	9.09	16	14.40	10.99	12.75	5.00	3.20	4.13	8.62
Natick,	14	14.00	12.02	13.24	6.00	3.50	4.53	8.71	-	-	-	-	-	-	-	-
Stoughton,	-	-	-	-	-	-	-	-	13	14.20	11.30	12.81	4.95	3.00	4.08	8.73
Watertown,	6	14.33	12.17	13.19	5.10	4.40	4.42	8.77	11	13.14	11.75	12.42	4.50	3.00	3.83	8.59
Wenham,	18	14.26	12.48	13.23	5.00	3.85	4.43	8.80	-	-	-	-	-	-	-	-
Weston,	4	13.81	13.20	13.62	4.50	4.20	4.39	9.23	-	-	-	-	-	-	-	-
Winchester,	4	13.89	13.00	13.57	5.20	4.30	4.73	8.84	15	13.87	12.13	13.06	4.90	3.25	4.29	8.84
Winthrop,	10	15.48	12.26	13.45	6.65	3.80	4.61	8.84	-	-	-	-	-	-	-	-
Summary,	99	15.48	12.02	13.44	6.65	3.50	4.48	8.96	76	15.71	10.99	12.63	7.10	3.00	4.09	8.54
Summary of cities and towns,	502	16.86	10.88	13.32	8.50	2.40	4.42	8.85	387	16.90	10.75	12.65	8.80	2.10	4.06	8.54

* Stall-fed cows. † Pasture-fed cows.

Bearing on the question of difference in normal quality of milk during the winter, or stall-fed season, and during the summer, or pasture-fed period, the foregoing table is of interest. December and June were selected as being months most typical of the two respective periods, and during these months all samples collected were analyzed for total solids and fat. The law recognizes a difference in total solids of 1 per cent. in these two periods, the standard being 13 per cent. of total solids in the winter period (of which 9.3 per cent. are solids not fat) and 12 per cent. in the summer (of which 9 per cent. are solids not fat).

It should be noted that the figures in this table refer to milk as it is sold to the consumer, as well as to milk as produced at the dairy.

It has long been supposed that, as a general rule, milk from the towns would be found of better quality than that from the cities, but this is not found to be true in any such marked degree as was anticipated. It is true, the winter milk does average some 0.2 of a per cent. higher in total solids in the towns than in the cities, but this is not true of the summer milk.

In preparing the above table all samples collected during the months named in the various cities and towns were analyzed in full, deducting, however, in obtaining the averages, all samples of skimmed milk, as well as all samples standing above 17 per cent. of total solids or under 10.75 per cent., so that the averages would show as closely as possible the quality of milk actually produced and sold to the consumer. It would seem as if the summer standard of 12 per cent. of total solids were too low, in view of the actual figures shown in the table, and that the standard for solids not fat is too high, both in winter and in summer. It is interesting to note that the average of all samples examined for both months stands at just 13 per cent. of total solids, of which 4.24 per cent. is fat and 8.76 per cent. is solids not fat.

Samples of milk were brought in for analysis, taken from a dealer in western Massachusetts, on whose milk route there were some twenty families who were undoubtedly made seriously sick by the use of the milk. After a careful search a cow was finally found in the milkman's herd affected with a sore udder and showing a temperature of 104 degrees. Milk taken from this cow was found to contain, on examination under the microscope, a considerable quantity of pus. This milk mixed with the rest was probably the cause of the trouble.

At the end of each month a report is submitted in which the samples analyzed during the month are classified with reference to their percentage of total solids.

The following table is a summary of the twelve monthly reports thus submitted for the year, showing the quality of the milk by months: —

Quality of Milk by Months.

	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total.
Number having more than 15 per cent. of total solids, .	20	14	19	25	24	16	21	13	10	18	23	16	219
Number having between 14 and 15 per cent. of total solids,	36	60	51	57	49	38	54	41	17	37	38	36	514
Number having between 13 and 14 per cent. of total solids,	199	227	279	233	201	237	189	144	110	117	129	128	2,193
Number having between 12 and 13 per cent. of total solids,	202	162	115	182	187	218	224	221	215	312	246	265	2,449
Number having between 11 and 12 per cent. of total solids,	47	20	23	25	18	26	29	37	57	75	89	73	518
Number having between 10 and 11 per cent. of total solids,	27	3	8	5	2	12	4	12	18	13	13	9	124
Number having between 9 and 10 per cent. of total solids,	4	1	1	5	4	4	5	5	8	10	5	6	58
Number having between 8 and 9 per cent. of total solids,	-	-	-	-	-	-	-	-	5	-	1	1	7
Number having less than 8 per cent. of total solids, .	1	-	-	-	-	-	-	-	5	-	-	-	6
Number samples of skimmed milk above the standard,	5	1	1	5	1	1	6	2	3	-	1	-	26
Number samples of skimmed milk below the standard,	1	1	1	2	3	1	-	1	-	3	-	3	16

Cream.

Of 23 samples examined, 4 proved to be adulterated, 2 with formaldehyde and 2 with boracic acid.

Condensed Milk and Evaporated Cream.

The universally accepted meaning of the term "condensed milk," in this country, is milk both condensed and preserved with sugar, being what is commonly known in England as "preserved milk." The "evaporated cream" is in reality whole milk condensed and canned without added sugar.

Methods.—Forty grammes of the thoroughly mixed sample are weighed out and made up to 100 cubic centimeters with water. For total solids, an aliquot part of this solution is further diluted with an equal amount of water, and 5 cubic centimeters of the diluted mixture, corresponding to 1 gramme of the condensed milk, is evaporated over the live steam of a boiling water bath for at least three hours and the residue weighed in a platinum dish.

For the ash, the residue from the total solids, as above obtained, is carefully burnt and weighed.

For the fat, which is the most important factor in determining the purity of the sample, the following modification of the method described in the analyst's report for 1896* has been adopted and has

* Twenty-eighth annual report of the State Board of Health, p. 630.

proved most satisfactory, — a method applicable to those samples preserved with cane sugar, — the chief precautions necessary being to remove the cane sugar, which would otherwise, by charring, interfere with the fat reading if the ordinary Babcock method were used.

Twenty-five cubic centimeters of the 40 per cent. solution, corresponding to 10 grammes of the original milk, are measured into the ordinary test bottle for milk fat determination used in the Babcock machine. The bottle is then filled nearly to the neck with water, the contents shaken and 4 cubic centimeters of a solution of copper sulphate of the approximate strength of Fehling's copper solution is added. The bottle is then well shaken and whirled in the centrifuge until the precipitate, which consists of the proteids and the fat, has settled out. The clear supernatant liquid, which contains the sugar in solution, is drawn off by means of a pipette having sufficient capacity, a small wisp of absorbent cotton being lightly twisted about the lower end of the pipette to serve as a filter. If a suction pump is available, it will be found convenient for this purpose. After the liquid is drawn up into the pipette, the cotton wad is removed from its lower end by rubbing against the inside of the neck of the bottle, and the pipette is withdrawn. The precipitate is washed twice as above by decantation, taking care to thoroughly mix the settled precipitate with the wash water. If the precipitate cakes down hard, it may be desirable to use a platinum wire as a stirrer. After the final washing, sufficient water is added to amount to about the normal volume of 17.6 cubic centimeters (the quantity of milk usually measured for the Babcock test). The contents of the bottle are thoroughly mixed and the regular amount of sulphuric acid is added, viz., 17.5 cubic centimeters.

From this point on, the usual Babcock centrifuge method is followed. Multiplying the final reading by 1.8 we get the percentage of fat. This method is considered more accurate than the ordinary Soxhlet extraction method, by reason of the fact that the cane sugar present forms a hard mass when dried on the Soxhlet coil, thereby rendering the extraction of the fat by the ether somewhat difficult. The fat in "evaporated creams" is best obtained by the ordinary Babcock method.

For the proteids, 5 cubic centimeters of the 40 per cent. solution originally prepared are diluted further to about 40 cubic centimeters, and just enough of the Fehling copper solution is added, drop by drop, to precipitate the albuminoids, taking care to avoid an excess of copper. Strain through a weighed filter paper, wash, dry in an air oven at 100 degrees Centigrade and weigh. The filter with the dry precipitate is then carefully burnt in a porcelain crucible, and the difference between the weight of the dry precipitate and the weight of the ash is the weight of the proteids and fat. Expressing this in percentage and deducting from it the per cent. of fat previously obtained, the result is the per cent. of proteids.

For the milk sugar, the filtrate and the washings from the preceding operation are made up to 100 cubic centimeters with water, and the amount of reducing sugar, obtained volumetrically by Fehling's solution, is reckoned as milk sugar.

The cane sugar is obtained by deducting the milk solids (viz., the sum of the milk sugar, proteids, fat and ash) from the total solids first obtained.

The analyses of 45 samples of condensed milk are given in full in the following table, arranged in the order of their fat contents: —

Condensed Milk.

Brand.	Total Solids.	Water.	Milk Solids.	Cane Sugar.	Milk Sugar.	Protein.	Fat.	Ash.	Fat in Original Milk.	Price per Pound (Cents).
Hero,	72.74	27.26	27.23	45.01	7.00	7.71	11.40	1.62	6.46	-
Tip Top,	79.03	20.97	34.54	44.49	12.88	8.49	11.40	1.77	4.56	11
Rose,	76.40	23.60	32.93	43.47	11.97	7.86	11.40	1.70	4.93	12
Eclipse,	73.97	26.05	32.10	41.85	10.47	8.47	11.40	1.76	5.13	11
Russell's,	67.98	32.02	29.22	38.76	7.61	8.61	11.25	1.75	5.86	-
Rival,	80.00	20.00	34.76	45.24	13.40	8.58	11.10	1.73	4.37	9
Sweetbriar,	71.67	28.83	35.89	35.78	15.78	7.79	11.10	1.77	4.18	9
Purity,	66.66	33.34	28.21	38.45	8.37	7.12	11.10	1.62	6.00	12
Thistle,	72.50	27.50	31.64	40.86	10.64	8.84	10.80	1.80	4.83	8
Leader,	75.07	24.93	28.50	46.57	10.47	5.36	10.80	1.87	5.86	12
Pine Tree,	71.14	28.86	32.16	39.98	12.50	7.39	10.74	1.58	4.66	12
Defiance,	74.29	25.71	32.39	41.90	11.97	8.46	10.65	1.29	4.61	12
Vermont,	75.37	24.63	28.01	47.36	9.05	6.84	10.50	1.62	5.30	-
Maine,	74.80	25.20	34.90	39.90	18.96	8.71	10.50	1.73	4.18	10
Windmill,	73.41	26.59	35.00	38.41	16.75	6.21	10.50	1.54	4.32	11
Union,	78.86	21.14	32.89	45.97	11.96	8.71	10.50	1.72	4.37	-
Thistle,	71.38	28.62	31.24	40.14	10.64	8.49	10.50	1.61	4.71	8
Ensign,	75.12	24.88	32.95	42.17	12.14	8.78	10.35	1.68	4.25	11

Condensed Milk — Concluded.

BRAND.	Total Solids.	Water.	Milk Solids.	Cane Sugar.	Milk Sugar.	Protein.	Fat.	Ash.	Fat in Original Milk.	Price per Pound (Cents).
Eclipse,	74.28	25.72	32.47	41.81	11.17	9.28	10.35	1.67	4.36	11
Milkmaid,	77.50	22.50	34.56	42.94	12.88	9.53	10.29	1.86	3.94	17
Mayflower,	68.43	31.57	34.62	33.81	15.48	7.39	10.20	1.55	3.90	-
Thistle,	72.85	27.15	31.56	41.29	10.64	8.86	10.20	1.86	4.43	8
Baby,	71.50	28.50	32.51	38.99	12.88	7.98	10.20	1.50	4.25	21
Lilly,	73.30	26.70	31.37	42.03	11.50	7.78	10.20	1.79	4.51	7
Our Own,	78.92	21.08	31.81	47.11	11.96	8.08	10.05	1.72	4.29	-
Eclipse,	75.74	24.26	33.44	42.30	12.88	8.87	10.05	1.64	4.00	11
Tulip,	74.51	25.49	35.68	38.82	16.75	7.21	9.90	1.82	3.57	-
Magnolia,	73.37	26.63	33.62	39.75	15.95	6.61	9.75	1.31	3.80	11
Acme,	71.17	28.83	31.08	40.09	11.96	7.72	9.75	1.65	4.24	7
Winooski,	68.98	31.02	26.15	42.83	7.44	7.51	9.60	1.60	5.39	12
Sachem,	73.02	26.98	32.73	40.29	13.40	8.09	9.60	1.64	3.05	-
Our Own,	77.08	22.29	34.34	42.69	16.25	6.75	9.54	1.80	3.22	-
Durham,	88.81	11.19	28.54	60.27	11.96	5.10	9.45	2.03	4.02	12
Milkmaid,	74.82	25.18	30.76	44.06	11.55	8.26	9.45	1.50	4.12	17
Hires,	70.33	29.67	31.57	38.76	11.96	8.66	9.30	1.65	3.89	-
Model,	71.30	28.70	31.71	39.59	12.88	7.96	9.15	1.72	3.76	7
Honeysuckle,	71.97	28.03	31.37	40.60	12.40	8.12	9.15	1.68	3.28	10
Purity,	68.97	31.03	34.12	34.82	16.25	7.55	8.70	1.65	3.18	9
Moosehead,	72.02	27.98	31.85	40.17	13.12	8.70	8.40	1.63	3.33	7
Beacon,	71.20	28.80	33.05	38.15	14.44	8.51	8.40	1.70	3.17	10
Ruby,	74.89	25.11	35.95	38.94	16.25	9.49	8.40	1.81	2.83	12

Evaporated Cream.

BRAND.	Total Solids.	Water.	Milk Sugar.	Protein.	Fat.	Ash.	Fat in Original Milk.
Imperial Cream,	36.00	64.00	11.56	11.63	12.00	1.72	4.69
Viking Unsweetened Condensed Milk,	36.77	63.23	12.88	11.83	10.50	2.00	3.71
Superb Cream,	31.25	86.75	12.88	7.02	9.60	1.23	3.95
Highland Cream,	30.60	63.40	12.50	7.76	9.60	1.63	4.26

Condensed Milk and Cocoa.

Brand.	Total Solids.	Water.	Cane Sugar.	Fat.	Ash.
Milkmaid, ...	73.93	26.07	45.80	6.45	2.63

The fat in the original milk has been computed for each sample as well as the price per pound, in the case of condensed milk.

None of the samples of condensed milk examined during the year were found to be adulterated. There is, however, a wide variation in the price per pound, as will be seen in the last column of the table, and it is by no means true that the higher priced milks stand the highest in butter fat.

Foods exclusive of Milk.

More than 85 per cent. of the food samples, exclusive of milk, brought in for examination are found to be pure, and the quickest possible methods consistent with accuracy are employed to sift out the pure samples, so that most of the time may be spent in a careful examination of those adulterated.

The following diagram shows the variation in percentage of adulterated samples of food, exclusive of milk, examined during the period since the food and drugs act has been in force, viz., from 1883 to and including 1899: —

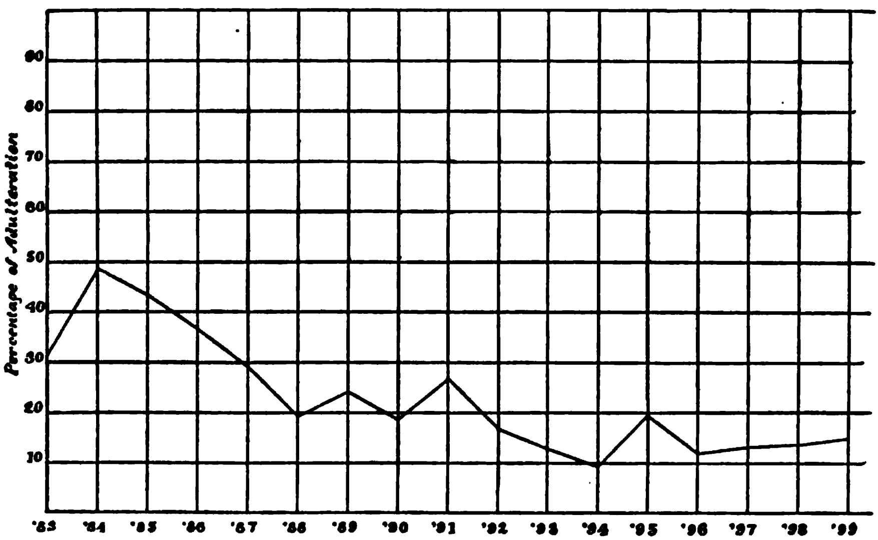

Fig. 2. Showing Variation in Food Adulteration (exclusive of Milk) from Year to Year.

There are various reasons to account for the variations of this curve. When foods were first examined, in 1883, the collection of samples was made somewhat indiscriminately from the whole field, including many articles of food afterward found to be rarely, if ever, subject to adulteration. Experience soon showed, however, just what kinds of food were most apt to be adulterated, and in the following year, 1884, as might be expected, the ratio of adulteration ran considerably higher, and from that time on for a period of five or six years it steadily dropped, owing to the efforts of the department in confining its attention to a few of the typically adulterated foods. Variations in the line since that time are due largely to the fact that new and different lines of adulterated foods are from time to time discovered, so that one could hardly expect a smooth curve.

A considerable number of compound articles of food have been examined, and if simply marked "compound" were classed as adulterated in accordance with section 3, chapter 344 of the Acts of 1897, which requires that in the case of mixtures or compounds the name and per cent. of each ingredient appear distinctly upon the label. While, as would naturally be supposed, there have been many evasions of this statute, there have been a number of instances of a desire on the part of manufacturers to comply with the law.

As examples of labels marked in accordance with the compound law are the following: —

Hotel Coffee Mixture. — *Ingredients:* 50 per cent. coffee, 5 per cent. wheat, 12 per cent. rye, 14 per cent. malt, 2 per cent. caramel, 9 per cent. chicory, 8 per cent. peas.

Homeopathic Cocoa. — *A compound.* Guaranteed to be one-half cocoa, one-quarter arrow-root and one-quarter pure sugar.

Butter.

Methods. — The Zeiss Refractometer furnishes the most ready means of discriminating between butter and oleomargarine. The Reichert number on the volatile fat acids is the chief reliance in court cases, the principal method of procedure being that set forth in Bulletin 13, No. 1, of the Department of Agriculture, division of chemistry, page 56.

Nine samples of oleomargarine were found of the 229 samples examined.

Owing to the extensive use of boracic acid in butter in Great Britain, as reported in the English food journals, a search has been made for boracic acid in samples of butter collected in Massachusetts, but none have been found thus preserved. The probable reason for the wide-spread use of this antiseptic in England is due to the fact that there unsalted butter is the rule, while in Massachusetts very little of the unsalted variety is found.

Canned Goods.

Thirty-one samples of canned fruits and vegetables, which had been kept from one to eight months in the laboratory before examination, were analyzed for tin and lead. The results are given in the following table: —

Canned Goods.

QUALITY.	Brand.	Received.	Examined.	Capacity of Can in Cubic Centimeters.	Tin (Grammes).	Lead (Grammes).	Copper (Grammes).
Strawberries,	Popular, . .	Jan. 1899.	Feb. 1899.	615	.0393	.00043	-
Raspberries, .	Navy, . . .	Jan. 1899.	Feb. 1899.	615	.0725	.00010	-
Raspberries, .	Webster, . .	Jan. 1899.	Feb. 1899.	615	.0848	.00020	-
Blueberries, .	Eagle, . . .	Jan. 1899.	Feb. 1899.	615	.1981	.00120	-
Blueberries, .	Eagle, . . .	Jan. 1899.	Feb 1899.	615	.0056	.00217	-
Blueberries, .	- -	Jan. 1899.	Feb. 1899.	615	.2226	.00080	-
Tomatoes, .	Monarch, . .	Jan. 1899.	Mar. 1899.	950	.0515	.00060	.0009
Tomatoes, .	Manilla, . . .	Jan. 1899.	Mar. 1899.	950	.0409	.00023	-
Tomatoes, .	Carson's Run, .	Jan. 1899.	Mar. 1899.	950	.0325	-	-
Tomatoes, .	Defy the World, .	Jan. 1899.	Mar. 1899.	950	.0372	.00040	-
Tomatoes, .	Defy the World, .	Jan. 1899.	Sept. 1899.	950	.0349	.00030	-
Tomatoes, .	Monarch, . .	Jan. 1899.	Sept. 1899.	950	.0146	.00006	-
Tomato soup,	Anderson's, . .	Jan. 1899.	Sept. 1899.	370	.0023	.00016	-
Strawberries,	- -	Jan. 1899.	Sept. 1899.	615	.0124	.00008	-
Blueberries, .	Eagle, . . .	Jan. 1899.	Sept. 1899.	615	.1721	.00037	-
Salmon, . .	Choice, . . .	Feb. 1896.	Sept. 1899.	470	.0819	.00005	-
Lobster, . .	Anchor,* . .	Feb. 1896.	Sept. 1899.	430	.0411	.00010	-
Rhubarb, .	Erie, . . .	Jan. 1899.	Sept. 1899.	615	.3506	.00022	-
Asparagus, .	Monarch, . .	Jan. 1899.	Sept. 1899.	930	.1249	.00010	-
String beans, .	Standard, . .	Jan. 1899.	Sept. 1899.	640	.0065	.00076	-
Peas, . .	Nanticoke, . .	Jan. 1899.	Sept. 1899.	615	.0024	.00004	-
Corn, . .	Phinney, . .	Jan. 1899.	Sept. 1899.	610	.0101	.00008	-
Corn, . .	Monarch, . .	Jan. 1899.	Sept. 1899.	650	.0045	.00109	-
Succotash, .	Monarch, . .	Jan. 1899.	Sept. 1899.	650	.0089	.00009	-
Squash, . .	Monarch, . .	Jan. 1899.	Sept. 1899.	950	.1577	.00027	-
Pumpkin, .	Monarch, . .	Jan. 1899.	Sept. 1899.	950	.1844	.00196	-
Squash, . .	Windsor, . .	Jan. 1899.	Sept. 1899.	950	.1798	.00870	-
Peas, . .	Monarch, . .	Jan. 1899.	Sept. 1899.	650	.0046	.00008	-
Beans, . .	Monarch, . .	Jan. 1899.	Sept. 1899.	650	.0499	.00027	-
Lima beans, .	Monarch, . .	Jan. 1899.	Sept. 1899.	650	.0064	.00048	-
Mutton broth,	Franco-American,	Jan. 1899.	Sept. 1899.	950	.0114	.00008	-

* Badly decomposed.

The action of fruit acids on tin has of late become of increased interest through certain cases of alleged tin poisoning, caused by the use of canned fruits.*

The question as to whether the amount of tin found dissolved in any of the samples examined is or is not dangerous is still an open one. A very wide range of variation exists in the amount of tin

* Zeit. fur Unters. der Nahr. u. Genuss., Vol. II., p. 915.

dissolved by various fruits. In the case of pumpkin and squash, for example, the tin dissolved is surprisingly large in quantity considering the supposed inert nature of these vegetables. From the above table, and others published in previous reports, it would seem as if of all canned fruits the blueberry exerts the greatest influence on the tin.

A series of experiments have been tried in the food laboratory of the Board on the action of various fruit acids on tin, with a view to ascertaining, among other facts, whether or not the element of time exerts an appreciable difference in the results.

Samples of various canned fruits and vegetables were titrated for their acidity. It was found that certain samples of canned blueberries, for instance, had an acidity of about one-twentieth normal. In the case of strawberries the acidity was about one-sixth normal. Canned raspberries were found to be about one-tenth normal in acidity, while that of canned tomatoes varied from one-tenth to one-fourteenth normal. Solutions of one-fifth, one-tenth and one-fifteenth normal malic acid, one-tenth and one-fifteenth normal tartaric acid, one-tenth and one-fifteenth normal citric acid, and one-tenth normal acetic acid were prepared and sealed in pint glass jars, being about the same capacity as the ordinary sized tin fruit cans, each jar containing an amount of tin plate equivalent to the interior exposed surface of a can. Solutions thus sealed were kept for three months, six months and a year, and examined at the end of these respective periods for tin. The results showing the amount of tin found at the end of three months in each case are given in the following list:

Action of Fruit Acids on Tin in Three Months.

Acid.	Grammes of Tin in One Pint of Solution.	Acid.	Grammes of Tin in One Pint of Solution.
N/5 Malic,	0.0578	N/15 Tartaric,	0.0246
N/10 Malic,	0.0201	N/10 Citric,	0.0374
N/15 Malic,	0.0197	N/15 Citric,	0.0236
N/10 Tartaric,	0.0382	N/10 Acetic,	0.0019

It was found, in general, that the amount of tin dissolved in three months, as indicated above, was the maximum amount dissolved, or, in other words, with a very few exceptions no additional tin was dissolved by added exposure to the acid for six months, or even a year.

Samples of sardines put up in mustard, oil and vinegar were last year examined for metallic tin and found to contain it in large quantities.* The acidity of the solution in these cans was found to be approximately one-tenth normal.

Experiments with tenth normal acetic acid sealed in jars with tin plate, as in the case of the fruit acids, and kept for three and six months respectively, showed that in three months 0.0019 gramme, and in six months 0.0083 gramme of metallic tin had been dissolved, indicating much less vigorous action than that of the same strength of fruit acids, and dissolving less tin than the samples of sardines examined.

Method for Determining Tin in Canned Goods. — The contents of the can are burnt to an ash, which is extracted with water acidified with hydrochloric acid. The tin is precipitated from its solution with hydrogen sulphide, the washed precipitate is dissolved in an excess of ammonium sulphide, which is filtered, and the tin is deposited directly from this solution by electrolysis in the platinum dish which contains it,† using a current of 0.05 ampere. This current is reduced from the ordinary 110 volt street circuit by means of lamps and a rheostat, the latter consisting of a long tube sealed at the bottom, containing a column of dilute acid through which the current passes, the resistance being changed by varying the length of the acid column contained between two electrodes immersed therein, one of which is movable.

Among the canned goods examined, have been 9 samples of canned peas, which come within the class known as "soaked goods," referred to in section 5 of the food statute of 1897, chapter 344. It has become quite common, especially in the case of peas, to take those that have grown old and dried and utilize them for canning purposes, under some such name as "Choice Early June Peas," such brands being sometimes sold at a very low price. The law now provides that such canned goods, to be sold legally, shall have plainly marked on the label of the can the words "Soaked Goods" in letters of a prescribed size (two line pica).

Of the 9 samples of canned peas examined 7 were found to be of the soaked variety, representing three brands, as follows: —

The "J. K. Brown & Co." brand, packed by Chas. G. Summers & Co. of Baltimore, Md.

* Thirtieth annual report of the State Board of Health, p. 705.

† Zeit. fur Unters. der Nahr. u. Genuss., Vol. II., p. 795.

The "Rosebud Brand," packed by the Rosebud Company of Baltimore, Md., and the "Lotta Brand," packed by J. R. Seward & Co. of Baltimore, Md.

The first brand was very indistinctly marked with the words "Soaked Goods," so indistinctly, in fact, as scarcely to be legible. The two latter brands were not so marked.

Methods of detecting soaked goods are distinctly physical rather than chemical. The appearance and taste of the goods furnish in most cases an unmistakable clue to their nature.

Cheese.

As usual there were no samples of adulterated cheese found among the 34 samples collected during the year, for the reason that there is no legal standard for fat in cheese. Several samples of skimmed milk cheese were found.

It is to be regretted, on many accounts, that Massachusetts has no law fixing the standard for fat in cheese, as in the absence of such a law skimmed milk cheese can be sold with impunity. Five of the western States have laws fixing the standard of fat at from 20 to 35 per cent.

Chocolate and Cocoa.

Thirty-six samples were examined, of which 21 were adulterated, the adulterants found being wheat, corn-starch and arrow-root. Several samples of cocoa were found to have admixtures of cane sugar. The worst adulterated sample contained 35 per cent. of corn-starch. Several samples of prepared chocolate were found colored with oxide of iron. Methods of detecting such adulterants as the starches in this class of food are largely microscopical.

Coffee.

One hundred and thirty-six samples of coffee were analyzed, 11 of which were found to be adulterated, the adulterants found being peas, wheat, chicory and pea hulls. The worst sample examined had less than 40 per cent. of pure coffee, the rest being peas, pea hulls and chicory.

Confectionery.

Of the 68 samples examined only 3 were found to be adulterated, these being chocolate candies colored with oxide of iron.

Cream of Tartar.

Methods.—Two-tenths of a gramme of the sample is weighed out, dissolved in hot water and titrated with tenth normal sodium hydroxide, using phenol phthalein as an indicator. If the sample is pure, it should require for neutralization 10.95 cubic centimeters of the alkali. An adulterated cream of tartar will almost invariably fail to dissolve in hot water. If the adulterant be alum, however, the sample would go into solution, but the alum would be precipitated by the sodium hydroxide, the precipitate being soluble in an excess of the alkali. The starches are best identified under the microscope; the mineral adulterants by common qualitative tests.

Three hundred samples of cream of tartar were analyzed, 6 of which were found to be adulterated. The adulterants found were acid phosphate of lime, gypsum and corn-starch. One sample was found containing no cream of tartar, being made up entirely of the adulterants named.

Honey.

All samples are polarized with the Schmidt & Haensch polariscope, using alumina cream as a clarifier. Pure honey should polarize to the left of the zero point. The approximate per cent. of commercial glucose present is computed by assuming a polarization of 150 degrees on the cane-sugar scale, as being the reading of a normal solution* of the particular grade of commercial glucose commonly used as an adulterant. The percentage of cane sugar is figured by the Clerget formula.

Sixty-six samples of honey were examined, 15 of these being adulterated with cane sugar or commercial glucose, or both. In one case 88 per cent. of commercial glucose was found.

Lard.

Twenty-two samples were examined, of which 5 were adulterated, the adulterant being cotton-seed oil.

The refractometer is the chief preliminary test employed, and has never failed in indicating adulterated samples. Further means of detecting adulterants consist in crystallization and examination under the microscope, determining the iodine number, the Bechi reaction, etc.

* 26.048 grammes glucose made up to 100 cubic centimeters with water and polarized in a 200 millimeter tube.

Maple Sugar.

Physical methods are principally relied on to recognize the admixture or substitution of brown sugar.

Fifty-eight samples were examined, 6 of which contained brown or molasses sugar in whole or in part.

Maple Syrup.

The normal weight of pure maple syrup, viz., 26.048 grammes, made up to 100 cubic centimeters and polarized in a 200 millimeter tube, will almost invariably read from 60 to 64 degrees on the cane-sugar scale. A reading much in excess of the larger figure indicates commercial glucose without doubt. Maple syrups for polarization can usually be weighed out and diluted without the aid of a clarifying agent. As in the case of honey, 150 degrees is assumed as the polarizing figure for commercial glucose for purposes of figuring the percentage of the latter.

Sixty-three samples of maple syrup were analyzed, 5 being adulterated with commercial glucose, or with cane syrup other than maple.

Molasses.

In making up a solution of the normal weight of molasses for polarizing, sub-acetate of lead is used as a clarifying agent. If the molasses is of average color its normal solution should polarize at less than 60 degrees on the cane-sugar scale in the 200 millimeter tube. If any sample exceeds this figure it should be further examined for commercial glucose by inversion. If the sample is very dark in color it should polarize considerably lower than 60 degrees.

Of 176 samples examined, 29 were found adulterated with commercial glucose, the worst adulterated sample containing 78.6 per cent.

Syrup.

Under this heading are included the table syrups, known as "Sugar House Molasses" or "Golden Drip" syrup, of which 6 samples were examined, 5 of them being found to contain commercial glucose; also two samples of fruit syrups, both of which were found preserved with salicylic acid. Sugar-house syrup should, like molasses, have for a normal solution a reading not higher than 60 degrees on the cane-sugar scale, using the 200 millimeter tube.

Tea.

The percentage of ash in a tea is the most ready means of determining its purity, in so far as its adulteration with foreign mineral matter and dirt of various kinds is concerned. The ash of a good sample should not exceed 7½ per cent. The tea is further examined by soaking the leaves in boiling water, which opens them out, so that their nature is readily apparent. Stems and fragments are then easily recognized, as well as foreign leaves, if present.

Of 66 samples of tea examined, 25 were found with admixtures of stems, fragmentary leaves and dirt of various descriptions, but none contained foreign leaves.

Toys.

A number of highly colored imported toys, such as dolls and wooden playthings of various kinds, especially such as would be used by very young children, have been examined for arsenic and other poisonous colors, but were found invariably free from anything at all harmful. Lead pigments, as chrome yellow and red lead, were found in several iron mechanical toys used by older children, who could hardly be expected to be injured thereby. It is, indeed, a common practice to use such pigments in this class of toys.

Nine samples of toys were examined, 4 of them being mechanical toys in which chrome yellow or red lead were found.

Vanilla Extracts.

*Method for Estimation of Vanillin.** — Two cubic centimeters of the vanilla extract are measured into a test tube and sufficient freshly precipitated lead hydrate is added to completely decolorize. The mixture is washed on to a filter, and filtrate and washings are collected in a Nessler tube. Bromine water is then added, after which enough of a freshly prepared 10 per cent. ferrous sulphate solution is added to get the maximum bluish-green color that will be produced if vanillin is present.

A standard solution is prepared by dissolving, say 50 milligrammes of pure vanillin in 100 cubic centimeters of water. A series of color standards is then made, taking for instance, ½, 1, 1½, 2, 2½, 3, etc., cubic centimeters of the vanillin solution in Nessler tubes, each being

* Zeitschrift fur Anal. Chemie, 1894, p. 242.

treated with two or three drops of bromine water, and with the ferrous sulphate solution, and made up to the 50 cubic centimeter mark.

The lead hydrate is prepared by dissolving 200 grammes of lead acetate in 850 cubic centimeters of water. The solution is filtered, a strong solution of potassium hydroxide is added in excess, and the precipitated hydrate is washed thoroughly several times by decantation.

Coumarin is estimated by taking 25 cubic centimeters of the extract and evaporating off the alcohol on the water bath, keeping up to the original volume with water. The solution is then put in a separatory funnel and shaken with ammonia water, which forms an ammonium compound with the vanillic aldehyde insoluble in ether. Three or four extractions are then made with ether. The combined ether extracts are evaporated in a tared platinum dish at a temperature not exceeding 50 degrees Centigrade in the oven. The residue, if purely crystalline, is weighed as coumarin.*

Sixty-eight samples of vanilla extracts were examined, of which 35 were adulterated, by reason of the presence of coumarin, or of insufficient vanillin, or as not being extracts of the vanilla bean. In a number of cases no vanillin whatever was found, such samples owing their flavoring efficiency entirely to the cheaper coumarin derived from the tonka-bean.

The following table shows the results of the examination of the various brands of vanilla extracts collected during the year: —

Vanilla Extracts.

Brand.	Vanillin (Per Cent.).	Coumarin (Per Cent.).	Capacity of Bottle in Cubic Centimeters.	Price of Bottle (Cents).	Manufacturer's Name and Address.
A. & P.,	.030	.000	25	10	The Great Atlantic and Pacific Tea Company, New York.
Acme,	.075	.000	45	25	Edwin J. Gillis & Co., New York.
Baker's,	.150	.000	55	20	Baker & Co., Springfield.
Bardwell's Extra Strong,	.050	.000	61	25	J. C. Bardwell & Co.
Beehive,	.000	.104	52	12	Geo. D. Emerson & Co., Boston.
Best,	.150	.000	45	10	Edwards & Co., Boston.
Blackstone,	.018	.120	47	10	Blackstone Extract Company, Boston.
Burnett's,	.175	.000	60	25	Joseph Burnett Company, Boston.
Charlton's,	.075	.000	40	10	E. P. Charlton, Fall River.

* Hess & Prescott, Jour. Am. Chem. Soc., Vol. XXI., p. 256.

Vanilla Extracts — Continued.

Brand.	Vanillin (Per Cent.).	Coumarin (Per Cent.).	Capacity of Bottle in Cubic Centimeters.	Price of Bottle (Cents).	Manufacturer's Name and Address.
Celebrated Champion,	.000	-*	44	5	
Celebrated Champion,	.013	.000	45	5	
Concentrated,	.000	-*	45	7	Myrtle Extract Company, Boston.
Concentrated,	.040	.074	42	10	
Concentrated Extract,	.000	.172	100	10	
Concentrated Extract,	.000	.024	41	10	B. Fish & Co., Portland, Me.
Concentrated XX,	.025	.092	45	10	Highland Extract Company.
Condell's Extra Fine,	.000	.330	47	10	H. W. Spurr & Co., Boston.
Colton's Select,	.088	.000	60	25	J. W. Colton, New York, Boston and Chicago.
Compound Extract,	.150	.000	48	15	Crosby & Co., Boston.
Compound Extract,	.100	.000	40	–	Union Wholesale Grocery Company, Claremont, N. H.
Diamond Pure Food,	.050	.000	40	10	
Double Concentrated Extract,	.040	.000	45	10	Tremont Extract Company, Boston.
Dr. Price's,	.075	.000	61	25	Price Flavoring Extract Company, New York and Chicago.
Eclipse,	.200	.000	45	10	J. E. P. Fearing.
Empire State,	.025	.064	65	10	
Folkin's Compound,	.050	-*	40	10	J. H. Folkins, Chelsea.
Foss's Pure,	.125	.000	60	25	Schlotterbeck & Foss Co., New York and Chicago.
French's Genuine,	.050	.000	36	15	French, Rochester, N. Y.
German,	.000	-*	43	–	
Globe,	.100	.000	83	–	Globe Extract Company.
Golden Cup,	.163	.000	43	10	Tremont Extract Company.
Golden Rod,	.019	.052	45	10	Miami Manufacturing Company, New York.
Grand Union Tea Co,	.025	.072	57	20	Grand Union Tea Company, Brooklyn, N. Y.
Gray's,	.100	.000	36	10	
Good Value,	.034	.096	47	10	Good Value Extract Company, New York.
Hartshorn's Highly Concentrated,	.075	.000	70	15	E. Hartshorn & Sons, Boston.
Holbrook's,	.250	.000	40	10	S. B. Holbrook, Boston.
Kellog's Pure,	.150	.000	55	25	F. P. Adams & Co., Boston.
Keystone,	.075	.000	46	10	
Kidder's Concentrated,	.000	.080	40	10	Kidder & Co., Boston.
Knickerbocker,	.006	.034	33	10	
Mathews Diamond,	.025	.000	63	23	A. I. Mathews, New York.
Metcalf's Water White,†	.250	.000	60	25	T. Metcalf Co., Boston.

* Considerable. † Artificial. Marked "compound."

Vanilla Extracts — Concluded.

Brand.	Vanillin (Per Cent.).	Coumarin (Per Cent.).	Capacity of Bottle in Cubic Centimeters.	Price of Bottle (Cents).	Manufacturer's Name and Address.
Miner's No. 1,	.063	.000	-	-	B. F. Miner, Montague, Mass.
Mrs. Bradford's Pure,	.225	.000	58	30	Mrs. M. J. Bradford, Claremont, N. H.
Nickel Concentrated,	.038	.064	28	15	
Oriental,	.080	.054	55	-	H. W. Spurr Specialty Company, Boston.
Oriental Pure Concentrated,	.025	.000	40	13	Oriental Drug Company, Boston.
Parlor City,	.019	.092	44	10	Parlor City Extract Works.
Perkins' High-proof,	.025	-*	-	-	Thomas Perkins & Co., Boston.
Pure Concentrated,	-†	-*	45	10	Eagle Extract Company, Boston.
Pure Concentrated,	.025	.060	46	12	W. H. Murphy, Boston.
Pure Concentrated,	.019	.000	43	15	Parlor City Extract Company, Binghamton, N. Y.
Puritan,	.250	.000	42	10	R. P. Hoagland, Boston.
Russell's Highest Grade,	.087	.000	-	-	O. H. Russell, Boston.
Standard Quality,	.125	.000	35	10	Samuel Stuart Extract Company, Hartford, Conn.
Standard Fruit Extract Company,	.113	.000	36	15	Salem Chemical and Supply Company.
Stickney & Poor's Best,	.100	.000	58	23	Stickney & Poor Spice Company, Boston.
Strictly Pure,	.100	.000	45	17	O. A. Dudley, Boston.
Superior,	.025	.144	45	12	Hall & Co., Portland, Me.
Superior,	.019	.000	35	10	Hall & Co., Portland, Me.
Taylor's Pure,	.013	.000	45	15	Taylor Extract Company, Portland, Me.
Trumbull & Co.,	.125	.053	32	10	Trumbull & Co., Hartford, Conn.
Waldorf,‡	.013	.080	50	15	
Williams' Choice,	.075	.000	60	25	Williams & Carlton Co., Hartford, Conn.
Winner,	.019	.112	50	10	J. F. Nickerson Co.
——,	.025	.000	43	20	Leo Freres & Co.
——,	.100	.000	75	15	

* Considerable. † Trace.
‡ Labelled "compound;" vanilla, 1.00; tonka, 2.70; aqua, 4.84; sugar, 1.44.

The artificial vanillin which many of the above preparations contain lacks much of the valuable flavor possessed by true extracts of the vanilla bean. The amount of alcohol by weight found in these extracts was found to vary from 5 to 30 per cent.

Vinegar.

For the total solids, 5 grammes are evaporated in a platinum dish in direct contact with the live steam of a boiling water bath for at least an hour and a half. The acidity is determined by titrating 6 cubic centimeters of the vinegar with decinormal sodium hydroxide, using phenol phthalein as an indicator. The percentage of acetic acid is exactly one-tenth of the number of cubic centimeters of alkali required for neutralization. Sulphates, chlorides and calcium are tested for by usual qualitative processes. Vinegar solids are sometimes reinforced by apple pomace, which in most cases has been wholly exhausted of malic acid. This sophistication is rendered apparent by a careful examination of the reducing sugar and of the ash. According to Dr. William Frear, any vinegar in which more than 50 per cent. of its total solids is reducing sugar may properly be condemned as having unfermented sugar-containing material, and it may be safely assumed that if the ash of the vinegar is less than 10 per cent. of the total solids, it may be suspected of having added unfermented material, while a per cent. of ash less than 6 is absolute evidence that the vinegar is not a genuine cider vinegar.*

Vinegar is best tested for malic acid by acetate of lead.

Of the commonly used foods vinegar is still by far the most adulterated. The following table shows the results of vinegars tested during the year as to acidity and total solids, but does not indicate the number adulterated whose solids and acidity conform to the standard. As usual, the full-faced type indicates those samples that fall below the legal standard.

Vinegar.

Per Cent. of Acetic Acid.	Per Cent. of Solids.	Per Cent. of Acetic Acid.	Per Cent of Solids.	Per Cent. of Acetic Acid.	Per Cent. of Solids.	Per Cent. of Acetic Acid.	Per Cent. of Solids.
7.32	0.76†	4.94	1.68	4.70	2.50	4.46	2.48
5.80	2.00	4.86	2.40	4.80	1.46	4.40	3.04
5.34	-‡	4.84	1.48	4.60	1.83	4.34	3.38
5.30	-‡	4.82	2.71	4.62	2.43	4.32	3.40
5.18	3.36	4.80	2.37	4.55	1.46	4.16	0.17
5.14	3.00	4.80	2.54	4.50	2.25	4.06	3.04
5.10	3.28	4.70	2.20	4.50	2.70	3.96	1.70
5.09	0.47	4.70	2.34	4.50	2.50	3.74	1.63
5.00	3.76	4.70	2.10	4.50	1.28	3.64	3.26
5.00	3.40	4.74	2.00	4.48	1.60	3.56	1.50
5.00	2.63	4.70	2.01	4.64	2.95	-	-

* Report of the Pennsylvania Department of Agriculture, 1898, p. 188.

† Malt vinegar. ‡ White-wine vinegar.

Spices.

Of all the foods regularly examined by the department, spices constitute a class least subject to variation. Reasons have already been given to account for the fluctuation of the milk curve in Fig. 1, and for the general food curve in Fig. 2, but the variation in adulteration of spices shows very nearly an even curve, gradually decreasing from 68 per cent. of adulteration in 1883, to nearly a constant level of less than 15 per cent. through the last five years. The following diagram shows the variation in percentage of adulterated samples of spices examined during the last seventeen years: —

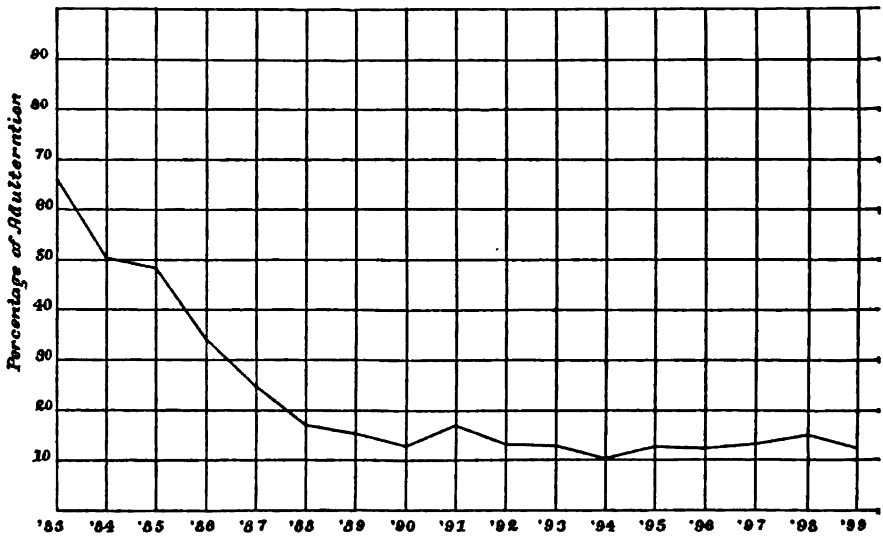

FIG. 3. SHOWING VARIATION IN SPICE ADULTERATION FROM YEAR TO YEAR.

While all authorities agree that such absolutely foreign ingredients in spices as cereals and inert filling materials should always be considered as adulterants, there is some difference of opinion as to how such substances as mustard hulls, clove stems, pepper dust and wild mace, some of which are often present as impurities in carelessly prepared ground spices, should be classed. Strictly speaking, each spice should be entirely free from the substances mentioned. It is very difficult, however, to find mustard which does not contain a few hulls, and cloves entirely free from their stems. When these substances are present in very small amount, and the spices are otherwise pure, they are not considered as adulterants, but when they constitute the chief ingredient of the spice in question, such spices should very properly come under the adulterated class, and are so considered.

The microscope furnishes the principal means for the detection of foreign substances in spices. Perhaps in no class of goods has the scientific adulteration of food been carried to such an extent as in spices. In many cases, not only the appearance, but also the taste of the skilfully adulterated article are so closely counterfeited as even to deceive the expert. Not only does the spice often resemble in physical appearance the color and taste of the genuine article, but even the microscopical appearance is intended to deceive. Various inert barks, for instance, resemble in some degree the cassia bark in structure. Sawdust of soft wood is not unlike the wood fibre of the ground ginger root, and buckwheat starch might possibly be mistaken under the microscope for pepper starch to a casual observer. A careful examination, however, will not fail to distinguish the difference in appearance between the pure and the adulterated.

Allspice. — One hundred and fifty-eight samples were examined, of which 13 were adulterated, the adulterants found being peas, pea hulls and roasted wheat. One sample contained 75 per cent. of these foreign ingredients.

Cassia. — Of the 190 samples collected and examined, 12 were impure, the adulterated samples being found to contain foreign bark, pepper, ginger, peas, pea hulls and ground fruit stones. One sample consisted almost entirely of wheat-bran, turmeric and undetermined dirt or sweepings. Another contained 50 per cent. of ground olive stones.

Cayenne. — Twenty-eight samples were analyzed, 5 of which were adulterated. One consisted almost wholly of mustard hulls and husks colored with red ochre, and another consisted chiefly of corn-starch and red wood, with only a minute trace of cayenne.

Cloves. — One hundred and seventy-two samples were examined, of which 22 were adulterated. The adulterants found were clove stems, turmeric, ginger, wheat, allspice, olive stones and nut shells. One sample contained 25 per cent. of peas and pea hulls, another 40 per cent. of peas, nut shells and foreign wood fibre.

Ginger. — Two hundred and eight samples were examined, 17 of which were adulterated. One sample contained 60 per cent. of buckwheat, turmeric, wheat and ground fruit stones. Rice was also found as an adulterant of ginger.

Mace. — Sixty-one samples were examined, of which 14 were adulterated. One sample contained 50 per cent. of wild mace; another was found to have 50 per cent. of corn-starch and wild mace. Other adulterants found were wheat, cassia, ground stems and ginger.

There would seem to be no doubt that the false or wild mace (*myristica fatua*) should be considered an adulterant, in view of the fact that it is devoid of taste and aroma. Wild mace is readily recognized under the microscope, and it may also be detected by Hefelmann's test, which consists in saturating a strip of filter paper with an alcoholic solution of the mace, removing the excess of liquid by pressure between filtering paper. On treating with a drop of potassium hydroxide solution, a red color is produced in the presence of the wild mace.*

Mustard. — Two hundred and fifty-one samples were examined, 67 of which were found to be adulterated. One sample contained as high as 80 per cent. of wheat, corn, turmeric and mustard hulls. Another consisted almost wholly of rice, wheat and turmeric. Other adulterants found were buckwheat, ground nut shells and cayenne.

Mustard is the most commonly adulterated of all spices. The old notion seems to be still alive that a certain amount of wheat flour is necessary in mustard to prevent lumping. This may account for the large number of samples found adulterated with wheat, as well as the fact that wild mustard often grows in the wheat fields in many localities, so that after the wheat crop has been harvested the mustard is gathered in and sold to certain dealers. Such mustard would necessarily contain a small admixture of wheat.

Nutmeg. — Two were found adulterated out of the 20 samples examined. Both contained small admixtures of wheat.

Pepper. — Three hundred and twenty-nine samples were examined, of which 24 were adulterated. Ground fruit stones, nut shells, charcoal, cayenne, wheat and buckwheat were the adulterants found. One sample contained 85 per cent. of the last two ingredients; another 60 per cent. of ground olive stones.

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* Pharm. Zeit., 1891.

PRESERVATIVES IN FOOD.

Six different preservatives have been found in the various foods and drugs examined during the year. These preservatives are salicylic acid, benzoic acid, boracic acid, sodium acid sulphite and formic aldehyde. Each of these preservatives seems to possess antiseptic qualities best adapted to certain classes of food.

The following table shows the results of the examination of classes of foods most apt to contain foreign preservatives: —

Table of Preserved Foods.

Character of Food.	Number of Samples examined.	Total Number preserved.	Number of Samples Preserved with — Salicylic Acid.	Benzoic Acid.	Boracic Acid.	Sodium Acid Sulphite.	Formic Aldehyde.	Per Cent. of Preserved Samples.
Sweet cider,	9	5	5	-	-	-	-	55.6
Strawberry jam,	1	1	1	-	-	-	-	100.0
Lime juice,	12	10	6	-	-	4	-	83.3
Ketchup,	39	28	15	13	-	-	-	71.8
Fruit syrup,	2	2	2	-	-	-	-	100.0
Cream,	23	6	-	-	4	-	2	26.1
Codfish,	25	11	-	-	11	-	-	44.0
Oysters,	6	6	-	-	6	-	-	100.0
Summary,	119	71	31	13	21	4	2	59.6

Salicylic acid seems to be adapted for preserving a wider range of foods than any of the other commonly used antiseptics. It is most often found in table sauces (including ketchups, chili sauce, and the like), in summer beverages, jellies, jams, fruit syrups, and also various food preparations for invalids, such as clam bouillon, grape juice and various beef preparations.

Next to salicylic, boracic acid seems to be the favorite preservative. This is found in such foods as codfish, oysters and sausages, as well as in milk and cream.

Sodium acid sulphite has been found this year only in lime juice.

Benzoic acid seems to be best adapted for such table condiments as ketchup, 13 samples of which were found preserved with it.

All of the samples of oysters brought in for examination were found to contain boracic acid.

According to the British food journals it is apparently a common practice in some localities to preserve bacon with boracic acid. A number of samples of bacon have been examined in this laboratory and found to be free from preservative.

Miscellaneous Articles of Food.

Following is a list of miscellaneous food preparations examined and found to be of good standard quality: —

Almond extract, arrow-root, bacon, bread (suspected of containing poison), buttermilk, celery salt, chicken giblets (canned), chocolate icing, cocoanut (shredded), cream custard, curry powder, flour, food color, food (suspected of containing poison), grape nuts, junket, horse-radish, "Koffeko" (a coffee substitute), lemonade tablets, lemon extract, marjoram, marmalade, orange cider, peanut butter, rice, sausage, sugar, thyme, vermicelli.

Additional miscellaneous articles worthy of comment as being found in more or less degree adulterated are the following: —

Baking Powder. — Alum in baking powder is tested for by burning a small quantity of the sample to an ash, which is then treated with boiling water and filtered. If on the addition of ammonium chloride to the filtrate a flocculent precipitate is formed, this will indicate the presence of alum in the sample. In this process the bicarbonate of soda, always present in baking powder, forms with the alum, if present, sodium aluminate, which is soluble in water, and the aluminum is precipitated in the form of the hydrate on treatment with ammonium chloride. The test is thus applicable in presence of phosphates.

Twenty-five samples of baking powder were examined, of which 16 were found to contain alum.

Following is a list of the alum brands of baking powder found during the year: —

Brands of Baking Powder containing Alum.

Boston, Donlon & Co., Dry Yeast, Eagle, Franklyn, I. C., Jaques, Crescent, Mascot, Quaker City, Union, White Star, Town Talk.

It is a common practice for manufacturers of cream of tartar baking powder to label their package somewhat as follows: "All grocers are fully authorized to guarantee this powder free from alum, ammonia, lime or any other adulterant."

The "Boston Baking Powder" is put out in cans having on the bottom the following label: "All grocers are authorized to guarantee bread, cake, pastry and all other products made wherein our powder is used free from alum, lime, ammonia, terra alba, rochelle salts or anything injurious as a result of its use."

As a matter of fact, this brand of powder contains alum, calcium sulphate (terra alba) and ammonia. The label is somewhat ingenious, for it will be noticed that grocers are not authorized to guarantee the *powder* to be free from these products, but what they do guarantee is that *bread*, *cake* and *pastry* made from this powder are free therefrom. This statement is partially true in that the alum present in the baking powder ceases to be alum when found in the bread, having been transformed into aluminum hydrate, and, moreover, that while ammonia is present in the baking powder, it is not found in the bread, having been driven off by the process of baking.

Baking Soda or Saleratus.—Eleven samples were examined, 2 of which contained appreciable quantities of salt.

Blanc Mange (Vanilla).—The sample examined consisted of corn-starch, flavored with coumarin, no vanilla being found.

Cider.—Nine samples of sweet bottled cider were examined, of which 5 contained salicylic acid.

Cider Jelly.—Of the 4 samples examined, 2 contained salicylic acid.

Codfish.—Twenty-five samples of salt codfish were examined, 11 of which were found preserved with boracic acid.

The following brands, with the names and addresses of the manufacturers, were found to be thus preserved:—

Salt Codfish preserved with Boracic Acid.

Brand.	Manufacturer.	Address.
Gorton Fish Cake,	Slade, Gorton & Co.,	Gloucester.
White Lilly,	D. J. Harrigan,	East Boston.
Nanticoke,	D. J. Harrigan,	East Boston.
Silver Brand,	- -	-
Knox-all Fleecy,	Henry B. Teed,	-
Beardsley's Shredded,	J. W. Beardsley's Sons,	New York.
Gilded Dome Threads of Codfish,	Pierre, Austin & Co.,	-

Besides the above, several samples of codfish in bulk (unbranded) were found preserved with boracic acid.

Gluten. — Nearly all the samples of this preparation were found to contain starch (see "Diabetic Flour" under "Drugs").

Jam. — The single sample of strawberry jam examined was found to contain salicylic acid.

Ketchup. — For the detection of salicylic acid or benzoic acid in ketchup, a portion of the sample is shaken with ether, and if an emulsion is formed it can be most readily separated in a centrifuge of the Robinson type. The ether extract is poured into a separatory funnel, treated with ammonium hydrate, and shaken. The ammonia extract is drawn off and evaporated on a water bath until all the ammonia gas has escaped. The solution is then treated with ferric chloride. A flesh-colored precipitate indicates the presence of benzoic acid, a purple coloration, salicylic.

Of the 39 samples of ketchup examined, 28 contained a preservative, 15 having salicylic acid and 13 benzoic acid.

Following is a list of brands of ketchup containing preservative, with the manufacturer's name and address, when given, and the preservative found: —

Brands of Ketchup containing Preservative.

Brand.	Manufacturer.	Address.	Preservative Found.
Columbia,	Mullen Blackledge Company,	Indianapolis, Ind.,	Salicylic acid.
Tomato Relish,	J. J. Reid Specialty Company,	Boston, Mass.,	Salicylic acid.
Bull,	Eagle Extract Company,	Boston, Mass.,	Salicylic acid.
Peerless,*	-	-	Salicylic acid.
Metropolitan Pure,	J. H. Folkins & Co.,	Chelsea, Mass.,	Salicylic acid.
Extra Fine,	-	-	Salicylic acid.
Star,	J. Weller Company,	Cincinnati, Ohio,	Salicylic acid.
Halford's,	Halford Sauce Company,	Boston, Mass.,	Salicylic acid.
Ward's,	E. C. Ward,	Boston, Mass.,	Salicylic acid.
Cruikshank's,	Cruikshank Bros.,	Allegheny, Pa.,	Salicylic acid.
Fulton,	Fulton Relish Company,	Indianapolis, Ind.,	Salicylic acid.
-	Anchor Preserving Company,	Boston, Mass.,	Salicylic acid.
Excellent,	-	-	Salicylic acid.
Home Made,	C. H. Russell,	Boston, Mass.,	Salicylic acid.
Gold Medal,	American Relish Company,	Indianapolis, Ind.,	Salicylic acid.
Snider's,	T. A. Snider Preserving Company,	Cincinnati, Ohio,	Benzoic acid.
Sunnyside,	Tip Top Ketchup Company,	Cincinnati, Ohio,	Benzoic acid.
Tomato Catsup,	-	-	Benzoic acid.
-	Lutz & Schram Company,	Allegheny, Pa.,	Benzoic acid.
Standard,	Standard Manufacturing Company,	Wheeling, W. Va.,	Benzoic acid.
Superior,	-	-	Benzoic acid.
Tomato Catsup,	-	-	Benzoic acid.
Green Label,	Little Silver Sauce Company,	Little Silver, N. Y.,	Benzoic acid.
Waldorf,	Williams Bros. & Charbonneau,	Detroit, Mich.,	Benzoic acid.

* "Made from selected goods."

Lemon Syrup. — One sample was examined and found to contain salicylic acid.

Oysters. — Six samples were examined and were found to be preserved with boracic acid. These were purchased from the following dealers: New England Oyster Company, The C. W. Badger Oyster Company, Norfolk Oyster Company, Atwood & Bacon, B. Atwood & Co., and H. & R. Atwood, all of Boston.

The oysters purchased were in all cases of the class sold to the trade in barrels and kegs. Oysters of this class are, as will be seen, very liable to contain added preservative.

"*Preservaline.*" — This is a food preservative consisting of salicylic acid.

Sage. — Three samples were examined, 1 of which was found to contain a small admixture of wheat.

Strawberry Syrup. — One sample was examined and found to be preserved with salicylic acid.

Summary of Statistics of Food exclusive of Milk.

Foods.	Genuine.	Adulterated.	Total.	Per Cent. of Adulteration.
Allspice,	145	13	158	8.2
Butter,	220	9	229	3.9
Canned goods,	40	16	56	28.6
Cassia,	178	12	190	6.3
Cayenne,	23	5	28	17.8
Cheese,	34	–	34	–
Chocolate,	15	21	36	58.3
Cloves,	150	22	172	12.8
Coffee,	125	11	136	8.1
Condensed milk,	45	–	45	–
Confectionery,	65	3	68	4.4
Cream of tartar,	294	6	300	2.0
Ginger,	191	17	208	8.2
Honey,	51	15	66	22.7
Lard,	17	5	22	22.8
Mace,	47	14	61	22.9
Maple sugar,	52	6	58	10.3
Maple syrup,	58	5	63	7.9
Miscellaneous,	106	63	169	37.3
Molasses,	147	29	176	16.5
Mustard,	184	67	251	22.7
Nutmeg,	18	2	20	10.0
Pepper,	305	24	329	7.3
Syrup,	1	7	8	87.5
Tea,	41	25	66	37.9
Toys,	5	4	9	44.4
Vanilla extracts,	33	35	68	51.5
Vinegar,	25	18	43	41.8
Totals,	2,615	454	3,069	14.8

Drugs.

With few exceptions the drugs brought in for examination during the year have been the pharmacopœial preparations regularly examined and found on our list for a number of years. As a rule all drugs are purchased by the inspectors, who are provided with slips, each containing from four to six articles written thereon, these order slips being presented in the drug store like prescriptions.

In filling these orders some odd mistakes have been made by druggists, who have in a number of instances, through carelessness or ignorance, mixed together the drugs which were, of course, intended to be put up separately. Instances of this kind not infrequently occur. As an example of this, one sample was brought in during the year consisting of a mixture of whiskey, gin, laudanum and distilled water. On another occasion, distilled water, hydrobromic acid, silver nitrate and subcarbonate of bismuth were mixed together by a druggist, with remarkable results. It has been found necessary on this account for the inspector to explicitly state at the time of purchase that the drugs specified on the slip are wanted separately; otherwise samples of "incompatible prescriptions," like the above, would constantly be received.

Unless otherwise specified, methods employed in the examination of the following drugs are those specified in the Pharmacopœia.

Acidum Tannicum. — Of the 10 samples examined, 5 were found to be impure by reason of the presence of resin or foreign gum.

Æther. — Two samples were examined and both found to contain too much alcohol.

Aqua Ammoniæ Fortior. — The single sample examined was found to contain insufficient ammonia gas.

Alcohol. — Two samples were tested, both of which were pure.

Aqua Destillata. — Of the 25 samples analyzed only 4 were free from residue.

The following table shows the total solids in parts per 100,000 of the samples examined: —

Aqua Destillata.

[Total solids. Parts per 100,000.]

0.0	1.7	4.7	9.7	11.5
0.0	1.9	4.0	10.6	12.4
0.0	1.9	6.3	10.7	13.0
0.7	2.3	6.8	11.0	20.0
1.7	3.8	8.9	11.5	23.7

Argenti Nitras. — Twelve samples were examined, all of which were pure.

Bismuthi Subcarbonas. — Eight samples, all of good quality, were examined.

Bismuthi Subnitras. — Of the 10 samples analyzed, 5 were found to contain carbonate.

Calx Chlorata. — All of the samples examined were found to be far below the standard of available chlorine, which should be 35 per cent.

Following are the brands examined, with the amount of chlorine contained in each : —

Calx Chlorata.

Brand.	Available Chlorine.	Brand.	Available Chlorine.
Acme, ...	3.00	Red Star,. . . .	25.34
Lion, ...	7.85	Witch City, . . .	21.75

Capsicum. — Seventy samples were examined, 10 of which were found to be adulterated. One sample contained 75 per cent. of corn and red wood; another 20 per cent. of wheat and corn. Other adulterants found were ginger and turmeric.

Caryophyllus. — The single sample analyzed was found pure.

Cera Alba. — Three samples, all genuine, were examined.

Cera Flava. — Four samples, all genuine, were examined.

Cerii Oxalas. — The single sample analyzed was found pure.

Chloral. — One sample only, and that a pure one, was examined.

Chloroformum. — Four samples were analyzed, 1 of which contained too much alcohol.

Cinnamomum Cassia. — The three samples examined were all found pure.

Diabetic Flour. — Thirteen samples of this preparation were examined for starch, and only 3, the product of one manufacturer, were found to be free from it; the other 10, or nearly 80 per cent.

of the samples collected, were found not only to contain starch, but that in large quantities, 7 being found with 60 per cent. or more of starch. These were in reality but little better than whole wheat flour, sold at prices varying from 11 to 50 cents per pound. Many of these brands were put on the market by dealers in so-called "health foods," being in most cases represented to be practically free from starch, or sold as pure gluten. The brands examined are as follows: —

Diabetic Flour.

Per Cent. Starch.	Price per Pound (Cents).	Label on Package.	Manufacturer.
-	25	(Bulk),	Crystal Springs Company, Watertown.
10.00	30	Cestus Diabetic Flour,	American Health Food Company.
16.66	20	Cestus Diabetic Flour,	American Health Food Company.
18.00	-	Cestus Diabetic Flour,	American Health Food Company.
56.20	50	Pure Vegetable Gluten,*	T. Metcalf Co.
64.28	25	Whole Wheat Gluten,	Health Food Company, New York.
63.38	15	(Bulk),	American Health Food Company.
64.29	11	-	Johnson Educator Food Company.
64.46	30	Unsurpassed Gluten Flour,	Johnson Educator Food Company.
64.29	-	-	-
68.74	-	-	-

* Label on the back of the container: Moisture, 11.22 per cent.; nitrogen, 2.67 per cent.; equivalent nitrogenous matter, 16.67 per cent.; starch, 18.14 per cent.

The starch in these flours is determined by the ordinary acid conversion process, using the volumetric Fehling method in estimating the converted sugar.

Extractum Glycyrrhizæ. — Nine samples were examined and all were found to contain admixtures of corn-starch, the worst sample being 25 per cent. adulterated.

Ferri et Quininæ Citras. — Eight samples were examined, 2 of which contained insufficient quinine.

Ferri et Strychninæ Citras. — Three samples were examined, all of which were of good standard quality.

Gin. — Six samples were examined, of which two were found low in alcohol. The percentage of alcohol found in each is as follows: —

Gin.

[Alcohol.]

32.25	37.67	38.36	41.40	41.80	42.38

Glycerinum. — This drug, as will be seen by referring to past reports, has hitherto been reported almost uniformly pure, and so far as the pharmacopœial requirements are concerned, very few samples fail to conform to the standards. Since it has become a well-established fact that arsenic is commonly found in medicinal glycerine, it has been thought best to test all samples for arsenic. Not until the last part of the year, however, were all the glycerine samples so tested. The first sample examined was a composite one, taken from the container into which samples received for more than a year back had been poured. Twenty-five grammes of this sample were found to contain 0.0006 gramme of arsenic.

Since July, 1899, all samples have been examined for arsenic, with the result that out of 29 samples thus tested 20 were found to contain it in amounts varying from a mere trace up to 0.002 gramme of arsenic in 25 grammes of the sample.

The most ready means of detecting arsenic in glycerine is the modification of the Gutzeit method suggested by Langmuir.*

Two cubic centimeters of the sample are run into a test tube and diluted with water, after which a little chemically pure granulated zinc is added, and enough chemically pure sulphuric acid to cause not too vigorous evolution of gas. A small filter paper, wet with a saturated solution of mercuric chloride, is held over the top of the tube by a cork loosely inserted, the paper being smoothly wrapped over the lower end of the cork in such a way that the hydrogen can escape between the paper and the sides of the tube. At the expiration of a given time, say ten minutes, the cork is removed and any arsenic present in the glycerine will show by a yellow stain on the paper, the depth of color varying very nearly proportionately with the amount of arsenic present. The arsenic may thus be roughly determined quantitatively by comparison with a series of color standards. For accurate quantitative work the diluted sample of glycerine may be run directly into a Marsh arsenic apparatus.

Iodum. — One sample was examined and found pure.

Limonis Succus. — Twelve samples were examined, all of which were found to be adulterated or impure.

The brands examined and the result of the examination are best shown as follows: —

* Journal American Chemical Society, Vol. XXI., p. 135.

Lime Juice.

Brand.	Citric Acid (Per Cent.).	Other Ingredients.
Sovereign,	4.15	Salicylic acid.
Sovereign,	3.94	Salicylic acid.
Thompson's,	3.64	Sodium sulphite.
Folkin's,	3.16	Salicylic acid.
Gold Leaf,	2.95	- -
Montego,	2.95	Salicylic acid.
Folkin's,	2.66	Salicylic acid.
Geer's,	2.62	Sodium sulphite.
Geer's,	2.50	Sodium sulphite.
Family Grocery Company's,	1.92	- -
Russell's,	2.26	Sodium sulphite.
Santiago Triple Refined,	-	Hydrochloric and salicylic acids.

All were found to be deficient in citric acid, which, according to the Pharmacopœia, should be present to the extent of 7 per cent. All but 2 samples contained added preservative.

The acidity of lime juice is obtained by titrating 6.8 cubic centimeters against decinormal sodium hydroxide with phenol phthalein. The number of cubic centimeters of the standard alkali required divided by 10 gives the percentage of citric acid present.

Sulphites are tested for by distilling a portion of the sample and treating the distillate first with barium chloride and then with bromine water. A precipitate with the latter reagent indicates presence of sulphurous acid.

Liquor Magnesii Citratis. — One sample was examined and found pure.

Magnesii Citras Effervescens. — Three samples, all pure, were analyzed.

Oleum Limonis. — Six samples were examined, 5 of which contained oil of turpentine.

The purity of oil of lemon is most readily determined by its optical rotation. Five cubic centimeters of the lemon oil are diluted with the same amount of alcohol and the mixture is polarized in a 100 millimeter tube of the Schmidt & Haensch instrument. The reading, multiplied by two, should be between 156.3 and 166.6 degrees to the right if the sample is pure, corresponding to a specific rotary power of 60 to 64 degrees.

Oleum Olivæ. — Fifty samples were examined, of which 13 consisted wholly or in part of cotton-seed oil.

In using the Zeiss refractometer for the examination of olive oil the following table will be found useful in indicating the normal reading of olive and cotton-seed oil at various temperatures: —

Readings on Zeiss Refractometer of Olive and Cotton-seed Oils.

Temperature (Centigrade).	Scale Reading — Olive Oil.	Scale Reading — Cotton-seed Oil.	Temperature (Centigrade).	Scale Reading — Olive Oil.	Scale Reading — Cotton-seed Oil.
35.0	57.0	61.8	25.5	62.4	67.5
34.5	57.2	62.1	25.0	63.0	67.9
34.0	57.4	62.3	24.5	63.3	68.2
33.5	57.7	62.5	24.0	63.6	68.5
33.0	58.0	62.8	23.5	63.9	68.8
32.5	58.3	63.0	23.0	64.2	69.1
32.0	58.5	63.2	22.5	64.5	69.4
31.5	59.0	63.6	22.0	64.8	69.7
31.0	59.2	64.0	21.5	65.1	70.0
30.5	59.4	64.2	21.0	65.4	70.3
30.0	59.9	64.5	20.5	65.7	70.6
29.5	60.1	64.9	20.0	66.0	70.9
29.0	60.3	65.1	19.5	66.3	71.2
28.5	60.6	65.3	19.0	66.6	71.5
28.0	60.9	65.7	18.5	66.9	71.8
27.5	61.1	66.0	18.0	67.2	72.1
27.0	61.5	66.5	17.5	67.5	72.4
26.5	62.0	67.0	17.0	67.8	72.7
26.0	62.2	67.3	16.5	68.1	73.0

Opii Pulvis. — All but 1 of the 9 samples brought in were pure. The percentages of morphine are as follows: —

Opii Pulvis.

[Percentage of morphine.]

16.40	14.75	14.40	13.61	7.90
15.90	14.51	13.70	13.40	

Piper. — Three samples, all pure, were examined.

Potassii Bitartras. — Of the 21 samples examined, 2 were found to be adulterated with corn-starch, gypsum and acid phosphate of lime.

Pulvis Glycyrrhizæ Compositus. — All 3 samples analyzed were found pure.

Pimenta. — One sample was examined and found to be pure.

Saccharum Lactis. — One sample was tested and found to be pure.

Sapo. — One sample was examined and found to be pure.

Sinapis Alba. — One sample was examined and found to be pure.

Spiritus Ætheris Compositus. — Four samples were examined, of which 1 contained insufficient ethereal oil.

Spiritus Frumenti. — Eight samples were examined, all of which were below the standard, having the following percentages of total solids and alcohol: —

Spiritus Frumenti.

Total Solids.	Alcohol.	Total Solids.	Alcohol.	Total Solids.	Alcohol.	Total Solids.	Alcohol.
0.55	42.95	0.25	43.38	0.90	39.40	0.77	36.33
1.54	39.80	0.83	43.71	1.05	44.46	1.36	36.56

All the residues were insoluble.

Spiritus Vini Gallici. — Three samples were examined, all of which were below the standard, as follows: —

Spiritus Vini Gallici.

Total Solids.	Alcohol.	Total Solids.	Alcohol.	Total Solids.	Alcohol.
0.84	38.33	0.40	37.67	1.25	39.80

All the residues were insoluble.

Sulphur Præcipitatum. — Of the fifteen samples examined, 10 were found to contain calcium sulphate, due to the fact that instead of being prepared by treating the sulphur with lime and hydrochloric acid, as the Pharmacopœia directs, this drug is more frequently prepared by the use of lime and sulphuric acid, the resulting calcium sulphate being left in the product. The worst adulterated sample contained 50 per cent. of calcium sulphate.

Syrupus. — Five samples were examined; 3 of these contained insufficient cane sugar.

Tinctura Iodi. — Fifty-nine samples were examined, of which 48 were below the standard. One sample contained considerably more than the strength called for by the Pharmacopœia. The following list shows how each sample examined stood with reference to the amount of iodine contained, the result being expressed in the percentage of the United States pharmacopœial strength required: —

Tinctura Iodi.

[Per Cent. of U. S. pharmacopœial strength.]

117.1	100.0	83.1	76.9	70.0	63.6	56.0
100.0	100.0	83.0	75.0	70.0	63.6	55.0
100.0	94.3	82.0	75.0	70.0	63.0	54.3
100.0	92.9	81.4	75.0	70.0	58.3	54.2
100.0	92.9	81.3	72.6	70.0	57.2	54.0
100.0	88.1	81.3	71.8	67.1	57.1	50.0
100.0	88.0	78.0	71.7	67.1	57.1	40.1
100.0	86.6	78.0	71.4	64.0	56.0	39.0
100.0	86.5	77.0				

Tinctura Opii. — Thirty-four of the 39 samples examined were found not of good standard quality, containing insufficient morphine. Those examined were found to stand as follows: —

Tinctura Opii.

[Grammes of morphine per 100 cubic centimeters.]

1.740	1.250	1.140	1.100	1.032	0.945	0.712	0.325
1.570	1.230	1.125	1.095	1.025	0.920	0.525	0.255
1.479	1.210	1.115	1.090	1.020	0.855	0.485	0.140
1.350	1.185	1.112	1.085	1.010	0.845	0.455	0.052
1.300	1.163	1.110	1.045	0.950	0.820	0.385	

Tinctura Opii Camphorata. — One sample was found to be of good and 1 of poor quality.

Vinum Album. — Thirty-four samples were examined, all of which were of poor quality, containing large sugar residues. They analyzed as follows: —

Vinum Album.

Total Solids.	Alcohol.	Total Solids.	Alcohol.	Total Solids.	Alcohol.
14.72	18.23	22.80	12.08	0.39	8.93

Vinum Rubrum. — Four samples, all below the standard, were examined as follows: —

Vinum Rubrum.

Total Solids.	Alcohol.	Total Solids.	Alcohol.	Total Solids.	Alcohol.	Total Solids.	Alcohol.
13.16	15.50	21.57	13.13	19.00	14.09	14.00	20.00

Zingiber. — Two samples, both of good quality, were analyzed.

Miscellaneous Drugs.

The following articles were examined and found to be of good quality or free from injurious ingredients: —

Cough cures (5 samples), essence of lemon, tincture of capsicum, tooth powder, wild cherry beverage, and "A Cure for the Alcohol Habit."

Two samples of wall paper were examined for arsenic and found to contain a small amount.

A sample of "Imperial" hair dye, made up in two solutions, was analyzed. Solution *A* was found to be an ammoniacal solution of nitrates of nickel and silver, with a trace of mercury; solution *B* consisted of pyrogallic acid.

Two preparations of the face lotion type were examined, and one of them, "Mrs. McCorrison's Diamond Lotion," was found to contain corrosive sublimate.

A sample of "Vigoral" (beef extract) was found to be preserved with salicylic acid.

"Peach Meal for the Complexion" proved to be finely ground corn meal flavored with artificial oil of bitter almonds.

Summary of Statistics of Drugs.

Drugs.	Genuine.	Adulterated.	Total.	Per Cent. of Adulteration.
Acidum tannicum,	5	5	10	50.0
Æther,	–	2	2	100.0
Aqua ammoniæ fortior,	–	1	1	100.0
Alcohol,	2	–	2	–
Aqua destillata,	5	20	25	80.0
Argenti nitras,	12	–	12	–
Bismuthi subcarbonas,	8	–	8	–
Bismuthi subnitras,	5	5	10	50.0
Calx chlorata,	–	4	4	100.0
Capsicum,	60	10	70	14.3
Caryophyllus,	1	–	1	–
Cera alba,	3	–	3	–
Cera flava,	4	–	4	–
Cerii oxalas,	1	–	1	–
Chloral,	1	–	1	–
Chloroformum,	3	1	4	25.0
Cinnamomum cassia,	3	–	3	–
Diabetic flour,	3	10	13	76.9
Extractum glycyrrhizæ,	–	9	9	100.0
Ferri et quininæ citras,	6	2	8	25.0
Ferri et strychninæ citras,	3	–	3	–
Glycerinum,	46	21	67	31.3
Gin,	4	2	6	33.3
Iodum,	1	–	1	–
Limonis succus,	–	12	12	100.0
Liquor magnesii citratis,	1	–	1	–
Miscellaneous,	18	5	23	21.7
Magnesii citras effervescens,	3	–	3	–
Oleum limonis,	1	5	6	83.3
Oleum olivæ,	37	13	50	26.0
Opii pulvis,	8	1	9	11.1
Piper,	3	–	3	–
Potassii bitartras,	19	2	21	9.5
Pulvis glycyrrhizæ compositus,	3	–	3	–
Pimenta,	1	–	1	–
Saccharum lactis,	1	–	1	–
Sapo,	1	–	1	–
Sinapis alba,	1	–	1	–
Spiritus ætheris compositus,	3	1	4	25.0
Spiritus frumenti,	–	8	8	100.0
Spiritus vini gallici,	–	3	3	100.0
Sulphur præcipitatum,	5	10	15	66.6
Syrupus,	2	3	5	60.0
Tinctura iodi,	11	48	59	81.3
Tinctura opii,	6	33	39	84.6
Tinctura opii camphorata,	1	1	2	50.0
Vinum album,	–	3	3	100.0
Vinum rubrum,	–	4	4	100.0
Zingiber,	2	–	2	–
Summary,	303	244	547	44.6

General Summary.

	Genuine.	Adulterated.	Total.	Per Cent. of Adulteration.
Milk.	4,435	1,656	6,091	27.2
Foods not milk,	2,615	454	3,069	14.8
Drugs,	303	244	547	44.6
Totals,	7,353	2,354	9,707	24.2

Respectfully submitted,

ALBERT E. LEACH,
Analyst.

REPORT

UPON THE

PRODUCTION, DISTRIBUTION AND USE OF DIPHTHERIA ANTITOXIN.

REPORT

UPON THE

PRODUCTION, DISTRIBUTION AND USE OF DIPHTHERIA ANTITOXIN,

FOR THE

TWELVE MONTHS ENDED MARCH 31, 1900.

The following summary relates to the operations of the Board regarding the production, distribution and use of diphtheria antitoxin for the twelve months ended March 31, 1900. The work of the Board in this direction has rapidly increased from the time when it was begun in the spring of 1895. As a condition of the use of antitoxin by boards of health, physicians, hospitals and others, it was required that a return should be made in each case where antitoxin was used upon blank forms furnished by the Board, upon which the details of each case were to be recorded. A portion only of these returns have been made, and hence the report must be deemed to be incomplete so far as the use of antitoxin is concerned.

The returns contributed from the Boston City Hospital form a large share of the report, since these are more complete than those received from other parts of the State.

The supervision of antitoxin production has been carried on, as in former years, under the charge of Dr. Theobald Smith, at the Bussey Institute, near the Forest Hills station of the New York, New Haven & Hartford Railroad in Roxbury. The distribution has been conducted at the State House, from the office of the Board.

The strength of the serum employed has varied from 200 to 400 units per cubic centimeter, and the serum has usually been issued in a 5 cubic centimeter vial, containing 1,500 units. For convenience, a vial containing 20 cubic centimeters has also been employed for use where several patients are to be treated at once, or where unusually large doses are used. The serum has been distributed throughout the whole State, wherever it has been called for, to local boards of health, to contagious disease hospitals and to physicians in private practice, the latter being usually supplied through the local boards of health. In many instances the local board of health has placed it in charge of a druggist, where it could be obtained at any time during the day or night.

The confidence which has been expressed quite generally by physicians with reference to the value of antitoxin in diminishing the fatality from diphtheria has become so firmly established that few practitioners would be willing to undertake the treatment of the disease without this important remedy. Expressions of doubt as to its efficacy are now rarely heard.

The total number of packages issued by the Board during the five years ending with March 31, 1900, was as follows:—

In 1895–96 (year ending March 31),	1,724 bottles.
In 1896-97 (year ending March 31),	3,219 bottles.
In 1897-98 (year ending March 31),	4,668 bottles.
In 1898–99 (year ending March 31),	12,491 bottles.
In 1899-1900 (year ending March 31),	31,997 bottles.*
Total,	54,099 bottles.

In consequence of the variable strength of the product, it would be difficult to present an exact numerical statement, in units, of the antitoxin issued in these packages, the tendency having been to increase its strength from year to year. The total amount thus far issued is probably about 65,000,000 to 70,000,000 units.

The marked increase in the demand for antitoxin during the year was due to two causes: first, an increase in the prevalence of diphtheria during the year, and secondly, an increase in the average dose employed in each case. An account was kept during the year of the amount of antitoxin employed in each case with few exceptions, the result of which is shown in the following table:—

* This number has reference to the actual number of bottles issued in packages of about 1,500 units each. In order to make this comparable with the figures of the first three years (1895-98), a package of 1,000 units should be employed as a standard, so that the 31,997 bottles would be equivalent to nearly 50,000 of the strength at first employed.

Amount of Antitoxin Used.	Number of Cases.	Deaths.	Amount of Antitoxin Used.	Number of Cases.	Deaths.
Less than 1,000 units, . .	302	20	5,000 to 10,000 units, . .	568	66
1,000 to 1,500 units, . .	176	10	10,000 to 15,000 units, . .	260	36
1,500 to 2,000 units, . .	325	15	15,000 to 20,000 units, . .	283	35
2,000 to 3,000 units, . .	200	18	20,000 and more units, . .	428	104
3,000 to 4,000 units, . .	302	23	Unknown, ...	34	3
4,000 to 5,000 units, . .	56	8			

Of the cases in which more than 20,000 units were used there were 142 in which the amount was between 20,000 and 30,000; 98 in which it was from 30,000 to 40,000; 33 in which it was from 40,000 to 50,000; 29 in which it was from 50,000 to 60,000; 6 in which it was from 60,000 to 70,000; 1, 78,000; 1, 80,000; 1, 82,000; 2, 84,000, and 1 in which the dose was 100,500 units.

Further comment has also been made in the reports of previous years upon the comparatively small ratio of reports which have been made relative to the use of the product by physicians. The same comment may also be made with reference to the work of the past year. The reports have exceeded in number those of 1898, but the ratio to the number of cases remains about the same.

The figures presented in this report speak for themselves so far as the reduction which has taken place in the fatality of diphtheria is concerned. The fatality in the pre-antitoxin period, as shown in past reports of this Board, was 28.3 per cent. for the period of four years, 1891–94, while during the years 1895–99 the general fatality from diphtheria throughout the State was only 14.9 (see page 696), and for those cases treated with antitoxin it was only 11.2 per cent. (see page 667).

The strength of antitoxin distributed by the Board averaged about 300 units per cubic centimeter.

The whole number of cities and towns to which antitoxin was distributed was 114, or 4 more than those which were published in the report of 1898. The actual number in each year was probably somewhat larger than these figures, since a few of the more distant cities acted as distributing centres for small towns in their neighborhood, and in some instances no returns were made from these towns. This serum was distributed to local boards of health and to physicians in the following cities and towns: —

Number of Bottles of Diphtheria Antitoxin distributed from April 1, 1899, to March 31, 1900.

City or Town.	Number Bottles.	City or Town.	Number Bottles.
Boston:		Brockton,	56
City Hospital,	20,180	Beverly,	54
Children's Hospital,	226	Winchester,	50
General supply,	1,552	Hyde Park,	50
Cambridge,	1,645	Medford,	46
Worcester,	1,104	Taunton,	45
Newton,	688	North Adams,	41
Lawrence,	589	Milton,	40
Springfield,	587	Stoneham,	40
Somerville,	582	Adams,	40
Brookline,	412	Dedham,	39
Waltham,	381	Peabody,	36
West Springfield,	248	Rockland,	36
Lynn,	234	Chicopee,	36
Lowell,	224	Agawam,	36
Everett,	174	Winchendon,	30
Chelsea,	166	Natick,	29
Quincy,	152	Lexington,	28
Salem,	148	Maynard,	28
North Brookfield,	138	Medway,	25
Fitchburg,	128	Ware,	24
New Bedford,	104	Warren,	22
Malden,	92	Danvers,	22
Marblehead,	89	Ayer,	22
Attleborough,	87	Revere,	22
Haverhill,	83	Gloucester,	20
Pittsfield,	80	Acton,	20
Melrose,	74	Amesbury,	18
Arlington,	74	Randolph,	18
Fall River,	68	Uxbridge,	18
Watertown,	67	Newburyport,	18
Marlborough,	62	Medfield,	17
Leominster,	58	Wakefield,	17
Milford,	57	Clinton,	15
Woburn,	57	Winthrop,	15
Reading,	56	Braintree,	15
Holyoke,	56	Weston,	15

Number of Bottles of Diphtheria Antitoxin distributed from April 1, 1899, to March 31, 1900 — Concluded.

City or Town.	Number Bottles.	City or Town.	Number Bottles.
Concord,	15	Great Barrington,	6
Provincetown,	12	Norwood,	6
Northampton,	12	Andover,	6
Framingham,	11	North Attleborough,	6
Worthington,	10	Templeton,	6
Palmer,	10	Bridgewater,	6
Holbrook,	10	Douglas,	6
Middleborough,	10	Needham,	6
Cohasset,	10	Sterling,	6
Norwell,	9	Ludlow,	5
Dighton,	8	Swampscott,	5
East Longmeadow,	8	Monson,	5
Tewksbury,	8	Hingham,	3
Shirley,	7	South Hadley,	3
Stoneham,	7	Dover,	3
Rowley,	7	Cheshire,	3
Greenfield,	7	Edgartown,	3
Hanover,	6	Wareham,	2
Spencer,	6	Mansfield,	2
Methuen,	6	Barnstable,	2
Nantucket,	6	Westborough,	2
Brookfield,	6	Total,	31,997

The following list presents the names of the cities and towns from which detailed reports were received relative to the use of antitoxin, with the number from each town, during the year ended March 31, 1900: —

List of Cities and Towns from which Reports have been received relative to the Use of Antitoxin in the Treatment of Diphtheria, with the Number of Reports from Each.

Places.	Cases in which Cultures were made.	Cultures were not made.	Places.	Cases in which Cultures were made.	Cultures were not made.
Adams,	2	1	Arlington,	5	-
Agawam,	-	2	Ashcroft,	1	2

List of Cities and Towns from which Reports have been received relative to the Use of Antitoxin in the Treatment of Diphtheria, with the Number of Reports from Each — Concluded.

Places.	Cases in which Cultures were made.	Cultures were not made.	Places.	Cases in which Cultures were made.	Cultures were not made.
Belmont,	8	1	Medway,	-	2
Beverly,	6	4	Methuen,	-	2
Boston,	83	21	Needham,	4	1
Boston City Hospital,	1,920	-	New Bedford,	6	4
Brockton,	1	-	Newburyport,	1	1
Brookline,	3	-	Newton,	2	-
Braintree,	5	2	North Adams,	1	-
Cambridge,	16	16	Northbridge,	-	7
Cambridge Hospital,	91	-	Pittsfield,	2	3
Chelsea,	7	5	Quincy,	1	2
Chelsea Hospital,	8	-	Randolph,	1	-
Cheshire,	2	1	Revere,	-	3
Chicopee,	-	4	Somerville,	4	7
Clinton,	1	-	Springfield,	53	26
Dalton,	-	3	Stockbridge,	-	1
Danvers,	-	1	Taunton,	1	1
Dover,	1	-	Templeton,	1	1
Dracut,	1	-	Uxbridge,	-	2
East Longmeadow,	-	1	Ware,	-	1
Fitchburg,	32	15	Watertown,	19	5
Haverhill,	1	21	Wayland,	-	1
Holyoke,	4	10	Weston,	-	7
Lawrence,	1	19	Waltham,	54	-
Lexington,	1	-	West Springfield,	1	3
Lowell,	17	7	Woburn,	-	1
Lynn,	19	26	Worcester,	59	7
Malden,	-	1	Worcester Hospital,	68	-
Mansfield,	-	1	Winchester,	6	2
Medford,	12	13	Wilbraham,	-	1
Millbury,	1	-	Unknown,	-	1

Summary Observations upon the Use of Antitoxin in Massachusetts for the Year ended March 31, 1900.

Cases in which a Bacterial Examination was made.

The same method is employed in this summary as was adopted for the four previous years. The cases in which cultures were made are classified into positive and negative cases, the former being those which proved on examination to be genuine diphtheria and the latter those which were not.

Diagnostic examinations were made in 2,581 cases reported to the Board as having been treated with antitoxin, and of these, 2,256 proved to be genuine cases of diphtheria and 325 gave a negative result.

Positive Cases.

Of the 2,256 positive cases, or those in which a diagnosis of diphtheria was made by bacterial cultures from the throat of the patient, there were 1,998 recoveries and 258 deaths, or 11.4 per cent., the results of the previous years having been, respectively, 13.7, 11.6, 8.2 and 7.9 per cent.

Sex. — The number of males was 1,064, and the deaths of these were 116, or 10.9 per cent. The females were 1,169, and the deaths of females 136, or 11.7 per cent. The sex of 23 was not stated; 6 deaths.

Ages. — The following table shows the cases and deaths by ages: —

Year ended March 31, 1900.

Age Periods.	Cases.	Deaths.	Fatality (Per Cent.). 1899.	Fatality (Per Cent.). 1898.
From 0 to 2 years, ...	284	74	26.1	18.9
From 2 to 5 years, ...	827	107	12.9	10.0
From 5 to 10 years, ...	644	55	8.5	4.4
Over 10 years, ...	442	11	2.5	3.4
Age unknown, ...	59	11	18.6	33.0
	2,256	258	11.4	7.9

Day of Illness when Antitoxin was first administered.—The following table presents the fatality, according to the day of illness on which the antitoxin was first administered:—

Day.	Cases.	Deaths.	Fatality (Per Cent.).				
			1899.	1898.	1897.	1896.	1895.
First, . . .	245	24	9.8	8.2	8.0	0.0	0.0
Second, . .	594	33	5.6	1.8	8.9	9.5	9.7
Third, . .	437	56	12.8	6.2	7.0	8.3	8.7
Fourth, . .	298	42	14.1	13.2	3.0	22.7	15.4
Fifth, . . .	167	26	15.6	11.8	11.8	0.0	22.2
Sixth, . . .	67	12	17.9	20.0	0.0	14.3	20.0
Seventh, . .	48	13	27.1	9.5	30.0	25.0	33.3*
Eighth and later,	102	15	14.7	10.4	13.6	16.6	-
Unknown, . .	298	37	-	-	-	-	-

* Seventh day and later.

The value of the foregoing table consists mainly in the definite statement of the fatality of cases according to the day of illness at which antitoxin treatment was begun. In general, it shows that the ratio of success in treatment depends largely upon the early date at which antitoxin is first administered. A fuller and more conclusive summary containing greater numbers may be found on a later page.

The cases in which antitoxin treatment was begun either upon the first, second or third days of illness constituted 56.6 per cent. of the whole number of positive cases to which antitoxin was administered.

Hospital and Private Practice.—The fatality of the positive cases treated in hospitals in 1899 was as follows: cases treated and reported upon, 1,827; deaths, 235, or 12.8 per cent. In private practice: cases, 429; deaths, 23, or 5.4 per cent.*

* This apparent difference in the fatality of hospital and of general or outside treatment with antitoxin is accounted for by the fact that a considerable number of severe and fatal cases of diphtheria, which were treated by physicians in general practice, were transferred to a hospital after one or more days of home treatment and died at the hospital.

Seasons of the Year. — The cases embraced in the foregoing enumeration occurred in the following order: —

Months.	Cases.	Deaths.	Months.	Cases.	Deaths.
1899.			1899.		
April,	114	11	October,	250	14
May,	145	11	November,	264	24
June,	81	10	December,	251	54
July,	43	6	1900.		
August,	122	2	January,	259	24
September,	252	33	February,	251	31
			March,	192	35
Total six months,	757	73	Total six months,	1,467	182

By the foregoing table it appears that there were 757 positive cases reported in the warmer months, with 73 deaths, and 1,467 cases in the colder months, with 182 deaths.

Negative Cases.

The reported cases in which a negative result was obtained were 325, and the deaths of these were 33, or 10.3 per cent.

Sex. — The females were 143, with 14 deaths, or 9.8 per cent., and the males 178, with 19 deaths, or 10.7 per cent.; and there were 4 cases the sex not being stated; no deaths.

Age. — The percentage of fatality by ages was as follows: 0 to 2 years, 35.9 per cent.; 2 to 5 years, 11.2 per cent.; 5 to 10 years, 3.6 per cent.; and all over 10 years, 5.3 per cent.

Summary of the Five Years ended March 31, 1900.

Positive Cases treated with Antitoxin.

Whole number for the five years, 4,404; deaths, 258; fatality, 10.26 per cent.

Sex. — The fatality by sexes was as follows: —

Sex.	Cases.	Deaths.	Fatality (Per Cent.).
Males,	2,047	212	10.4
Females,	2,305	228	9.9

The sex of 52 was not stated; 9 deaths.

Ages. — The fatality by ages was as follows: —

Age Periods.	Cases.	Deaths.	Fatality (Per Cent.).
0 to 2 years,	532	120	22.6
2 to 5 years,	1,531	191	12.5
5 to 10 years,	1,268	98	7.7
Over 10 years,	997	31	3.1
Age unknown,	76	12	-

Hospitals and Private Practice.

	Cases.	Deaths.	Fatality (Per Cent.).
In hospitals,	3,095	342	11.1
In private practice,	1,307	110	8.4

Cases in which no Bacteriological Examination was made during the Year ended March 31, 1900.

Reports were made of 292 cases where antitoxin was employed in which no cultures were taken. Out of this number there were 41 cases which proved fatal, or 14.0 per cent. of the whole.

The unsatisfactory character of the information in regard to this class of cases must be acknowledged, since in none of them was a diagnosis made by means of a culture from the throat of a patient.

Sex. — The number of males in this class was 132, and the deaths of these were 22, or 16.6 per cent. The number of females was 146, and the deaths of these were 18, or 12.3 per cent. The number of those whose sex was unknown or not stated was 14, of which number one died.

Ages. — The following table presents the cases and fatality by ages among this class: —

Age Periods.	Cases.	Deaths.	Fatality (Per Cent.).
From 0 to 2 years, ...	43	14	32.6
From 2 to 5 years, ...	91	13	14.3
From 5 to 10 years, ...	78	11	14.1
Over 10 years, ...	77	3	3.9
Age unknown, ...	3	–	–

Sequelæ.

Among the cases reported in 1899, some sort of eruption, either urticaria or erythema, is reported to have been noticed in 1,116 instances. These were usually slight and evanescent in character. Albuminuria was reported in 598 cases, but in more than three-fourths of these it was slight or consisted of a trace only.

In 52 cases rheumatic pains or joint affections were reported.

Operations.

Notes are made in the returns of 298 cases in which intubation was performed, and in several cases the operation was repeated once or oftener.

The number of deaths among these intubated cases was 92, or 30.8 per cent. Tracheotomy is reported as having been performed five times and was followed by death in each case, except one.

Among the cases reported, diphtheria was said to have been complicated with scarlet-fever in one hundred and seventy instances; with scarlet-fever and measles four times; with whooping-cough nine times; with measles sixty-four times; with chicken-pox nine times; with measles and whooping-cough three times; with measles and bronchitis once; with tuberculosis once; Pott's disease once; rickets once; pregnancy twice. Pneumonia occurred as a complication twenty-five times, in three of which it was complicated with the addition of measles, in one with scarlet-fever, in one with phthisis, in one with measles and whooping-cough, in one with measles and scarlet-fever, and in another with congenital syphilis. Pneumonia proved to be a serious complication, since all of these cases in which it occurred, except three, proved fatal.

In four fatal cases in which antitoxin was administered it was recorded that the patient was moribund on admission. In another it was stated that the parents persistently objected to its use, and that when finally given it was too late to be of use.

The following statement, published in the annual report for 1896, applies equally to the results of the year 1899: —

It is quite plain that a comparison of the fatality of cases treated with antitoxin with the general fatality of cases of diphtheria previous to the introduction of this therapeutic agent, or even with cases not treated with antitoxin, which occurred at the same period with those so treated, does not do justice to the merits of antitoxin, for the reason that such a comparison must be made between two groups or classes of cases which are not strictly comparable, since one contains a larger and the other a smaller percentage of severe cases than the average. That is to say, the general run of cases treated with antitoxin by physicians in private practice, and especially of those sent to hospital, must necessarily be a selected class, in which the percentage of severe cases is greater than it is in the whole number of cases of diphtheria occurring or reported in a given community.

It has been urged, and with some degree of reason, that the diminution in the fatality from diphtheria is partly due to the introduction of bacterial diagnosis by means of cultures from the throat, whereby mild cases of illness are shown to be cases of true diphtheria which would otherwise have passed unnoticed. But this statement is in some measure offset by the fact that a considerable number of cases which might have passed for diphtheria before the days of bacterial diagnosis are now classed as "negative."

The most important lesson which is taught by these returns is the necessity of *early administration of the antitoxin in each and every case.*

Out of 731 cases in which antitoxin was administered on the first day of illness there were only 56 deaths, or 7.7 per cent.; and out of 2,120 cases treated during the first two days of illness there were only 138 deaths, or 6.5 per cent.; while the deaths in 524 cases in which antitoxin was not employed until the sixth and seventh days and later were 94, or 17.9 per cent., the patients in the former instances having a chance of living nearly three times as great as in the latter.

GENERAL SUMMARY, 1895-1899.

Positive cases treated in the years ending March 31, 1900, and reported to the State Board of Health,	4,404
Cases in which no bacteriological examination was made,	1,484
Total,	5,888*
Deaths of these,	657
Fatality (per cent.),	11.2

Sexes.

The number of males who were treated was †	2,718
The number of females who were treated was †	3,060
The number whose sex was not stated was †	110
Total,	5,888*
Deaths of males,	317
Fatality of males (per cent.),	11.7
Deaths of females,	320
Fatality of females (per cent.),	10.5
Deaths, sex not stated,	20

Deaths by Ages.

AGE PERIODS.	Cases.	Deaths.	Fatality (Per Cent.).
0 to 2 years,	710	170	23.9
2 to 5 years,	1,987	273	13.7
5 to 10 years,	1,740	150	8.6
Over 10 years,	1,340	48	3.6
Age unknown or not stated,	111	16	14.4
Total,	5,888	657	11.2

* In this number (5,888) 641 cases in which a bacterial diagnosis showed negative results are not included, so that the whole number treated with antitoxin of which returns were made to the Board was 6,529.

† Except cases determined to be "negative."

Day of Administration.

Day.	Cases.	Deaths.	Fatality (Per Cent).
First,	731	56	7.7
Second,	1,389	82	5.9
Third,	996	110	11.0
Fourth,	708	101	14.2
Fifth,	381	59	15.5
Sixth,	178	34	19.1
Seventh and later,	346	60	17.3
Unknown,	867	114	13.1

Immunization.

Considerable quantities of antitoxin have been used in each year for the purpose of immunization of healthy persons who have been exposed to the infection of diphtheria.

Returns giving the results of such immunization have been received, as in the case of its therapeutic use, only in a portion of these cases, numbering in all about 200 in the past year from 14 cities and towns and from 3 public institutions.

The majority of the immunized patients were children in families where other children were attacked with diphtheria and were under treatment. In some cases the parents or other adults were thus treated, and five nurses were also immunized.

The doses administered for the purpose of immunization varied from 150 units in one case to 1,500 units, the latter quantity being employed in 15 cases. The average dose used was about 700 units.

Diphtheria is recorded as having developed in five of the immunized cases, once after three days, once after four days, once after eight days. In one case a "suspicious throat" followed its use. None of these cases is reported as having proved fatal.

At the Children's Hospital, an institution at which several hundred patients are annually received for treatment, medical and surgical, but not for infectious diseases, it has been the custom to immunize each patient with diphtheria antitoxin soon after entrance.

DIPHTHERIA CULTURES EXAMINED DURING THE YEAR ENDED MARCH 31, 1900.

During the year, 3,258 cultures have been received from 106 towns and cities in the State. Of these, 1,778 were for diagnosis, 1,463 were for release from quarantine and 17 were unclassified. The following table gives the results of these examinations:—

PLACE.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.			Cultures examined for Release from Quarantine.
		Positive.	Negative.	Doubtful.	
Adams,	12	6	-	-	6
Andover,	69	36	25	-	8
Arlington,	63	8	18	-	37
Attleborough,	53	25	16	-	12
Barnstable,	3	2	-	1	-
Bedford,	14	-	14	-	-
Belmont,	12	1	2	-	9
Beverly,	57	16	24	1	16
Boston,	9	1	8	-	-
Boxford,	2	-	-	-	2
Braintree,	3	2	1	-	-
Bradford,	1	1	-	-	-
Bridgewater,	9	4	2	-	3
Brockton,	144	30	29	-	85
Brookfield,	1	-	1	-	-
Brookline,	1	-	-	-	1
Cambridge,	6	2	4	-	-
Canton,	3	-	-	-	3
Chelsea,	239	63	46	1	129
Concord,	14	2	12	-	-
Clinton,	10	4	5	-	1
Cheshire,	3	2	1	-	-
Clarksburg,	1	1	-	-	-
Danvers,	22	2	7	-	13
Dartmouth,	2	1	-	-	1
Dedham,	6	1	-	-	5
Dover,	4	1	1	-	2
Duxbury,	2	1	-	-	1
Everett,	326	52	57	1	216
Edgartown,	3	-	2	1	-
Egremont,	2	-	2	-	-
Fall River,	1	1	-	-	-

Place.	Whole Number of Cultures examined.	Cultures examined for Diagnosis. Positive.	Negative.	Doubtful.	Cultures examined for Release from Quarantine.
Falmouth,	1	-	-	-	1
Fairhaven,	1	-	1	-	-
Framingham,	31	4	6	1	20
Fitchburg,	20	4	5	-	11
Gloucester,	12	3	9	-	-
Greenfield,	40	7	9	-	24
Great Barrington,	3	1	2	-	-
Groveland,	4	-	4	-	-
Hamilton,	1	-	1	-	-
Hanover,	17	2	4	-	11
Harvard,	1	-	1	-	-
Haverhill,	31	7	24	-	-
Hingham,	15	1	4	-	10
Hyde Park,	62	10	20	1	31
Lancaster,	1	-	1	-	-
Lawrence,	106	27	57	2	20
Lexington,	20	3	8	-	9
Malden,	135	18	32	2	83
Marblehead,	73	23	27	-	23
Marlborough,	87	14	28	3	42
Marshfield,	13	-	3	-	10
Medfield,	17	1	4	-	12
Medford,	113	35	67	-	11
Medway,	3	-	3	-	-
Melrose,	33	8	6	2	17
Methuen,	3	3	-	-	-
Middleborough,	1	-	1	-	-
Milton,	55	7	29	-	19
Montague,	1	1	-	-	-
Natick,	4	1	3	-	-
New Bedford,	170	12	37	1	120
Newburyport,	45	20	25	-	-
North Adams,	30	9	7	-	14
North Attleborough,	2	1	1	-	-
North Brookfield,	52	13	3	-	36
Norwell,	11	1	2	-	8
Norwood,	5	1	4	-	-
Orange,	1	-	1	-	-
Peabody,	17	5	6	-	6
Pembroke,	1	-	-	-	1
Quincy,	53	24	19	-	10
Randolph,	3	1	2	-	-
Reading,	112	13	48	-	51
Revere,	6	1	3	-	2
Rockland,	13	4	7	1	1
Rowley,	2	1	1	-	-
Salem,	119	14	16	-	89
Saugus,	1	1	-	-	-
Sherborn,	2	-	2	-	-
Shirley,	5	2	3	-	-
Somerville,	222	55	127	1	39
Southborough,	1	-	1	-	-

Place.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.			Cultures examined for Release from Quarantine.
		Positive.	Negative.	Doubtful.	
Southbridge,	1	-	-	1	-
Sterling,	3	-	3	-	-
Stoneham,	7	1	6	-	-
Sutton,	1	1	-	-	-
Swampscott,	13	3	8	-	2
Taunton,	4	3	1	-	-
Templeton,	1	1	-	-	-
Wakefield,	8	5	2	-	1
Ware,	1	-	1	-	-
Wareham,	3	3	-	-	-
Warren,	16	4	11	-	1
Watertown,	102	16	23	-	63
Westborough,	2	-	2	-	-
West Boylston,	1	-	1	-	-
West Springfield,	4	3	-	-	1
Weymouth,	5	-	-	-	5
Winchendon,	12	1	11	-	-
Winchester,	127	20	34	-	73
Winthrop,	49	7	6	-	36
Woburn,	6	2	4	-	-
Worthington,	1	-	1	-	-
Wrentham,	1	-	1	-	-
Unclassified, and place not stated,	17	-	-	17	-
State,	3,258	692	1,066	37	1,463

Relation of Clinical to Bacteriological Diagnosis.

Clinical Diagnosis.	Bacteriological Diagnosis.			Percentage of Error in Clinical Diagnosis.
	Positive.	Negative.	Doubtful.	
Positive in 574 cases,	361	209	4	36.6
Negative in 384 cases,	67	315	2	17.5
Doubtful in 394 cases,	114	276	4	-
Not given in 288 cases,	103	179	6	-

Persistence of Diphtheria Bacilli in the Throats of Patients Convalescent from Diphtheria.

Among these cases are included only those in which frequent cultures were made until the throat was clear of the bacilli. The time of persistence is given from the date of the earliest symptoms to when the bacilli were last found.

Time.	Number of Cases.	Time.	Number of Cases.
7 days, ...	2	36 days, . . .	2
10 days, ...	2	37 days, . . .	1
11 days, ...	2	39 days, . . .	3
12 days, ...	5	40 days, . . .	4
13 days, ...	4	41 days, . . .	1
14 days, ...	12	42 days, . . .	3
15 days, ...	5	43 days, . . .	1
16 days, ...	5	44 days, . . .	4
17 days, ...	10	50 days, . . .	2
18 days, ...	6	53 days, . . .	1
19 days, ...	7	56 days, . . .	1
20 days, ...	12	61 days, . . .	1
21 days, ...	8	66 days, . . .	2
22 days, ...	9	67 days, . . .	1
23 days, ...	4	70 days, . . .	2
24 days, ...	9	73 days, . . .	1
25 days, ...	7	76 days, . . .	1
26 days, ...	11	78 days, . . .	1
27 days, ...	9	79 days, . . .	1
28 days, ...	6	90 days, . . .	2
29 days, ...	6	97 days, . . .	1
30 days, ...	9	108 days, . . .	1
31 days, ...	3	111 days, . . .	1
33 days, ...	3		
34 days, ...	2	Average days, 28.6.	
35 days, ...	4		

Summary of the Four Years ending March 31, 1900.

The whole number of cultures examined during the four years is 8,523. Of these, 4,621 were made for the diagnosis of diphtheria, and 3,902 were made for release from quarantine. Of the cultures made for diagnosis 1,984 were positive, 2,563 were negative, and 74 were doubtful.

Relation of Clinical to Bacteriological Diagnosis.

Clinical Diagnosis.	Bacteriological Diagnosis.			Percentage of Error in Clinical Diagnosis.*
	Positive.	Negative.	Doubtful.	
Positive in 1,739, ...	1,098	624	17	36.2
Negative in 947, ...	190	740	17	20.4
Doubtful in 1,023, ...	339	668	16	-
Not given in 912, ...	357	531	24	-
Total, 4,621, ...	1,984	2,563	74	-

* These figures are percentages of the sum of the positive and negative cases in which a bacteriological diagnosis was definitely determined.

In 691 cases in which frequent cultures were made until the throat was free from the bacilli, the average time of persistence of the bacilli from the date of the earliest symptoms was 27.4 days.

EXAMINATIONS OF SPUTUM AND OTHER MATERIAL SUSPECTED OF CONTAINING THE BACILLI OF TUBERCULOSIS.

During the year ending March 31, 1900, microscopic examinations have been made of 571 specimens of sputum or other material suspected of containing the bacilli of tuberculosis. This material was received from 89 different towns and cities in the State. The following tables show the results of these examinations and the places from which the material was received:—

Tabular Statement of Examinations of Material.

City or Town.	Number of Cases examined.	Males.		Females.		Sex not stated.	
		Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
Adams,	1	-	-	-	1	-	-
Arlington,	8	2	1	-	4	-	1
Attleborough,	14	3	4	3	4	-	-
Barnstable,	2	-	-	-	2	-	-
Belmont,	1	1	-	-	-	-	-
Berlin,	1	-	1	-	-	-	-
Beverly,	1	-	-	-	1	-	-
Blackstone,	2	-	2	-	-	-	-
Boston,	61	20	15	4	17	2	2
Bridgewater,	3	1	-	1	1	-	-
Brockton,	15	-	6	5	4	-	-
Brookfield,	3	-	2	-	1	-	-
Brookline,	2	-	1	-	1	-	-
Cambridge,	4	-	2	1	1	-	-
Chelsea,	14	2	1	4	4	2	1
Clinton,	11	2	-	4	5	-	-
Cohasset,	2	1	1	-	-	-	-
Concord,	16	3	10	1	2	-	-
Cummington,	1	-	1	-	-	-	-
Danvers,	7	1	1	4	1	-	-
Danversport,	2	2	-	-	-	-	-
Dartmouth,	1	-	1	-	-	-	-
Dedham,	10	1	4	2	2	1	-
East Bridgewater,	2	-	1	-	1	-	-

Tabular Statement of Examinations of Material— Continued.

City or Town.	Number of Cases examined.	Males.		Females.		Sex not stated.	
		Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
Everett,	20	4	3	5	6	1	1
Fall River,	75	18	17	18	20	2	-
Fairhaven,	1	-	-	1	-	-	-
Fitchburg,	5	-	3	1	1	-	-
Foxborough,	4	1	1	1	1	-	-
Framingham,	20	-	4	5	11	-	-
Georgetown,	3	-	3	-	-	-	-
Gloucester,	5	1	2	-	2	-	-
Greenfield,	1	1	-	-	-	-	-
Haverhill,	5	2	-	2	1	-	-
Holbrook,	1	-	-	-	-	1	-
Lawrence,	5	2	1	-	1	-	-
Lee,	2	2	-	-	-	-	-
Lexington,	1	-	-	-	-	-	-
Littleton,	2	-	1	-	1	-	-
Malden,	6	1	3	1	1	-	-
Mansfield,	2	-	-	-	2	-	-
Marlborough,	2	1	-	1	-	-	-
Medford,	13	4	2	4	2	-	-
Medway,	2	-	-	-	1	-	1
Melrose,	4	2	2	-	-	-	-
Methuen,	5	2	-	1	2	-	-
Middleborough,	5	-	-	1	4	-	-
Milford,	2	-	1	-	1	-	-
Milton,	2	1	1	-	-	-	-
New Bedford,	19	6	5	5	3	-	-
Newton,	1	-	-	-	1	-	-
Norfolk,	1	-	1	-	-	-	-
North Adams,	27	12	4	4	7	-	-
North Attleborough,	3	1	1	-	-	-	1
North Brookfield,	7	2	3	1	1	-	-
Norton,	1	-	-	-	1	-	-
Norwood,	1	-	-	-	1	-	-
Oxford,	6	2	2	-	2	-	-
Peabody,	2	-	-	1	-	1	-
Provincetown,	2	-	1	-	1	-	-
Quincy,	10	1	2	2	3	1	1
Randolph,	4	1	-	-	-	1	2
Reading,	1	1	-	-	-	-	-
Revere,	7	1	2	1	3	-	-
Rowley,	1	-	-	1	-	-	-
Rockland,	8	2	4	-	2	-	-
Salem,	5	1	-	1	1	1	1
Sheffield,	2	1	-	-	1	-	-
Sherborn,	1	-	-	-	1	-	-
Somerville,	10	3	3	1	3	-	-
Spencer,	8	2	2	1	2	-	1
Stoughton,	1	1	-	-	-	-	-
Taunton,	1	-	-	-	-	-	1

Tabular Statement of Examinations of Material—Concluded.

City or Town.	Number of Cases examined.	Males.		Females.		Sex not stated.	
		Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
Wakefield,	1	-	1	-	-	-	-
Waltham,	3	1	1	1	-	-	-
Warren,	4	-	1	-	2	-	1
Watertown,	2	-	-	1	1	-	-
Westborough,	1	-	1	-	-	-	-
West Brookfield,	1	-	-	1	-	-	-
Westford,	17	5	4	1	6	-	1
Weymouth,	8	1	7	-	-	-	-
Whitman,	1	-	1	-	-	-	-
Williamstown,	2	-	1	-	-	1	-
Winchendon,	3	-	2	1	-	-	-
Winchester,	12	2	4	6	-	-	-
Winthrop,	5	1	2	-	1	-	1
Woburn,	1	-	-	1	-	-	-
Worthington,	1	-	-	1	-	-	-
Wrentham,	1	-	-	-	1	-	-
Not stated,	4	-	-	-	2	1	1
State,	571	129	152	102	155	16	17

Distribution by Ages.

	Number of Cases examined.	Positive.	Negative.
Between the age of 1 and 10,	9	-	9
Between the age of 10 and 20,	67	29	38
Between the age of 20 and 30,	142	68	74
Between the age of 30 and 40,	148	68	80
Between the age of 40 and 50,	73	30	43
Between the age of 50 and 60,	44	11	33
Between the age of 60 and 70,	22	3	19
Between the age of 70 and 80,	3	-	3
Age not stated,	63	38	25
Total,	571	247	324

Distribution by Sexes.

	Total.	Males.	Females.	Sex not stated.
Number of cases examined (positive),	247	129	102	16
Number of cases examined (negative),	324	152	155	17
Total,	571	281	257	33

Summary of the Four Years ending March 31, 1900.

The whole number of specimens examined in the four years was 1,345; of these, 610, or 45.3 per cent., were positive, and 735 were negative.

Ages.—Of the 178 specimens from persons who were under twenty years of age 37.6 per cent. were positive, of 871 specimens from persons who were between the age of twenty and fifty years 48.2 per cent. were positive, and of 145 specimens from persons who were over fifty years of age 27.6 per cent. were positive. Of the *positive cases*, 67, or 12.7 per cent., were under twenty years of age, 420, or 79.7 per cent., were between twenty and fifty years of age, and 40, or 7.6 per cent., were over fifty years of age. The age was not stated in 78 cases.

Sexes.—Of the 1,345 cases examined, 635 were males, 631 were females and the sex of 79 was not stated. Of the male cases 46.3 per cent. and of the female cases 43.2 per cent. were positive.

MALARIA.

During the year preparations of blood suspected of containing malaria parasites were received from 76 cases, or but little more than half as many as were received in 1898. Of this number, only 20 contained the parasite of malaria, and these 20 came from Concord, Everett, Middleborough, Uxbridge and Winchester; 14 of the number were from Concord.

All of the specimens came from eastern Massachusetts and none were received from places farther west than the eastern part of Worcester County.

The distribution is presented in the following table: —

Malaria.

City or Town.	Number of Patients.	Positive.	Negative.	City or Town.	Number of Patients.	Positive.	Negative.
Boston,	1	-	1	Northbridge,	1	-	1
Brookline,	2	-	2	Somerville,	1	-	1
Cambridge,	1	-	1	Stoneham,	1	-	1
Chelmsford,	1	-	1	Swampscott,	1	-	1
Clinton,	4	-	4*	Uxbridge,	4	2	2
Concord,	37	14	23	Waltham,	2	-	2
Everett,	1	1	-	Westford,	2	-	2
Lancaster,	1	-	1	Winchester,	11	2	9
Lowell,	2	-	2	Winthrop,	1	-	1
Melrose,	1	-	1	Total,	76	20	56
Middleborough,	1	1	-				

* In one case preparation worthless.

STATISTICAL SUMMARIES

OF

DISEASE AND MORTALITY.

STATISTICAL SUMMARIES OF DISEASE AND MORTALITY.

The statistical information received by the Board during each year, either through the medium of voluntary returns or in consequence of legal requirements, has, in the last five reports of the Board, been presented under four different heads or groups, which are summarized and defined as follows: —

1. *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 are voluntary, and serve principally to show the seasonal prevalence of each of the chief infectious diseases, and the mortality of children under five years old in weekly periods. This series of statistics has been continued by the Board for more than twenty years, and has been published as a summary for fifteen years.

2. *The Reports of Certain Infectious Diseases, — Diphtheria and Croup, Scarlet-fever, Typhoid Fever and Measles.* — These are obtained from the annual reports of local boards of health for the year 1899, which are forwarded to the State Board from cities and towns. 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.

3. *Reports of Cities and Towns, made under the Provisions of Chapter 302 of the Acts of 1893.* — 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.

4. *Annual Reports, made under the Provisions of Chapter 218 of the Acts of 1894.* — 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. These reports are made under the requirements of the following statute: —

[ACTS OF 1894, CHAPTER 218, SECTION 2.]

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.

NOTE. — A supply of the postal cards necessary for the reporting of voluntary mortality returns such as are required for the data presented in section 1 of the following summary, will be forwarded to the registration officers of any city or town who are willing to contribute the necessary information.

Postal cards are also sent to all boards of health in the State, for the purpose of aiding them to comply with the provisions of chapter 302 of the Acts of 1893, relative to the reporting of diseases dangerous to the public health to the State Board 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 218 of the Acts of 1894.

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 1899. 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 years or more, and also as a publication of the Board, in a weekly bulletin, since and including 1883.

These returns are necessarily incomplete, since they are voluntary and consequently embrace the statistics of a portion only of the population, the reporting places being chiefly the cities and large towns.

The estimated population of the cities and towns contributing to these returns in 1899 was 1,729,878, or about two-thirds of the total population.

The following items are embraced in this summary: —

Average height of barometer for each week.
Mean maximum temperature.
Mean minimum temperature.
Rainfall, expressed in inches.
Total deaths reported for each week.
Deaths of children under five years.
Deaths from infectious diseases.
Deaths from consumption.
Deaths from acute lung diseases.
Deaths from typhoid fever.
Deaths from diarrhœal diseases.
Deaths from scarlet fever.
Deaths from measles.
Deaths from diphtheria and croup.
Deaths from puerperal fever.
Deaths from whooping-cough.
Deaths from malarial fever.
Deaths from erysipelas.
Deaths from cerebro-spinal meningitis.

The following table contains a summary of the statistics compiled from these weekly returns of mortality: —

Summary for 1899.

1899.		Barometer.	Mean Maximum Thermometer for Each Week.	Mean Minimum Thermometer for Each Week.	Humidity.	Rainfall, in Inches.	Total Deaths.	Deaths under Five Years of Age.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diphtheria and Croup.	Scarlet Fever.	Measles.	Diarrhœal Diseases.	Whooping-cough.	Malarial Fever.	Puerperal Fever.	Erysipelas.	Cerebro-spinal Meningitis.
Jan.	7,	30.28	39	20	74	-	714	204	65	97	8	14	2	1	6	11	-	-	3	9
	14,	30.32	32	16	58	-	781	194	82	192	14	15	2	2	5	10	-	-	3	5
	21,	30.04	45	27	61	-	710	160	66	168	10	12	2	3	2	11	-	-	2	5
	28,	29.85	44	38	68	3.91	697	182	76	124	5	15	-	1	3	3	-	1	4	5
Feb.	4,	30.06	29	16	62	-	624	143	78	129	3	12	1	1	5	4	-	-	2	10
	11,	30.00	21	8	69	-	597	156	54	108	4	9	1	-	4	7	-	-	-	6
	18,	30.02	23	18	77	-	613	169	54	130	8	23	4	1	4	2	-	1	4	7
	25,	29.81	46	30	63	4.19	738	231	78	147	4	15	1	1	10	9	-	1	3	6
March	4,	30.06	42	29	78	-	560	165	46	110	3	6	4	-	3	2	-	-	2	10
	11,	29.98	43	27	80	-	587	155	45	101	4	7	4	-	6	7	-	-	5	5
	18,	30.08	43	29	70	-	541	164	69	109	4	11	2	2	5	4	1	-	2	6
	25,	29.93	36	25	70	6.67	634	201	72	106	3	10	3	3	6	7	-	1	4	11
April	1,	29.78	42	30	68	-	624	185	69	93	5	9	2	5	10	2	-	-	7	7
	8,	29.96	54	39	54	-	570	153	73	89	7	9	2	4	3	-	-	1	2	5
	15,	29.97	54	39	55	-	640	190	49	120	5	14	3	7	4	4	-	1	1	11
	22,	30.03	55	35	59	-	590	177	67	105	5	10	3	4	8	5	-	1	5	8
	29,	30.14	70	46	56	1.78	632	175	64	92	4	8	2	6	17	5	-	1	5	9
May	6,	29.98	70	50	56	-	627	166	74	81	6	9	6	2	11	3	-	1	1	5
	13,	29.93	70	51	56	-	585	175	68	91	9	6	-	9	4	3	-	-	3	6
	20,	30.01	58	47	60	-	476	125	60	56	4	6	5	2	9	3	-	1	2	11
	27,	30.18	67	49	65	1.87	508	138	70	57	2	8	2	6	4	6	-	1	2	9
June	3,	29.96	77	57	64	-	540	183	62	74	1	18	11	6	8	3	-	-	2	9
	10,	29.95	83	61	61	-	531	164	52	66	2	5	9	2	7	5	-	-	2	12
	17,	30.04	78	59	69	-	462	184	47	45	5	5	3	4	17	-	-	-	1	4
	24,	30.03	79	60	64	3.69	459	183	49	37	3	9	1	5	27	3	-	-	4	1
July	1,	30.05	79	58	59	-	518	179	62	28	-	9	3	2	30	-	-	-	2	5
	8,	29.98	88	68	69	-	506	218	51	30	3	17	2	-	80	6	-	1	-	4
	15,	29.92	83	64	59	-	680	294	63	29	15	10	4	2	186	6	-	-	-	12
	22,	29.90	79	62	68	-	752	358	61	35	6	5	2	2	227	10	-	-	-	6
	29,	30.01	76	63	76	3.86	735	392	52	28	12	12	1	4	205	2	-	-	-	10
Aug.	5,	29.90	81	63	69	-	617	306	47	22	9	7	2	1	154	4	-	1	3	4
	12,	29.92	73	59	67	-	674	332	66	22	14	18	2	1	174	7	-	1	-	4
	19,	30.04	82	62	65	-	615	278	50	30	9	9	2	-	146	5	-	-	-	6
	26,	29.96	71	64	59	2.14	602	283	54	25	10	8	2	-	152	2	-	1	-	3

Sept. 2,	30.22	73	59	86	-	595	298	46	27	6	10	3	-	144	6	1	-	-	5
9,	29.96	74	56	73	-	506	204	44	27	14	7	2	-	72	8	-	1	3	5
16,	30.11	65	50	68	-	587	256	62	24	20	12	3	-	91	8	-	-	-	4
23,	30.06	78	55	78	-	594	255	45	43	13	17	-	1	53	6	1	-	-	6
30,	30.07	68	51	80	4.76	583	221	55	30	15	23	2	-	56	4	-	2	1	3
Oct. 7,	30.22	58	42	66	-	527	183	54	34	12	25	1	-	31	5	-	-	-	4
14,	30.22	64	50	88	-	483	174	55	41	12	30	2	-	16	2	-	1	-	8
21,	30.21	63	49	80	-	501	168	43	52	19	23	5	-	12	4	-	-	-	3
28,	30.71	62	47	77	2.29	475	157	40	56	10	15	4	-	14	3	-	-	1	9
Nov. 4,	29.99	58	43	81	-	521	164	47	65	11	18	3	1	19	3	-	-	2	4
11,	30.07	56	39	71	-	519	146	61	53	18	12	-	1	10	2	-	-	-	5
18,	30.23	43	29	80	-	481	150	40	64	13	19	3	2	3	3	-	1	3	5
25,	29.90	48	36	71	2.06	581	178	61	86	10	27	4	1	18	1	-	1	1	7
Dec. 2,	29.80	49	36	71	-	541	158	64	92	8	22	1	1	4	-	-	-	2	8
9,	30.01	42	29	63	-	526	171	50	88	13	21	3	2	4	1	-	-	-	4
16,	30.19	51	34	69	-	613	185	65	100	7	34	3	1	7	1	-	-	-	7
23,	30.37	47	35	75	-	593	157	52	106	6	20	3	1	8	2	-	-	2	3
30,	29.68	33	20	66	1.77	612	195	57	93	6	35	12	2	4	2	-	1	1	7
Totals,	-	-	-	-	38.43	30,490	10,292	3,036	3,859	405	723	159	100	2,049	220	3	22	36	345
Weekly averages,	-	-	-	-	-	586	198	58	74	7.8	14	3	2	39	4.2	0.06	0.42	1.65	6.63
Rate per 1,000 deaths,	-	-	-	-	-	-	337.58	99.5	126.5	13.28	23.71	5.21	3.27	67.20	7.15	0.09	0.71	2.82	11.31
Rate per 1,000 population,	-	-	-	-	-	17.62	5.94	1.75	2.23	0.23	0.42	0.09	0.06	1.18	0.12	0.002	0.012	0.049	0.19

Average reporting population, ... 1,729,378

Total Deaths.

The whole number of deaths reported for the year 1899 from the cities and towns contributing to these reports was 30,490, and the average per week was 586. The greatest number of deaths reported in a single week was 752, in the week ending July 29; the least number was 459, in the week ending June 24. The weekly average number of deaths reported for each month was: —

January,	725	July,	628
February,	646	August,	627
March,	581	September,	563
April,	611	October,	496
May,	530	November,	525
June,	498	December,	577

The percentage of mortality in each of the four quarters of the year was as follows: —

	All Ages.		Ages under 5 Years.	
	Numbers.	Percentages.	Numbers.	Percentages.
First quarter,	7,809	25.58	2,124	20.65
Second quarter,	7,194	23.57	2,098	20.38
Third quarter,	,514	27.95	3,894	37.83
Fourth quarter,	6,973	22.90	2,176	21.14
	30,490	100.00	10,292	100.00

Deaths under Five Years of Age.

The reported number of deaths of children under five years of age was 10,292. The average weekly number was 198. The greatest number reported in one week was 392, in the week ending July 29, and the least number was 125, in the week ending May 20. The ratio of the deaths of this class to the total reported mortality was 33.7 per cent. The average weekly number of deaths of children under five years of age, by months, was as follows: —

January,	185	July,	293
February,	174	August,	298
March,	171	September,	247
April,	176	October,	169
May,	151	November,	159
June,	143	December,	172

The months having the greatest number of deaths of children under five years of age were July, August and September, and those having the least number were May, June and November.

CONSUMPTION.

The number of reported deaths from consumption was 3,036. The weekly average was 58. The greatest number of deaths reported from this cause in a single week was 82, in the week ending January 14, and the least number was 40, in the weeks ending October 28 and November 18. The average weekly number of reported deaths from this cause in each month was as follows: —

January,	72	July,	58
February,	66	August,	54
March,	58	September,	50
April,	64	October,	48
May,	68	November,	52
June,	52	December,	58

The following table presents the variations from the weekly average number of deaths from this cause for the past four years: —

	1896.	1897.	1898.	1899.		1896.	1897.	1898.	1899.
January,	+1	+8	0	+20	July,	–1	+3	–4	0
February,	+3	+7	–1	+8	August,	+10	–7	–7	–4
March,	–1	+7	+11	0	September,	–7	–6	–5	–8
April,	+21	+6	+7	+6	October,	–5	–4	–2	–10
May,	+2	+4	+2	+10	November,	–10	+2	–2	–6
June,	+1	–1	–3	–6	December,	–9	–3	+8	0

The ratio of reporting deaths from consumption to the mortality from all causes was 99.5, while that of previous years was as follows: —

1890,	130.0	1895,	107.7
1891,	116.5	1896,	105.3
1892,	111.3	1897,	104.2
1893,	106.5	1898,	104.6
1894,	111.3	1899,	99.5

The ratio to the reported living population in 1899 was 1.75 per 1,000, as compared with 1.88 in 1898.

Acute Lung Diseases.

The number of reported deaths from acute lung diseases (bronchitis, pneumonia, pleurisy and asthma) during the year was 3,859, and the weekly average was 74. The greatest number of deaths reported from this group of causes in a single week was 192, in the week ending January 14, and the least number was 22, in the weeks ending August 5 and August 12. The average weekly number of reported deaths from these causes for each month was as follows: —

January,	145	July,	30
February,	129	August,	25
March,	106	September,	30
April,	99	October,	46
May,	71	November,	67
June,	55	December,	96

The months having the greatest number of reported deaths from these causes were January, February and March, and those having the least number were July, August and September. The ratio of reported deaths from acute lung diseases to the reported mortality from all causes was 126.56 per 1,000. The estimated death-rate per 1,000 of the reporting population from these causes was 2.23 as compared with 2.12 in 1898.

Diarrhœal Diseases.

The diseases included in this group are diarrhœa, dysentery, cholera morbus and cholera infantum. From these causes combined, the number of deaths reported in 1899 was 2,049, and the weekly average number was 39. The greatest number of deaths reported from this group of causes in a single week was 227, in the week ending July 22, and the least number was 3, in the weeks ending January 21, January 28, March 4, April 8 and 22, June 3 and November 18. The average weekly number of reported deaths from these causes in each month was as follows: —

January,	4	July,	136
February,	7	August,	156
March,	6	September,	83
April,	7	October,	18
May,	7	November,	11
June,	13	December,	6

The months having the greatest number of reported deaths from these causes in 1899 were July, August and September, and those having the least were January, February, March and December.

The deaths from these causes in the third quarter of the year constituted 83 per cent. of the number of deaths from the same cause for the entire year. The ratio of the reported deaths to the reported mortality from all causes was 67.20 per 1,000, and the death-rate of reporting population from these causes was 1.18 per 1,000, as compared with 1.55 in 1898.

Typhoid Fever.

The total number of reported deaths from this cause in 1899 was 405, and the average weekly number was 8. The greatest number reported in any single week from this cause was 20, in the week ending September 16, and there were no deaths reported from typhoid fever in the week ending July 1.

The average weekly number of deaths reported from this cause for each month was as follows: —

January,	9	July,	8
February,	5	August,	11
March,	3	September,	13
April,	6	October,	13
May,	5	November,	12
June,	3	December,	6

The months having the least number of deaths from this cause were March and June, and those having the greatest number were September and October. The ratio of reported deaths from typhoid fever to the reported mortality from all causes was 13.28 per 1,000, and the ratio of reporting population was .23 per 1,000, as compared with .25 in the previous year.

Diphtheria and Croup.

The total number of reported deaths from diphtheria and croup in 1899 was 723, and the average number in each week was 14. The greatest number reported in a single week from these combined causes was 35, in the week ending December 30, and the least number was 5, in the weeks ending June 17 and July 22.

The average weekly number of reported deaths from these causes for each month was as follows: —

January,	14	July,	11
February,	15	August,	9
March,	9	September,	14
April,	10	October,	23
May,	7	November,	19
June,	8	December,	26

The ratio of deaths from diphtheria and croup to the reported mortality from all causes was 23.71 per 1,000, and the death-rate for the reporting population was .42 per 1,000, as compared with .32 in the previous year.

Scarlet Fever.

The reported deaths from scarlet fever in 1899 were 159. The greatest number reported from this cause in a single week was 12, in the week ending December 30. There were four weeks in which no deaths from scarlet fever were reported. The average weekly number reported in each month was as follows: —

January,	2	July,	2
February,	2	August,	2
March,	3	September,	2
April,	3	October,	3
May,	3	November,	2
June,	6	December,	7

The ratio of deaths from this cause to the reported deaths from all causes was 5.21 per 1,000, and the death-rate of the reporting population from this cause was .09 per 1,000, as compared with .04 in the previous year.

Cerebro-spinal Meningitis.

The total number of reported deaths from this cause was 345, and the weekly average was 7. The greatest number reported in any week from this cause was 12, in the weeks ending June 10 and July 15, and the least number was 1, in the week ending June 24.

The average weekly number of deaths reported from this cause for each month was as follows: —

January,	7	July,	7
February,	7	August,	4
March,	9	September,	5
April,	8	October,	6
May,	9	November,	5
June,	7	December,	6

The months having the greatest number of reported deaths from this cause were May and July, and those having the least were August and November.

Whooping-cough, Measles, Malarial Fever, Erysipelas and Puerperal Fever.

The essential statistics relating to these five diseases are embraced in the following table: —

Diseases.	Total Deaths reported.	Weekly Average.	Ratio per 1,000 of Total Reported Deaths.	Ratio per 1,000 of Reporting Population.
Whooping-cough,	220	4.20	7.15	.127
Measles,	100	2.00	3.27	.060
Malarial fever,	3	0.06	0.09	.002
Erysipelas,	86	1.65	2.82	.049
Puerperal fever,	22	0.42	0.71	.012

II.

Fatality of Certain Diseases.

The following tabular statement has been published annually since and including 1891. It consists of the statistics presented relative to the principal notifiable diseases in those cities and towns from which annual reports have been sent by the local boards of health to the State Board.

By comparing the deaths from each one of the four diseases enumerated in the table with the reported cases, a fairly accurate estimate may be obtained of the fatality of these diseases. It should be borne in mind, however, that the system of reporting cases is probably not quite so thoroughly carried out as the registration of deaths, the latter having been in force for more than a half century. Hence it is quite probable that the general fatality percentage is a little too high for each disease.

Cases of Certain Infectious Diseases and Deaths from the Same as reported to Local Boards of Health, Massachusetts, 1899.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Acushnet,	-	-	10	6	4	2	-	-
Adams,	14	6	13	6	-	-	-	-
Amesbury,	5	1	27	-	26	4	22	-
Arlington,	2	-	8	-	14	-	44	-
Attleborough,	41	4	18	-	12	3	41	-
Ayer,	4	-	27	-	2	1	262	-
Belmont,	3	-	6	-	6	-	10	-
Boston,	2,836	304	1,261	74	765	166	4,110	23
Bridgewater,	3	2	3	-	-	-	-	-
Brockton,	83	9	31	1	22	7	8	-
Brookline,	118	11	60	-	13	2	99	-
Beverly,	22	4	21	1	29	4	32	1
Cambridge,	502	55	160	8	190	26	473	8

Cases of Certain Infectious Diseases and Deaths from the Same as reported to Local Boards of Health, Massachusetts, 1899 — Continued.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Chelmsford,	3	-	12	-	2	-	44	-
Chelsea,	86	13	27	3	63	10	259	2
Chicopee,	33	6	10	-	22	6	66	-
Clinton,	11	2	33	-	17	3	184	-
Concord,	9	2	-	-	5	-	57	-
Danvers,	6	-	6	-	8	1	8	-
Dedham,	15	-	7	-	3	3	15	-
Duxbury,	2	-	1	-	7	-	25	-
Easthampton,	3	1	26	-	-	-	35	-
Everett,	130	18	60	3	24	7	137	0
Falmouth,	4	2	-	-	-	-	8	-
Fitchburg,	50	7	96	4	39	3	1,513	10
Franklin,	-	-	10	1	6	-	89	1
Fall River,	67	10	101	3	67	11	90	12
Gardner,	37	18	101	3	16	2	-	-
Great Barrington,	15	3	7	1	-	-	-	-
Greenfield,	9	-	62	1	3	1	11	-
Haverhill,	101	17	82	2	65	5	30	-
Hingham,	6	1	10	-	-	-	-	-
Hyde Park,	25	3	60	1	17	1	8	-
Holyoke,	68	11	44	3	48	11	16	-
Ipswich,	1	-	17	-	3	-	34	-
Lancaster,	3	-	14	-	5	-	38	-
Lee,	-	-	30	3	-	-	-	-
Leicester,	-	-	5	-	3	-	3	-
Leominster,	29	2	36	2	7	1	121	-
Lexington,	5	-	15	-	7	-	15	-
Lincoln,	-	-	1	-	2	1	-	-
Lowell,	152	39	173	9	57	17	1,181	26
Lynn,	176	10	108	3	73	13	552	7
Malden,	56	9	67	-	42	4	184	2
Marblehead,	28	3	3	-	5	-	-	-
Marlborough,	13	3	50	4	3	-	2	-
Medford,	47	9	65	-	17	5	116	-
Middleborough,	3	1	7	1	7	-	-	-

Cases of Certain Infectious Diseases and Deaths from the Same as reported to Local Boards of Health, Massachusetts, 1899 — Continued.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Millbury,	7	-	44	-	5	-	-	-
Milton,	5	-	11	-	4	2	20	-
Melrose,	8	-	19	1	14	6	10	-
Natick,	6	-	19	-	-	-	29	-
New Bedford,	87	25	210	11	72	16	-	-
Newton,	183	5	59	2	43	3	-	-
North Adams,	17	3	41	-	20	5	258	3
Northampton,	30	-	30	-	12	-	19	-
North Andover,	4	1	15	-	3	2	9	-
North Attleborough,	10	1	8	-	-	-	-	-
Norwood,	2	-	6	-	7	-	4	-
Palmer,	25	7	56	2	7	1	4	-
Pittsfield,	21	-	88	3	15	1	5	-
Quincy,	77	6	59	-	60	9	303	-
Reading,	9	-	23	-	3	-	13	-
Revere,	41	5	32	-	-	-	-	-
Rockland,	3	-	23	-	9	-	1	-
Salem,	32	4	53	-	36	5	-	-
Sharon,	1	-	-	-	5	-	1	-
Somerville,	147	11	157	3	73	15	-	-
Springfield,	463	55	76	2	130	15	126	5
Stoneham,	11	-	10	-	23	2	3	-
Swampscott,	7	1	8	-	1	1	12	-
Wakefield,	14	-	11	-	16	-	103	-
Walpole,	2	-	-	-	2	-	4	-
Waltham,	58	4	144	1	84	6	229	1
Ware,	3	1	54	1	1	-	5	-
Warren,	3	1	20	1	6	-	8	-
Watertown,	17	2	25	1	8	1	31	-
Wellesley,	3	-	5	-	3	-	162	-
Westborough,	-	-	9	-	-	-	-	-
West Brookfield,	-	-	8	-	-	-	5	-
Westfield,	15	1	22	-	17	8	225	2
Weston,	10	-	5	-	3	-	6	-
Whitman,	2	1	2	-	1	-	4	-

Cases of Certain Infectious Diseases and Deaths from the Same as reported to Local Boards of Health, Massachusetts, 1899 — Concluded.

City or Town.	Diphtheria and Croup.		Scarlet Fever.		Typhoid Fever.		Measles.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
Winchendon,	6	-	26	1	6	-	4	-
Winchester,	14	1	18	1	7	1	177	1
Winthrop,	3	-	4	-	15	2	5	-
Woburn,	21	2	51	1	8	2	27	-
Worcester,	377	40	585	10	104	19	144	5
Total,	6,540	758	5,130	171	2,433	435	11,877	119
Fatality (per cent.),	11.6		3.3		17.7		.9	

The summary of the foregoing figures for 1899 is as follows: —

Reported cases of diphtheria and croup,	6,540
Registered deaths from diphtheria and croup in the same cities and towns,	758
Fatality (per cent.),	11.6
Reported cases of scarlet fever,	5,130
Registered deaths from scarlet fever in the same cities and towns,	171
Fatality (per cent.),	3.3
Reported cases of typhoid fever,	2,433
Registered deaths from typhoid fever in the same cities and towns,	435
Fatality (per cent),	17.7
Reported cases of measles,	11,877
Registered deaths from measles in the same cities and towns,	119
Fatality (per cent.),	0.9

The number of cities and towns contributing to this table in 1899 was 89, or 1 less than the number for the previous year. Most of the large cities are included, and the estimated number of their population was about 75 per cent. of the entire population of the State.

The reported cases of diphtheria and croup were 70 per cent. greater in number than those of 1898, and the number of deaths about 50 per cent. greater. The fatality had again fallen from 13.2 in 1898 to 11.6 in 1899. These figures compare very favorably with the pre-antitoxin period, 1891–94, when the fatality was 28.3 per cent.

The reported cases of scarlet fever were also 46 per cent. greater than those of the previous year, and the fatality (3.3 per cent.) was also slightly greater, but much less than the mean fatality of the previous eight years (5.6).

The reported cases of typhoid fever were 13 per cent. in excess of those of 1898, but the fatality (17.7) was less, and was also less than the mean fatality of the eight years 1891–98, which was 19.0.

The reported cases of measles were greater than those of any of the previous eight years except 1897, but the fatality, .9 of 1 per cent., was less than that of either of the previous eight years except 1896 and 1897, in which it was respectively .9 and .7 of 1 per cent.

The following table presents the summary of these statistics for the nine years 1891–99: —

Reported Cases of Infectious Diseases in Massachusetts.

Diphtheria and Croup.

[Pre-Antitoxin Period.]

	1891.	1892.	1893.	1894.	Total.
Reported cases,	2,444	3,053	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 and Croup.

[Antitoxin Period.]

	1895.	1896.	1897.	1898.	1899.	Total.
Reported cases,	7,856	8,915	7,856	3,843	6,540	35,010
Deaths,	1,484	1,348	1,107	507	758	5,204
Fatality (per cent.),	18.9	15.1	14.1	13.2	11.6	14.9

Scarlet Fever.

	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	Total.
Reported cases,	4,517	6,112	7,420	7,416	6,050	3,873	5,406	3,509	5,130	49,433
Deaths,	151	281	624	504	357	220	253	101	171	2,662
Fatality (per cent.),	3.3	4.6	8.8	6.8	5.9	5.7	4.7	2.9	3.3	5.3

Typhoid Fever.

	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	Total.
Reported cases, .	2,414	1,892	2,457	2,814	2,665	3,016	2,151	2,143	2,438	21,985
Deaths, ...	460	435	492	488	458	471	454	464	435	4,152
Fatality (per cent.),	19.0	23.0	20.0	17.0	17.2	15.6	21.1	21.7	17.7	18.9

Measles.

	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	Total.
Reported cases, .	5,861	783	6,290	2,051	5,033	6,861	13,705	4,160	11,877	56,681
Deaths, ...	84	31	98	37	75	65	96	42	119	647
Fatality (per cent.),	1.4	4.0	1.6	1.8	1.5	0.9	0.7	1.0	0.9	1.2

In the foregoing tables the statistics relating to diphtheria and croup 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. The mean fatality in the former period (1891–94) was 28.3 per cent. (ratio of deaths to cases), and in the latter period (1895–99) it was 14.9 per cent., or but little more than half as large.

In order to compare the general fatality from diphtheria in Massachusetts with that of another country in which systematic notification of a large number of cases has been conducted for a period of several successive years, the following figures for England are presented, as published in the annual reports of the Local Government Board: —

England.

[Local Government Board figures.]

	Diphtheria.		Croup.		Total.		Per Cent.
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1890, ...	-	-	-	-	2,953	753	25.5
1891, ...	-	-	-	-	11,919	2,829	23.7
1892, ...	13,977	3,177	1,169	401	15,146	3,578	23.6
1893, ...	20,712	4,751	1,436	685	22,148	5,436	24.5
1894, ...	17,581	4,236	1,256	486	18,837	4,722	25.1
1895, ...	18,700	4,225	1,268	540	19,968	4,765	23.9
1896, ...	25,498	5,372	1,365	556	26,863	5,928	22.1
1897, ...	24,290	4,521	1,153	473	25,443	4,994	19.6
1898, ...	26,189	4,655	994	397	27,183	5,052	18.6
Total, ...	-	-	-	-	170,405	38,057	-
Mean fatality (per cent.), .	-		-		-		22.3

The following figures present the fatality from diphtheria and croup, scarlet fever and typhoid fever in England, as reported by the Local Government Board of England for the years 1890–98: —

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
Diphtheria and croup, .	25.5	23.7	23.6	24.5	25.1	23.9	22.1	19.6	18.6
Scarlet fever, . . .	8.0	5.8	4.4	4.2	4.8	4.2	4.0	3.9	3.7
Typhoid fever, . . .	19.9	20.8	17.8	17.0	17.5	16.9	17.7	16.8	16.8

Statistics relating to the fatality of different diseases in the United States for periods anterior to 1890 are extremely meagre so far as the prevalence of such diseases among the general population is concerned. Figures compiled from hospital practice would show a higher fatality than general statistics, since hospital cases are usually those of the more severe type.

In 1857 and 1858 an attempt was made to collect the number of cases and deaths from those diseases which were then termed "zymotic," and the results were published in the "Transactions of the Massachusetts Medical Society" for 1859–60.

Comparing the figures then published (forty years ago) with those of the past nine years, it appears that the fatality of scarlet fever was 8.1 per cent., or the ratio of 107 deaths to 1,316 observed cases; that of typhoid fever was 5.6 per cent., or the ratio of 63 deaths to 1,113 cases; that of measles was 1.5 per cent., or the ratio of 15 deaths to 977 cases.

These figures, collected in 1857 and 1858 from about 130 physicians distributed throughout Massachusetts, in nearly all of the counties, show that the fatality of the diseases in question did not differ materially from that of the present day, with the exception of typhoid fever, in which the fatality at that time appears to have been scarcely one-third as great as it is now. It would be difficult to determine whether this difference, in the case of typhoid fever, is actual, or is due to difference in methods of diagnosis.

III.

Official Returns of Notified Diseases Dangerous to the Public Health, 1899.

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 1899, under the provisions of chapter 302 of the Acts of 1893. In this act no disease is specified as being "dangerous to the public health" except small-pox. 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: small-pox, scarlet fever, measles, typhoid fever, diphtheria, membranous croup, cholera, yellow fever, typhus fever, cerebro-spinal meningitis, hydrophobia, malignant pustule, leprosy and trichinosis.

The whole number of cases of infectious diseases reported to the Board in 1899, under the provisions of this act, was 27,719, which were divided as follows: —

Reported cases of small-pox,	105
Reported cases of diphtheria and croup,	7,134
Reported cases of scarlet fever,	5,349
Reported cases of typhoid fever,	2,776
Reported cases of measles,	12,355
Total,	27,719

The summary for the seven years 1893–99 is as follows: —

	Reported Cases of					Total.
	Small-pox.	Diphtheria and Croup.	Scarlet Fever.	Typhoid Fever.	Measles.	
1893 (four months only),	35	1,109	2,914	1,525	1,503	7,086
1894,	181	4,178	6,731	2,372	2,133	15,595
1895,	1	7,806	6,194	2,488	4,868	21,307
1896,	5	8,515	3,801	2,637	6,362	21,320
1897,	18	7,613	5,495	2,104	12,695	27,925
1898,	10	3,980	3,667	2,196	4,478	14,331
1899,	105	7,134	5,349	2,776	12,355	27,719
Total,	355	40,335	34,151	16,048	44,394	135,283

Seasonal Distribution. — By months these diseases were reported as follows: —

Cases of Infectious Diseases reported to the State Board of Health by Months in 1899.

	Small-pox.	Diphtheria and Croup.	Scarlet Fever.	Typhoid Fever.	Measles.		Small-pox.	Diphtheria and Croup.	Scarlet Fever.	Typhoid Fever.	Measles.
January, .	–	434	360	146	1,066	August, .	6	475	245	336	88
February, .	–	400	348	78	1,200	September, .	7	763	380	567	60
March, .	–	366	482	102	2,060	October, .	16	1,021	633	447	138
April, . .	9	313	304	135	1,840	November, .	6	927	713	306	236
May, . .	34	424	435	81	2,361	December, .	13	1,108	849	256	686
June, . .	12	383	329	100	1,967						
July, . .	2	485	241	158	614	Total, .	106	7,098	5,269	2,786	12,356

The difference between the total figures in the foregoing tables is accounted for by the fact that the returns of several small towns were not reported by months, but in some instances only at the close of the year, a method which is not sanctioned by the statutes, the law requiring that such reports shall be sent to the State Board "within twenty-four hours" after their receipt by the local board of health.

The significance of the foregoing figures may be more clearly understood and compared with those of the previous years by consulting the following table: —

Intensity of Prevalence.

Months.	Diphtheria and Croup.			Scarlet Fever.			Typhoid Fever.			Measles.		
	1899.		1898.	1899.		1898.	1899.		1898.	1899.		1898.
	A	B	B	A	B	B	A	B	B	A	B	B
	Mean Daily Number of Reported Cases in Each Month.	Decimal Ratio for Each Month.	Decimal Ratio for Each Month.	Mean Daily Number of Reported Cases in Each Month.	Decimal Ratio for Each Month.	Decimal Ratio for Each Month.	Mean Daily Number of Reported Cases in Each Month.	Decimal Ratio for Each Month.	Decimal Ratio for Each Month.	Mean Daily Number of Reported Cases in Each Month.	Decimal Ratio for Each Month.	Decimal Ratio for Each Month.
January, .	14.0	7.2	13.8	11.6	8.1	11.2	4.7	6.2	6.0	34.4	10.2	6.4
February, .	14.3	7.4	11.8	12.4	8.6	7.6	2.6	3.4	4.5	42.9	12.7	9.2
March, .	11.8	6.1	9.5	13.9	9.7	9.2	3.3	4.4	5.6	66.1	19.5	9.1
April, .	10.4	5.4	9.9	10.1	7.0	9.8	4.5	6.0	5.3	61.3	18.1	14.3
May, . .	13.7	7.1	7.4	14.0	9.7	14.7	2.6	3.4	4.6	76.2	22.5	16.9
June, . .	12.8	6.6	5.7	11.0	7.6	8.4	3.3	4.4	5.3	66.2	19.5	12.6
July, . .	15.6	8.0	6.0	7.8	5.4	4.9	5.1	6.8	5.0	20.8	6.1	7.8
August, .	15.3	7.9	5.0	7.9	5.5	4.9	12.4	16.4	12.9	2.8	0.8	2.8
September,	25.4	13.1	7.4	12.7	8.8	7.5	18.9	25.0	26.1	2.0	0.6	2.0
October, .	32.9	17.0	10.9	20.4	14.2	12.7	14.4	19.1	21.1	4.2	1.2	4.3
November,	30.9	15.9	17.5	23.8	16.5	14.9	10.2	13.5	14.0	7.8	2.3	12.6
December,	35.7	18.4	15.3	27.4	19.0	13.8	8.3	11.0	9.6	22.1	6.5	21.9
Mean, .	19.4	10.0	10.0	14.4	10.0	10.0	7.5	10.0	10.0	33.8	19.9	10.0

The object of the foregoing table is to present the figures for each month upon a uniform basis of comparison, month by month, so that the relative intensity of prevalence of each disease is shown for each month. The method also has the advantage of eliminating the apparent errors of computation arising from the unequal length of the months.

The figures may be read as follows: For example, the mean daily number of reported cases of diphtheria and croup in January, 1899, was 14.0; of scarlet fever, 11.6; of typhoid fever, 4.7; and of measles, 34.4 (see columns marked A); and the mean daily number of reported cases of the same diseases for the whole year 1899 was, respectively, 19.4, 14.4, 7.5 and 33.8. Assuming a standard of 10 as a daily mean of each disease for the year, the ratios for January were as follows: diphtheria and croup, 7.2; scarlet fever, 8.1; typhoid fever, 6.2; and measles, 10.2. (See columns marked B.) That is to say, for each 10 cases of diphtheria and croup reported daily throughout the year 1899, as a mean, there were 7.2 in January, 7.4 in February, 6.1 in March, etc.

It appears from the foregoing table that the seasonal prevalence of diphtheria and croup in the year 1899 maintained a fairly uniform course throughout the first eight months, and then showed a sudden rise in September and remained at a high rate for the rest of the year. In 1898 it was at its lowest ebb in August, and in 1899 in April. It reached its maximum in 1898 in November and in 1899 in December.

Scarlet fever also appears to have maintained an intensity below the mean during the first nine months of the year, rising to a maximum in December; while in 1898 its course was more irregular, having a rise above the mean in January, May and the last three months of the year.

The prevalence of typhoid fever was, as in previous years, more uniform than that of the other specified diseases, reaching its maximum in September both in 1898 and 1899.

Measles prevailed with the greatest severity throughout the first six months of 1899, and reached its minimum in August and September, when comparatively few cases were reported. The prevalence of this disease in 1898 was more irregular, since in that year its course was above the mean in April, May and June, then falling to a minimum in August and September. There was also a recrudescence in November and December. The whole number of cases of measles reported in 1899 was nearly three times as many as those reported in 1898, and almost as many as those reported in 1897.

The following table presents the number of cases of infectious diseases reported to the State Board of Health from each city and town in 1899. The number of reporting cities and towns was 219, that of the preceding year having been only 167. The difference is undoubtedly due to an unusual prevalence of infectious diseases in 1899. Many towns having a population of less than 2,000 in each reported in 1899 which did not report in 1898, probably on account of the entire absence of the specified diseases in those towns.

The slight difference in numbers presented in this table and in that of Section II. is accounted for by the deficiency in the number of official returns made to the State Board of Health.

Cases of Infectious Diseases reported to the State Board of Health from Two Hundred and Nineteen Cities and Towns during 1899.

	Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.		Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.
Acton,	-	15	-	-	Bolton,	2	-	-	4
Acushnet,	10	-	4	-	BOSTON,	1,381	2,873	771	4,211
Adams,	6	8	-	-	Braintree,	4	15	-	-
Agawam,	4	24	6	-	Bridgewater,	3	3	-	4
Amesbury,	24	4	20	26	BROCKTON,	20	44	16	6
Amherst,	2	-	1	-	Brookfield,	26	5	2	-
Andover,	8	25	18	5	Brookline,	53	111	17	101
Arlington,	6	2	12	38	Burlington,	1	-	-	-
Ashburnham,	4	1	-	-	CAMBRIDGE,	149	496	99	468
Ashland,	1	1	-	-	Canton,	1	1	-	-
Attleborough,	23	32	8	36	Carlisle,	-	2	-	-
Ayer,	11	4	1	84	Carver,	-	1	-	-
Auburn,	-	3	-	-	Chelmsford,	11	3	2	15
Avon,	3	-	-	-	CHELSEA,	24	81	55	202
Barnstable,	2	-	1	6	Cheshire,	-	6	-	-
Barre,	-	-	-	5	Chester,	2	2	-	-
Bedford,	-	1	4	85	CHICOPEE,	9	33	23	63
Belchertown,	2	-	-	4	Clinton,	23	10	14	174
Bellingham,	-	1	2	-	Colrain,	1	6	-	-
Belmont,	6	2	6	-	Concord,	-	7	5	50
Berkley,	1	-	-	-	Cottage City,	-	-	3	1
BEVERLY,	21	20	27	31	Dalton,	1	4	-	-
Billerica,	11	1	3	-	Danvers,	6	7	8	8

Cases of Infectious Diseases reported to the State Board of Health from Two Hundred and Nineteen Cities and Towns during 1899 — Continued.

	Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.		Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.
Dartmouth,	1	1	-	-	Hinsdale,	-	2	-	-
Dedham,	2	10	1	15	Holden,	13	-	-	-
Dighton,	-	13	1	-	Holliston,	2	-	1	12
Douglas,	5	1	-	-	HOLYOKE,	43	49	44	9
Dover,	-	5	-	1	Hopedale,	7	2	-	4
Dracut,	-	-	52	-	Hopkinton,	-	-	1	-
Duxbury,	1	1	4	17	Hudson,	15	1	3	2
Easthampton,	14	8	-	4	Hull,	1	-	-	-
East Longmeadow,	-	7	-	1	Huntington,	-	2	1	-
Edgartown,	-	-	3	-	Hyde Park,	27	14	9	4
EVERETT,	52	126	28	107	Ipswich,	17	1	2	33
Fairhaven,	2	2	22	-	Lancaster,	9	1	6	11
FALL RIVER,	62	41	65	1	LAWRENCE,	159	380	129	754
Falmouth,	-	3	-	5	Leicester,	4	-	10	2
FITCHBURG,	96	51	39	1,519	Lenox,	7	-	-	-
Foxborough,	2	2	1	1	Leominster,	32	29	6	61
Franklin,	-	1	8	70	Lexington,	14	6	7	12
Gardner,	30	35	5	1	Lincoln,	-	-	3	-
Gill,	-	1	-	-	Littleton,	1	-	-	-
GLOUCESTER,	22	12	15	104	LOWELL,	185	149	56	1,029
Grafton,	4	5	-	-	Ludlow,	-	8	52	-
Granville,	3	5	-	5	Lunenburg,	1	-	-	-
Great Barrington,	-	11	-	-	LYNN,	97	150	71	476
Greenfield,	51	9	3	8	MALDEN,	61	56	35	173
Groton,	9	-	9	2	Manchester,	1	4	-	-
Groveland,	10	2	1	1	Mansfield,	1	2	1	-
Hadley,	-	-	1	-	Marblehead,	2	23	4	-
Hamilton,	1	1	1	-	MARLBOROUGH,	35	8	2	2
Hampden,	7	1	-	-	Marshfield,	1	2	2	3
Hardwick,	72	2	4	-	Maynard,	-	8	-	-
Harvard,	3	-	-	-	Medfield,	3	4	-	4
Hatfield,	5	-	5	-	MEDFORD,	47	32	17	70
Harwich,	-	-	1	-	Medway,	-	6	-	43
HAVERHILL,	82	100	63	29	MELROSE,	3	2	4	-
Hingham,	5	8	-	-	Mendon,	1	3	-	-

Cases of Infectious Diseases reported to the State Board of Health from Two Hundred and Nineteen Cities and Towns during 1899 — **Continued.**

	Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.		Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.
Merrimac,	2	1	-	-	Randolph,	1	2	1	-
Middleborough,	7	1	4	-	Reading,	17	9	2	14
Middleton,	2	-	-	-	Revere,	29	35	-	-
Milford,	6	5	14	3	Rochester,	2	-	-	-
Millbury,	44	6	6	3	Rockland,	23	3	9	-
Milton,	12	4	3	16	Rockport,	27	1	4	30
Monson,	3	4	3	-	Rowley,	-	1	7	2
Monterey,	2	-	-	-	Royalston,	-	-	1	-
Needham,	2	4	3	1	SALEM,	116	33	25	223
NEW BEDFORD,	200	80	73	37	Salisbury,	4	1	1	-
New Braintree,	1	-	-	-	Sandisfield,	-	-	1	9
NEWBURYPORT,	6	10	27	112	Saugus,	9	8	1	3
NEWTON,	59	174	41	360	Sharon,	-	-	5	1
NORTH ADAMS,	33	11	19	146	Sherborn,	-	1	-	5
NORTHAMPTON,	11	22	60	1	Shirley,	27	8	3	96
North Andover,	13	4	3	9	Somerset,	8	-	-	14
North Attleborough,	6	2	-	-	SOMERVILLE,	143	140	70	82
Northborough,	3	6	-	-	Southampton,	-	1	-	3
Northbridge,	16	14	1	-	Southborough,	3	-	-	1
North Brookfield,	6	50	2	3	Southbridge,	-	1	-	-
Northfield,	-	-	5	-	South Hadley,	37	5	1	-
Norton,	15	-	-	1	SPRINGFIELD,	60	354	124	74
Norwell,	-	7	1	-	Sterling,	3	4	3	-
Norwood,	5	1	5	1	Stoneham,	7	6	30	-
Orange,	-	4	2	-	Stoughton,	1	-	-	-
Palmer,	33	14	1	-	Sutton,	14	3	-	-
Paxton,	2	-	-	-	Swampscott,	4	5	1	7
Peabody,	21	13	6	-	Swansea,	1	2	-	-
Pelham,	-	1	-	-	Stockbridge,	4	-	1	1
Pembroke,	-	-	1	-	TAUNTON,	43	31	8	3
Pepperell,	2	1	3	-	Templeton,	8	39	2	11
PITTSFIELD,	47	13	9	8	Tisbury,	-	1	-	-
Plymouth,	3	8	8	75	Townsend,	-	-	-	13
Princeton,	-	1	-	-	Upton,	8	1	6	47
QUINCY,	55	68	50	212	Uxbridge,	-	5	-	-

Cases of Infectious Diseases reported to the State Board of Health from Two Hundred and Nineteen Cities and Towns during 1899 — Concluded.

	Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.		Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.
Wakefield,	7	14	-	109	Westport,	18	-	-	-
Walpole,	-	2	3	4	West Springfield,	10	217	6	3
WALTHAM,	184	59	28	78	West Stockbridge,	3	-	-	-
Ware,	46	2	-	-	Weymouth,	12	16	2	13
Wareham,	1	4	-	-	Whitman,	8	3	1	2
Warren,	29	3	7	6	Wilbraham,	-	5	2	-
Watertown,	25	16	8	23	Williamstown,	27	1	4	8
Wayland,	13	1	-	-	Winchendon,	24	5	5	4
Webster,	6	2	9	-	Winchester,	-	2	1	-
Wellesley,	4	3	3	185	Winthrop,	1	2	11	2
Westborough,	9	1	-	-	WOBURN,	37	20	2	10
West Boylston,	29	1	-	10	WORCESTER,	497	348	89	80
Westfield,	5	2	2	10	Worthington,	-	4	-	-
Westford,	7	-	1	-	Wrentham,	5	-	1	-
Westminster,	2	-	-	9	Yarmouth,	3	-	-	-
West Newbury,	6	-	-	-	Totals,	5,349	7,184	2,776	12,355
Weston,	5	3	4	1					

Small-pox occurred in the following cities and town:—

BOSTON,	29
CHELSEA,	27
FALL RIVER,	37
EVERETT,	6
Swampscott,	3
MELROSE,	1
LOWELL,	2
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LIST OF TOWNS FROM WHICH NO REPORTS WERE RECEIVED.

I. *Towns having a Population of More than 5,000 in Each.*

Athol,
Blackstone,
Framingham,
Methuen,
Natick,
Spencer. — 6.

II. *Towns having a Population of More than 1,000 but Less than 5,000 in Each.*

Abington,
Amherst,
Ashfield,
Auburn,
Ayer,
Bourne,
Bradford,
Buckland,
Charlemont,
Charlton,
Chatham,
Clarksburg,
Cohasset,
Conway,
Deerfield,
Dennis,
Dudley,
East Bridgewater,

II. Towns having a Population of More than 1,000 but Less than 5,000 in Each — Concluded.

Easton,	Mattapoisett,	Seekonk,
Essex,	Millis,	Sheffield,
Freetown,	Nantucket,	Shelburne,
Georgetown,	Newbury,	Shrewsbury,
Hanover,	New Marlborough,	Sturbridge,
Hanson,	Orleans,	Sudbury,
Harwich,	Oxford,	Tewksbury,
Hatfield,	Provincetown,	Topsfield,
Holbrook,	Raynham,	West Bridgewater,
Hubbardston,	Rehoboth,	West Brookfield,
Kingston,	Sandwich,	Williamsburg,
Lee,	Scituate,	Williamstown. — 54.

III. Towns having Less than 1,000 Inhabitants.

Alford,	Halifax,	Plympton,
Ashby,	Hancock,	Prescott,
Becket,	Hawley,	Rowe,
Berlin,	Heath,	Russell,
Bernardston,	Lakeville,	Rutland,
Blandford,	Lanesborough,	Savoy,
Boxborough,	Leverett,	Shutesbury,
Boxford,	Leyden,	Southwick,
Boylston,	Longmeadow,	Stow,
Brewster,	Lynnfield,	Sunderland,
Brimfield,	Marion,	Tolland,
Chesterfield,	Mashpee,	Truro,
Chilmark,	Middlefield,	Tyngsborough,
Cummington,	Montgomery,	Tyringham,
Dana,	Mount Washington,	Wales,
Dunstable,	Nahant,	Warwick,
Eastham,	New Ashford,	Washington,
Egremont,	New Salem,	Wellfleet,
Enfield,	Norfolk,	Wendell,
Erving,	North Reading,	Wenham,
Florida,	Oakham,	Westhampton,
Gay Head,	Otis,	West Tisbury,
Goshen,	Peru,	Whately,
Gosnold,	Petersham,	Windsor. — 76.
Granby,	Phillipston,	
Greenwich,	Plainfield,	

A supply of postal cards for the purpose of reporting infectious 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 141, State House, Boston.

IV.

Official Returns of Deaths in Cities and Large Towns (Chapter 218, Acts of 1894).

The following summary comprises the results obtained from the tabulation of the returns required by chapter 218 of the Acts of 1894, whereby the board of health of each city and populous town is directed to send to the State Board of Health an annual statement of the deaths in such city or town upon a blank form furnished by the State Board.

The whole number of cities and towns included in this list is 85.* The total population of these 85 cities and towns by the census of 1895 was 2,034,658.

The death-rates of these towns in the following summary for the year 1899 are calculated upon an estimated population, such estimate being based upon the rate of growth from 1890 to 1895, as taken from the census returns.

This estimate would add several more towns to the list for 1899, and seven towns (Bridgewater, Easthampton, Hingham, North Brookfield, Reading, Williamstown and Winthrop) have voluntarily sent returns to the Board, although not required by the statute, thus making (with the omission of Montague, Northbridge and Pittsfield) the total number of cities and towns included in the summary 89.

The estimated population of these 89 towns in 1899 was 2,268,272, or about 80 per cent. of the total population of the State.

The whole number of deaths registered in these towns in 1899 was 39,176, and the death-rate calculated upon the foregoing estimated population was 17.26 per 1,000 living. This rate was unusually low, and was very nearly the same as that of the preceding year.

Sexes. — The number of deaths of males was 20,007, or 51.1 per cent. of the whole number of deaths of those whose sex was known;

* The towns of Montague and Northbridge and the city of Pittsfield have failed to make the necessary returns for the year 1899.

and the deaths of females were 19,161, or 48.9 per cent. There were 8 in which the sex was not stated in the returns.

Ages.—The deaths by four groups of ages were as follows:—

Ages.	Deaths. 1899.	Percentages of All Deaths.		Ages.	Deaths. 1899.	Percentages of All Deaths.	
		1899.	1898.			1899.	1898.
Under 1 year, .	8,940	22.84	24.77	20 to 50, . .	9,817	25.09	25.44
1 to 20 years, .	6,239	15.94	15.05	50 and over, . .	14,139	36.13	34.74

The deaths of infants under one year old were 8,940, or 22.84 per cent. of the total mortality, as compared with 24.77 per cent. in the previous year, and those of children under five years old were 12,480, or 31.9 per cent. of the total mortality, as compared with 33.07 per cent. in 1898.

All of the percentages in this table are estimated upon the number of deaths of those whose ages were specified in the returns. The total number of deaths in which the age was not specified was 41.

Still-births.—The number of still-births was 2,220.

The most noteworthy fact in the foregoing figures for 1899 is the low percentage of infant mortality, which was only 22.8, as compared with 22.9, 24.9, 23.5 and 24.8, respectively, for the years 1895, 1896, 1897 and 1898.

The percentages of deaths at ages 1 to 20 years was also the lowest of this period, with the exception of that of 1898. This unusually low percentage of mortality at all ages below twenty is due mainly to the low death-rate from infectious diseases, which bear most heavily on the early ages of life.

Months and Quarters.—The number of deaths in each quarter of the year is shown in the following table:—

	Deaths. 1899.	Percentages.	
		1899.	1898.
First quarter, ...	10,566	26.97	23.69
Second quarter, ...	9,109	23.25	23.06
Third quarter, ...	10,380	26.50	28.96
Fourth quarter, ...	9,121	23.28	24.29
Total, ...	39,176	100.00	100.00

The foregoing percentages of mortality by quarters of the year differ from those of the previous four years in the high percentage of the first quarter, which in 1899 exceeded that of each of the other quarters, a fact which was probably due to an unusual prevalence of pneumonia in that quarter.

The intensity of the seasonal death-rate is shown in the following table, the method employed being explained on page 701 in Section III., relating to disease notification: —

	Mean Daily Deaths per Month. 1899.	Centesimal Ratio.			Mean Daily Deaths per Month. 1899.	Centesimal Ratio.	
		1899.	1898.			1899.	1898.
January, . .	132.0	123.0	95.3	August, . .	117.7	109.7	129.1
February, . .	119.2	111.1	95.4	September, . .	104.7	97.6	114.0
March, . .	101.2	94.3	97.4	October, . .	92.8	86.5	95.9
April, . . .	109.2	101.8	100.7	November, . .	95.3	88.8	91.2
May, . . .	97.2	90.6	93.2	December, . .	109.2	101.8	101.9
June, . . .	93.5	87.1	83.6	Annual mean, .	107.3	100.0	100.0
July, . . .	115.8	107.9	101.5				

The figures in the foregoing table indicate an excessive departure in excess of the mean death-rate, in January and February, while that of May, June and October was correspondingly low.

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 in the twenty-year period 1876–95 it was 20 per cent. in August, while that of August, 1899, was only 9.7 per cent., and that of January, 1899, was 23 per cent.

In the two years having the highest death-rates in Massachusetts in the past half century (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.

Causes of Death.

Table IV. presents the mortality of the cities and towns embraced in this summary, classified by causes of death for the year 1899. The same figures are again presented in a condensed form in Table V., wherein the comparative mortality from different diseases and groups of diseases for the past five years may be examined.

It appears from Table V. on page 726 that the low general death-rate, which was noted in the last annual report, has continued throughout 1899, so far as can be judged from the usual estimates of population, the principal improvement being shown in the infectious diseases near the top of the column. It is a source of much satisfaction to note that marked changes have taken place in the death-rate from those diseases which are clearly preventable, and this may be taken as an index of better sanitary organization and work in the cities and towns named in the list.

Consumption, measles, scarlet fever, diphtheria, whooping-cough, typhoid fever, puerperal fever and cholera infantum are diseases which yield to the action of human agencies, such as isolation, disinfection, cleanliness, purification of water supplies and improvement in methods of infant care and feeding, and the decided decrease in the combined death-rate from these diseases is well marked in Table V.

The combined death-rate per 10,000 of the population from these eight diseases was as follows for the five years 1895–99 in the cities and towns named in the foregoing list, or about four-fifths of the total population of the State: —

	Combined Death-rate per 10,000 from Certain Diseases.		Combined Death-rate per 10,000 from Certain Diseases.
1895,	46.4	1898,	36.3
1896,	46.8	1899,	35.2
1897,	39.7		

Comment was made in the last two reports upon the fact that estimates made in intercensal years are liable to error in either direction, and that no method of estimating populations can produce exact results, in the absence of other definite knowledge. It was for this reason that the tables of death-rates made up from the total estimated population have been published in parallel columns, together with the percentages of the total mortality in each of the annual reports since and including 1892 (see pages xlviii, xlix, twenty-fourth annual report, 1892), and especially in the very full report of 1896, embracing the statistics of forty years (1856–95).

The table of percentages of total mortality acts, in a measure, as a check or control in case of erroneous estimates of population. It is for this reason that a similar condensed statement is here introduced in Table V.

The changes in the death-rate from consumption, typhoid fever and puerperal fever (see child-birth in report of 1896, page 804) have been 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 five years.

Examined from another stand-point (the mortality from all causes) these eight preventable causes of death, consumption, measles, scarlet fever, diphtheria, whooping-cough, typhoid fever, puerperal fever and cholera infantum, together constituted 27.2 per cent. of the total mortality in 1894, but had fallen off successively to 24.2, 24.2, 21.9, 21.1 and 20.4 in the five 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 and 40.2 per cent. in the same years.

These all combined constituted the greater part of the total mortality in each of the six years 1894–99, and of the diseases specified in the table entitled the "Balance of Mortality," in the annual report of 1896, page 812.

The most notable changes in the figures of Table V. are the steady decrease in the death-rate from consumption and typhoid fever, each of which in 1899 presented a lower death-rate than at any time since the beginning of registration in Massachusetts in 1842. The death-rate from cholera infantum was also lower than it was in any one of the five previous years. The death-rate from pneumonia was higher than that of any year since 1893. That of heart diseases had maintained a nearly uniform rate for the 3 years 1897, 1898 and 1899. That of brain diseases had diminished from 13.3 per 10,000 in 1895 to 11.99 in 1899. The death-rate of kidney diseases has slightly increased since 1895. The death-rates from cancer, suicide and accident have maintained a fairly uniform rate for the past four years.

The figures of the United States census of 1900 had been partially published at the time of compilation of the foregoing figures; those of the cities having a population of more than 25,000 being first issued. A comparison of these with the estimates which have been published by the Board in the past three years shows that the death-rates hitherto presented were very nearly correct, and any changes which would be necessitated by the figures of the census would be limited chiefly to the second place of decimals in the death-rates.

TABLE I.

Population of Cities and Large Towns estimated for 1899.

Reporting Cities and Towns.	Estimated Population for 1899.
Adams,	6,736
Amesbury,	10,136
Andover,	6,147
Arlington,	7,223
Athol,	8,200
Attleborough,	8,856
BEVERLY,	12,594
Blackstone,	5,959
BOSTON,	539,416
Braintree,	5,681
Bridgewater,	5,086
BROCKTON,	38,759
Brookline,	19,412
CAMBRIDGE,	92,308
CHELSEA,	34,236
CHICOPEE,	18,316
Clinton,	12,855
Concord,	5,773
Danvers,	8,762
Dedham,	7,281
Easthampton,	5,106
EVERETT,	28,102
FALL RIVER,	103,142
FITCHBURG,	30,523
Framingham,	9,780
Franklin,	5,380
Gardner,	9,788
GLOUCESTER,	31,426
Grafton,	5,180
Greenfield,	7,010
HAVERHILL,	37,969
Hingham,	5,023
HOLYOKE,	44,510
Hudson,	5,818
Hyde Park,	13,182
LAWRENCE,	59,072
Leominster,	10,764
LOWELL,	90,114
LYNN,	68,219
MALDEN,	36,418
Marblehead,	7,246
MARLBOROUGH,	15,914
MEDFORD,	17,190
MELROSE,	14,721
Methuen,	6,390
Middleborough,	7,188
Milford,	9,102
Millbury,	5,857
Milton,	6,510
Natick,	8,570
NEW BEDFORD,	70,511
NEWBURYPORT,	15,036
NEWTON,	30,461
NORTH ADAMS,	21,563
NORTHAMPTON,	18,150
NORTH ATTLEBOROUGH,	6,455
North Brookfield,	5,246
Orange,	5,995
Palmer,	7,128
Peabody,	10,786
Plymouth,	8,471
QUINCY,	24,578
Reading,	5,220
Revere,	8,827
Rockland,	5,771
Rockport,	6,251
SALEM,	37,723
SOMERVILLE,	64,393
Southbridge,	8,726
Spencer,	6,707
SPRINGFIELD,	58,266
Stoneham,	6,387

TABLE I.— *Concluded.*

Reporting Cities and Towns.	Estimated Population for 1899.	Reporting Cities and Towns.	Estimated Population for 1899.
Stoughton,	5,608	West Springfield,	6,963
TAUNTON,	28,527	Weymouth,	11,631
Wakefield,	9,861	Whitman,	6,786
WALTHAM,	22,791	Williamstown,	5,419
Ware,	7,908	Winchester,	7,181
Watertown,	8,860	Winthrop,	5,284
Webster,	8,418	WOBURN,	14,722
Westborough,	5,267	WORCESTER,	111,782
Westfield,	11,849	Total,	2,268,272

TABLE II.

Total Deaths, Deaths by Sexes and Age Periods, and Still-births in Cities and Towns having over 5,000 Inhabitants in Each, with General Death-rates estimated for 1899.

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Deaths under 1.	1-2.	2-3.	3-4.	4-5.	5-10.	10-15.	15-20.	20-30.	30-40.	40-50.	50-60.	60-70.	70-80.	Over 80.	Age Unknown.	Rate per 1,000.
Adams,	182	85	95	2	12	50	8	6	4	11	6	4	6	7	18	12	15	18	14	8	-	27.02
Amesbury,	161	79	82	-	7	31	4	3	4	1	6	4	5	7	8	9	13	19	21	20	6	15.88
Andover,	117	60	57	-	8	14	7	2	2	1	3	-	7	5	6	5	9	21	19	16	-	19.08
Arlington,	111	59	52	-	10	18	9	1	3	1	1	3	4	6	5	14	15	15	11	10	-	15.87
Athol,	100	60	40	-	5	18	2	1	-	1	-	1	1	8	6	4	7	19	17	15	-	12.19
Attleborough,	154	68	86	-	8	28	5	4	3	4	3	-	7	20	15	15	11	10	18	11	-	17.39
BEVERLY,	196	86	110	-	11	38	9	3	2	3	5	4	5	11	15	9	19	25	27	21	-	15.56
Blackstone,	110	64	46	-	4	18	8	-	-	2	3	1	2	14	16	9	7	18	8	9	-	18.46
BOSTON,	11,167	5,768	5,399	-	539	2,404	680	288	165	104	290	112	268	1,024	1,205	1,092	1,106	1,101	911	477	-	20.70
Braintree,	102	52	50	-	6	17	4	1	3	-	3	1	3	2	7	4	12	12	21	12	-	17.95
Bridgewater,	*133	104	29	-	-	4	1	1	2	-	-	1	1	12	10	24	16	26	28	7	-	12.12
BROCKTON,	458	250	208	-	28	99	15	16	4	5	16	5	17	50	43	31	36	48	46	27	-	11.82
Brookline,	241	122	119	-	18	40	3	4	3	4	6	1	3	20	24	21	25	27	33	22	-	12.41
CAMBRIDGE,	1,539	776	763	-	91	367	88	45	28	17	50	22	40	129	127	97	182	159	181	107	-	16.67
CHELSEA,	606	320	284	2	30	118	39	10	6	3	12	2	12	52	43	47	73	81	75	31	2	17.70
CHICOPEE,	361	185	176	-	26	126	18	7	7	1	8	6	7	35	21	29	18	38	26	14	-	19.71
Clinton,	190	97	93	-	12	54	8	2	-	3	3	-	5	20	8	17	18	23	24	10	-	15.87
Concord,	60	30	30	-	2	10	1	3	1	1	-	-	3	7	3	3	3	6	18	6	-	10.39
Danvers,	104	49	55	-	6	16	5	-	1	-	1	1	1	6	9	7	18	10	23	13	-	11.86

Dedham, ...	109	56	51	2	-	13	2	-	-	1	4	1	2	10	13	4	15	14	19	11	-	14.97
Easthampton, ...	70	27	43	-	6	11	2	-	1	-	1	1	2	5	5	-	8	12	17	5	-	13.71
EVERETT, ...	350	161	189	-	25	89	14	15	5	4	9	8	5	34	30	31	28	29	27	22	-	12.45
FALL RIVER, ...	1,924	1,012	912	-	108	701	†-	†-	†-	†-	68	‡-	‡-	152	152	140	134	121	100	38	-	18.65
FITCHBURG, ...	407	206	201	-	85	114	20	7	5	5	19	6	8	31	26	23	42	45	34	22	-	13.35
Framingham, ...	144	64	80	-	18	24	4	2	-	-	5	5	6	10	19	4	18	14	21	17	-	14.80
Franklin, ...	72	44	26	2	1	17	2	2	2	1	-	-	1	6	3	1	7	8	9	13	-	13.38
Gardner, ...	272	146	126	-	17	85	12	8	11	9	11	6	4	16	19	12	12	23	32	12	-	27.79
GLOUCESTER, ...	335	169	166	-	29	67	§-	§-	§-	§-	16	‖-	‖-	24	32	28	23	30	43	21	-	10.66
Grafton, ...	78	42	36	-	2	16	1	-	1	-	2	-	1	4	7	3	5	13	20	5	-	15.06
Greenfield, ...	120	63	57	-	5	18	1	4	1	1	2	1	1	12	6	13	12	16	15	17	-	17.11
HAVERHILL, ...	534	266	268	-	40	90	22	15	12	7	9	10	7	48	58	42	60	54	68	37	-	14.06
Hingham, ...	77	41	36	-	2	11	-	1	2	-	-	1	1	1	4	2	4	10	11	17	12	15.33
HOLYOKE, ...	713	366	347	-	60	249	37	9	11	4	19	10	24	71	57	43	53	61	36	23	1	16.02
Hudson, ...	68	36	32	-	2	14	1	-	-	-	3	1	-	6	5	3	6	14	10	5	-	11.69
Hyde Park, ...	211	115	96	-	11	42	9	3	3	2	5	3	3	22	18	20	24	13	24	20	-	16.07
LAWRENCE, ...	1,234	594	640	-	91	394	88	36	27	17	40	16	24	100	97	82	105	107	62	38	1	20.87
Leominster, ...	173	87	86	-	10	38	2	5	3	1	4	1	4	7	14	11	14	22	30	17	-	16.07
LOWELL, ...	1,848	923	925	-	137	551	114	46	34	27	39	21	44	165	156	133	170	144	134	70	-	20.50
LYNN, ...	1,019	519	500	-	62	186	45	16	11	8	24	16	23	80	104	93	96	124	119	74	-	14.94
MALDEN, ...	454	221	233	-	56	84	20	11	4	3	7	6	11	31	39	50	46	54	54	34	-	12.47
Marblehead, ...	117	52	65	-	5	12	2	1	1	-	2	4	3	5	8	6	12	20	28	13	-	16.15
MARLBOROUGH, ...	226	126	100	-	7	50	7	3	5	1	5	1	6	25	23	12	10	29	27	19	3	14.20
MEDFORD, ...	216	114	102	-	14	42	8	5	2	4	8	3	4	17	11	18	24	19	28	23	-	12.56

* Includes seventy-two deaths at State Almshouse.
† Two hundred and forty-three from one to five years.
‡ Seventy-five from ten to twenty years.
§ Forty from one to five years.
‖ Eleven from ten to twenty years.

TABLE II. — *Concluded.*

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Deaths under 1.	1-2.	2-3.	3-4.	4-5.	5-10.	10-15.	15-20.	20-30.	30-40.	40-50.	50-60.	60-70.	70-80.	Over 80.	Age Unknown.	Rate per 1,000.
MELROSE,	179	90	89	-	7	22	-	3	2	-	6	2	2	17	21	16	15	25	29	19	-	12.16
Methuen,	113	55	58	-	9	30	6	4	3	3	4	2	2	6	3	5	9	10	18	8	-	17.68
Middleborough,	116	59	57	-	5	5	4	-	1	-	1	2	4	8	8	9	13	21	23	17	-	16.11
Milford,	209	124	85	-	9	30	11	5	3	1	2	4	9	19	15	11	22	28	32	15	2	22.96
Millbury,	79	37	42	-	6	12	3	2	-	1	1	-	3	7	6	7	7	10	10	10	-	13.49
Milton,	78	45	33	-	5	14	3	2	-	-	2	-	8	3	5	5	7	10	13	6	-	11.96
Natick,	131	73	58	-	11	11	3	2	1	-	-	4	6	9	7	14	14	28	24	8	-	15.28
NEW BEDFORD,	1,161	595	566	-	77	343	59	33	19	8	27	18	28	92	61	68	110	99	108	87	1	16.46
NEWBURYPORT,	272	118	154	-	15	34	14	10	4	2	3	2	5	18	17	20	24	47	43	29	-	18.09
NEWTON,	439	228	211	-	8	92	24	6	7	5	9	11	10	24	18	40	37	48	61	47	-	14.41
NORTH ADAMS,	306	135	171	-	30	78	20	11	1	-	4	5	12	33	24	21	22	32	35	8	-	14.18
NORTHAMPTON,	292	150	142	-	12	29	*-	*-	*-	*-	8	†-	†-	32	29	34	39	33	49	26	-	16.09
North Attleborough,	98	46	52	-	1	15	4	1	3	3	3	-	4	6	7	6	9	14	11	12	-	15.18
North Brookfield,	88	42	46	-	6	17	4	4	2	1	4	1	3	5	4	7	6	14	11	5	-	16.77
Orange,	78	35	43	-	13	11	2	1	1	1	3	2	2	11	4	6	8	11	6	9	-	17.01
Palmer,	132	68	64	-	18	50	7	4	3	2	5	1	-	16	7	9	9	5	9	5	-	18.52
Peabody,	190	95	95	-	10	30	10	3	2	-	5	2	6	15	17	17	22	23	28	10	-	17.61
Plymouth,	206	107	99	-	7	36	1	2	1	3	4	4	6	11	13	17	15	25	34	34	-	24.82
QUINCY,	357	198	159	-	25	98	19	9	5	-	7	7	6	31	33	19	33	23	42	25	-	14.58
Reading,	83	33	50	-	5	13	2	-	1	2	-	1	1	5	7	9	8	7	18	8	1	15.90
Revere,	114	55	59	-	3	36	5	-	-	2	4	6	4	3	6	7	11	11	11	8	-	12.91

Rockland,	75	34	41	-	3	8	-	4	-	-	-	1	2	4	5	7	7	10	15	12	-	12.99
Rockport,	82	43	39	-	1	12	7	3	-	-	-	1	8	4	4	9	3	10	11	15	-	13.12
SALEM,	712	377	335	-	23	195	47	23	9	5	7	9	12	51	39	30	62	71	85	67	-	18.87
SOMERVILLE,	801	396	405	-	57	173	39	15	9	6	13	7	13	67	66	55	71	114	99	54	-	12.44
Southbridge,	194	96	98	-	14	67	6	6	3	2	2	1	3	15	12	9	14	14	24	15	1	22.23
Spencer,	104	50	54	-	6	16	4	2	2	3	7	2	3	10	4	7	11	8	16	8	1	15.51
SPRINGFIELD,	949	449	500	-	54	162	45	26	13	16	31	6	28	88	76	79	82	118	102	77	-	16.28
Stoneham,	113	60	53	-	2	15	1	3	1	3	2	5	3	6	7	10	13	13	19	12	-	17.69
Stoughton,	100	50	50	-	2	21	5	1	1	-	-	-	2	5	3	11	5	19	14	10	3	17.83
TAUNTON,	658	364	294	-	28	129	25	9	5	5	13	3	14	50	50	43	77	78	72	69	2	23.07
Wakefield,	132	61	71	-	5	29	3	2	3	-	1	2	2	3	11	4	13	16	20	13	-	14.10
WALTHAM,	315	137	178	-	10	52	3	7	1	-	7	14	12	33	31	21	23	41	39	21	-	13.82
Ware,	110	56	54	-	10	36	2	6	-	2	1	2	5	7	3	6	5	12	12	11	-	13.91
Watertown,	127	68	59	-	3	25	5	1	1	-	4	1	-	7	11	10	15	13	13	11	-	15.19
Webster,	142	70	72	-	7	40	3	5	2	1	3	1	4	19	11	3	8	14	18	5	-	16.83
Westborough,	‡188	72	66	-	1	7	2	1	-	1	1	-	2	9	9	13	22	19	27	20	-	14.62
Westfield,	204	116	88	-	14	44	9	5	1	2	4	2	2	11	21	13	21	26	24	19	-	17.98
West Springfield,	133	70	63	-	3	29	3	5	-	3	5	7	2	9	10	11	10	14	11	8	1	19.10
Weymouth,	193	103	90	-	8	24	4	3	1	-	5	2	6	16	13	11	24	30	33	21	-	16.59
Whitman,	89	49	40	-	4	9	3	1	1	1	2	2	4	6	3	8	12	9	17	11	-	13.11
Williamstown,	46	26	20	-	2	11	-	-	-	-	1	-	-	2	4	4	6	9	6	2	1	8.49
Winchester,	87	32	55	-	5	12	2	-	1	-	-	1	2	6	8	5	9	8	19	14	-	12.12
Winthrop,	54	30	24	-	2	9	3	2	1	1	1	-	1	1	4	5	5	6	8	4	3	10.22
WOBURN,	234	116	118	-	9	57	14	5	4	2	3	2	4	24	24	11	21	21	30	12	-	15.90
WORCESTER,	1,800	930	870	-	114	369	70	32	29	14	42	29	48	133	165	168	195	225	171	110	-	16.11
Total,	39,176	20,007	19,161	8	2,220	8,940	1,801	855	526	358	960	468	884	3,284	3,405	3,128	3,640	4,114	3,954	2,431	41	17.26

* Eight from one to five years.

† Ten from ten to twenty years.

‡ Includes sixty-one deaths at Westborough Insane Hospital.

TABLE III.

Deaths by Months in Each City and Town having a Population of more than 5,000 by Census of 1895.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Unknown.
Adams,	22	15	21	16	9	10	14	20	13	11	13	9	-
Amesbury,	21	21	13	10	15	15	14	18	15	10	10	4	-
Andover,	18	9	18	7	13	5	8	12	9	3	9	11	-
Arlington,	3	11	8	12	7	3	10	18	6	16	3	14	-
Athol,	14	9	11	7	8	9	8	12	6	4	5	7	-
Attleborough,	11	12	11	17	16	3	12	23	10	16	12	8	-
BEVERLY,	22	13	16	11	21	11	15	38	11	16	16	6	-
Blackstone,	11	10	11	10	11	7	11	5	8	6	8	18	-
BOSTON,	1,150	918	925	972	890	780	967	957	876	841	874	1,083	-
Braintree,	7	11	8	3	14	7	9	8	6	7	7	10	-
Bridgewater,	24	9	9	8	12	11	14	6	10	9	10	11	-
BROCKTON,	49	40	35	50	37	36	48	38	41	36	31	38	-
Brookline,	19	23	20	24	19	12	20	23	19	27	13	17	-
CAMBRIDGE,	139	126	106	96	111	116	151	161	130	124	136	141	-
CHELSEA,	76	51	56	54	34	45	54	48	42	48	48	58	2
CHICOPEE,	44	28	26	24	31	31	42	38	34	29	23	17	-
Clinton,	18	16	7	18	17	9	22	24	10	20	10	19	-
Concord,	7	7	5	5	6	4	3	2	6	2	4	9	-
Danvers,	15	8	5	8	8	10	9	16	6	5	8	11	-

Dedham,	13	8	6	7	4	13	13	4	10	12	8	11	-
Easthampton,	8	10	9	3	4	3	4	8	6	5	4	7	-
EVERETT,	36	22	27	45	28	27	28	31	35	24	21	31	-
FALL RIVER,	141	150	127	158	148	183	240	227	183	188	188	146	-
FITCHBURG,	45	33	37	37	30	20	31	47	32	32	26	32	-
Framingham,	11	19	7	18	10	8	10	17	8	7	13	16	-
Franklin,	11	6	7	2	3	5	2	14	5	7	2	8	-
Gardner,	39	17	19	28	31	22	24	21	29	13	15	14	-
GLOUCESTER,	47	40	29	22	20	9	25	39	28	19	26	31	-
Grafton,	10	6	10	5	6	1	5	11	8	8	5	3	-
Greenfield,	7	7	9	7	9	5	14	11	14	10	15	12	-
HAVERHILL,	55	57	58	40	45	40	42	46	43	26	38	49	-
Hingham,	7	3	5	8	5	6	4	9	11	7	6	6	-
HOLYOKE,	69	51	62	51	44	59	65	70	73	61	42	66	-
Hudson,	11	5	5	9	6	5	3	2	9	4	2	7	-
Hyde Park,	20	12	9	21	20	11	22	28	15	16	16	26	-
LAWRENCE,	166	108	112	96	97	94	126	116	92	75	80	77	-
Leominster,	19	13	12	14	8	14	18	13	10	22	17	16	-
LOWELL,	178	142	158	146	161	151	211	170	148	142	110	141	-
LYNN,	104	84	75	81	77	70	74	102	87	83	91	91	-
MALDEN,	60	38	36	39	28	27	56	34	34	30	33	39	-
Marblehead,	12	10	9	6	9	15	13	11	7	11	5	9	-
MARLBOROUGH,	26	24	19	16	20	15	14	23	21	16	11	21	-
MEDFORD,	21	16	13	21	18	21	22	16	17	13	14	24	-
MELROSE,	28	15	15	15	19	16	8	12	14	9	11	17	-

TABLE III. — *Concluded.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Unknown.
Methuen,	14	22	12	7	8	10	9	9	3	3	7	12	
Middleborough,	10	10	11	12	7	8	7	12	9	12	10	10	-
Milford,	26	22	17	17	17	15	20	16	10	19	12	7	-
Millbury,	9	5	11	10	4	3	4	3	7	9	3	9	-
Milton,	11	4	8	12	3	1	4	10	8	7	3	6	-
Natick,	19	10	10	3	8	9	13	9	9	14	7	13	-
NEW BEDFORD,	113	107	92	116	92	76	94	120	100	66	77	90	-
NEWBURYPORT,	31	28	18	27	20	20	30	34	34	18	18	23	-
NEWTON,	45	41	35	30	29	28	52	37	26	41	37	48	-
NORTH ADAMS,	20	20	19	28	20	23	48	27	18	23	18	26	-
NORTHAMPTON,	26	26	26	21	16	23	20	16	28	24	26	35	-
North Attleborough,	13	14	5	3	11	8	4	3	6	11	4	6	-
North Brookfield,	12	10	4	9	9	6	6	6	14	5	6	1	-
Orange,	18	3	7	3	5	4	3	3	5	3	6	4	10
Palmer,	18	12	7	11	8	5	9	18	9	18	18	10	-
Peabody,	28	14	11	13	20	11	9	20	12	9	18	20	-
Plymouth,	31	19	14	14	14	16	18	27	16	13	12	18	-
QUINCY,	45	31	23	27	18	28	36	44	37	28	28	29	-
Reading,	7	13	6	5	7	7	4	5	5	3	10	11	-
Revere,	9	9	6	6	3	6	12	28	13	7	11	10	-
Rockland,	6	7	2	9	3	7	5	5	7	3	12	4	-

Rockport,	12	8	7	12	5	9	3	7	7	6	8	3	-
SALEM,	51	56	48	50	44	98	90	61	58	44	50	67	-
SOMERVILLE,	81	62	65	87	61	50	66	82	69	53	54	72	-
Southbridge,	25	21	20	19	16	6	19	20	20	6	10	12	-
Spencer,	11	10	9	13	7	5	10	7	11	5	6	10	-
SPRINGFIELD,	118	70	108	86	63	78	70	77	65	75	71	79	-
Stoneham,	14	12	12	7	10	7	6	11	7	9	9	9	-
Stoughton,	12	9	6	6	5	12	6	9	9	7	9	10	-
TAUNTON,	66	62	45	55	55	46	75	68	47	50	46	49	-
Wakefield,	15	13	7	19	8	4	9	7	12	16	10	13	-
WALTHAM,	83	33	24	22	24	29	29	24	18	16	27	36	-
Ware,	15	11	10	9	6	9	13	5	9	6	10	7	-
Watertown,	11	10	10	14	7	9	12	5	10	11	15	13	-
Webster,	19	10	7	11	7	13	14	13	12	12	9	15	-
Westborough,	19	21	9	11	8	14	9	9	7	7	11	18	-
Westfield,	14	18	21	9	12	28	28	22	18	7	17	20	-
West Springfield,	19	12	5	6	19	10	9	15	9	13	8	8	-
Weymouth,	19	15	10	15	18	18	14	18	12	19	11	28	1
Whitman,	12	19	8	7	5	8	7	7	5	4	4	8	-
Williamstown,	6	5	3	3	1	1	3	7	6	3	5	3	-
Winchester,	14	5	1	10	7	4	9	8	9	8	7	5	-
Winthrop,	6	4	4	3	2	5	6	6	5	7	2	4	-
WOBURN,	22	16	22	26	18	16	23	31	18	15	9	18	-
WORCESTER,	154	171	167	136	151	124	153	171	140	136	143	154	-
Total,	4,093	3,337	3,136	3,292	3,012	2,805	3,589	3,650	3,141	2,876	2,860	3,385	13

TABLE IV.

Deaths from Specified Causes in Cities and Towns having more than 5,000 Inhabitants in Each.

	Consumption.	Small-pox.	Measles.	Scarlet Fever.	Diphtheria and Croup.	Whooping-cough.	Typhoid Fever.	Cerebro-spinal Meningitis.	Erysipelas.	Puerperal Fever.	Influenza.	Malarial Fever.	Cholera Infantum.	Dysentery.	Diarrhoea and Cholera Morbus.	Pneumonia.	Bronchitis.	Diseases of the Heart.	Diseases of the Brain and Spinal Cord.	Diseases of the Kidneys.	Cancer.	Suicide.	Accident.	Unknown or Ill-defined Causes.	All Other Causes.
Adams,	11	-	4	-	6	-	8	3	-	1	-	-	9	3	3	18	4	10	10	8	6	2	4	-	66
Amesbury,	14	-	1	2	1	1	6	9	1	-	2	-	7	1	2	17	4	23	28	14	6	-	6	3	18
Andover,	13	-	1	-	4	-	1	1	-	-	2	1	-	4	-	4	3	17	5	-	2	-	3	-	58
Arlington,	12	-	1	-	-	-	1	1	-	-	-	-	3	-	-	6	3	12	16	5	6	-	5	-	40
Athol,	9	-	-	-	-	-	-	2	-	-	-	-	2	3	1	9	2	11	5	1	4	2	-	1	48
Attleborough,	16	-	-	-	4	1	3	5	1	-	2	-	13	2	-	13	-	12	17	5	9	1	9	10	81
BEVERLY,	17	-	1	1	4	-	4	7	-	-	2	-	10	1	3	17	5	20	17	17	9	1	2	-	53
Blackstone,	17	-	1	2	1	2	4	1	-	1	-	1	1	-	-	15	3	4	9	8	-	2	9	23	1
BOSTON,	1,236	5	33	74	304	76	165	86	42	11	49	1	280	31	85	1,455	393	966	631	428	402	93	481	57	3,794
Braintree,	6	-	-	-	5	-	1	-	-	-	4	-	1	-	-	12	1	18	15	5	3	1	3	-	28
Bridgewater,	33	-	-	-	3	-	1	1	-	-	1	-	-	-	6	14	6	14	21	6	3	-	4	3	12
BROCKTON,	66	-	-	1	11	4	7	6	-	-	-	-	15	10	-	46	11	84	2	25	20	4	10	3	184
Brookline,	25	-	-	-	11	-	2	-	1	-	-	-	10	-	5	16	4	22	18	19	6	1	6	8	86
CAMBRIDGE,	166	-	8	3	55	23	20	8	2	3	12	-	62	6	58	163	51	182	200	59	51	6	86	114	696
CHELSEA,	75	5	2	3	10	5	10	9	2	-	-	-	18	4	6	74	9	56	2	19	33	1	5	-	258
CHICOPEE,	34	-	-	-	6	2	6	1	-	-	4	-	86	1	6	27	8	28	53	13	10	-	7	5	111
Clinton,	15	-	-	-	2	1	3	-	2	-	2	-	14	1	6	13	6	17	-	2	6	1	5	-	98
Concord,	7	-	-	4	2	-	-	1	-	-	1	1	3	-	-	7	2	3	3	2	1	1	3	-	18
Danvers,	11	-	-	-	-	-	-	-	-	-	3	-	-	-	3	10	1	13	18	6	9	-	5	19	1
Dedham,	15	-	-	-	-	2	3	1	-	-	-	-	2	-	1	7	1	15	24	2	4	-	4	-	22
Easthampton,	2	-	-	-	1	1	-	-	-	-	-	2	1	-	-	8	5	5	1	1	1	-	4	-	36
EVERETT,	34	2	-	3	18	1	7	2	-	-	4	-	13	1	1	40	12	25	38	13	17	1	4	-	114
FALL RIVER,	137	-	12	3	10	14	11	5	5	4	2	16	262	16	86	171	38	104	273	73	24	-	59	11	588

FITCHBURG,	37	-	10	4	7	4	4	7	-	6	9	-	20	4	3	33	11	35	46	12	13	4	9	-	127
Framingham,	21	-	-	1	-	-	2	1	-	-	2	-	2	-	-	17	1	20	7	4	7	-	9	-	50
Franklin,	5	-	1	1	-	-	-	2	-	-	1	1	6	-	2	8	-	5	7	4	3	1	4	-	21
Gardner,	19	-	1	3	18	4	2	-	-	1	2	-	18	-	3	18	11	20	25	9	7	-	6	-	105
GLOUCESTER,	34	-	2	-	6	4	8	-	-	-	6	-	15	-	3	46	-	30	55	4	15	2	9	-	96
Grafton,	7	-	-	-	1	-	-	-	-	-	-	-	3	-	-	5	4	6	-	3	3	-	3	-	43
Greenfield,	18	-	-	1	-	1	1	-	-	1	-	-	2	1	1	8	3	9	14	11	6	-	6	-	87
HAVERHILL,	58	-	-	2	17	9	5	2	8	-	11	-	21	-	1	53	19	56	58	27	24	9	24	1	128
Hingham,	8	-	-	-	1	-	-	-	-	-	2	-	-	1	1	1	4	12	17	5	6	1	2	5	11
HOLYOKE,	84	-	-	3	11	10	11	11	4	-	14	1	55	5	41	37	30	35	29	32	19	5	26	6	244
Hudson,	9	-	-	1	-	-	-	-	-	-	5	-	6	-	-	3	4	3	9	2	5	1	1	9	10
Hyde Park,	31	-	-	1	8	-	1	-	-	-	-	-	8	-	-	18	-	13	-	-	-	2	6	-	128
LAWRENCE,	65	-	4	2	60	22	20	4	2	1	11	-	111	9	7	108	36	94	49	18	24	7	15	26	538
Leominster,	20	-	-	2	4	2	1	5	-	-	1	-	4	4	-	15	5	16	3	9	7	3	5	-	67
LOWELL,	181	1	26	9	39	14	17	6	-	-	5	-	176	2	8	182	72	156	29	54	44	7	61	-	759
LYNN,	85	-	7	3	10	7	18	-	4	1	23	3	45	11	8	85	25	78	6	25	51	6	3	5	520
MALDEN,	51	-	2	-	9	-	4	4	-	-	-	-	23	18	-	34	15	22	6	31	14	2	9	-	215
Marblehead,	9	-	-	-	3	-	1	1	-	-	-	-	4	1	-	6	-	9	5	5	10	-	2	-	61
MARLBOROUGH,	27	-	-	4	3	1	-	13	-	1	-	1	11	7	-	18	4	21	2	1	4	1	7	1	99
MEDFORD,	13	-	-	-	9	-	5	-	-	-	7	-	7	-	-	14	3	21	-	6	4	1	12	1	113
MELROSE,	16	-	-	1	-	-	6	-	-	1	1	-	1	1	-	20	3	20	21	16	11	-	18	48	-
Methuen,	7	-	1	3	11	-	2	3	1	-	9	-	15	-	-	16	1	9	8	6	2	-	3	16	-
Middleborough,	13	-	-	-	1	-	-	2	-	-	3	-	1	-	-	7	2	16	8	5	5	2	2	-	49
Milford,	28	-	-	1	1	-	1	7	-	1	2	3	9	-	-	44	5	12	36	8	8	-	2	2	39
Millbury,	7	-	-	-	2	-	3	3	-	-	2	-	4	-	2	7	3	9	5	1	1	-	5	1	24
Milton,	6	-	-	-	-	-	2	6	-	-	1	-	1	-	1	8	4	10	9	5	1	-	3	7	14
Natick,	18	-	-	-	-	-	5	5	-	-	-	-	5	-	-	18	-	14	8	7	5	1	2	-	42
NEW BEDFORD,	105	-	-	11	25	-	16	3	2	-	12	-	74	6	4	109	33	109	64	59	45	3	7	-	474
NEWBURYPORT,	25	-	2	-	2	2	4	2	2	1	-	1	6	2	2	20	3	23	12	20	15	4	10	-	114
NEWTON,	35	-	1	2	5	3	4	3	-	-	11	-	14	27	-	48	8	28	5	31	17	-	9	2	181
NORTH ADAMS,	37	-	-	-	-	-	6	3	-	-	-	-	14	1	5	16	7	13	15	5	6	2	10	-	165
NORTHAMPTON,	41	-	-	-	6	-	9	-	-	-	6	-	6	-	-	24	4	33	13	9	8	-	12	-	121
North Attleborough,	8	-	-	1	4	-	1	1	-	-	1	2	1	1	2	9	4	9	16	5	3	1	1	-	28

TABLE IV. — *Concluded.*

	Consumption.	Small-pox.	Measles.	Scarlet Fever.	Diphtheria and Croup.	Whooping-cough.	Typhoid Fever.	Cerebro-spinal Meningitis.	Erysipelas.	Puerperal Fever.	Influenza.	Malarial Fever.	Cholera Infantum.	Dysentery.	Diarrhœa and Cholera Morbus.	Pneumonia.	Bronchitis.	Diseases of the Heart.	Diseases of the Brain and Spinal Cord.	Diseases of the Kidneys.	Cancer.	Suicide.	Accident.	Unknown or Ill-defined Causes.	All Other Causes.
North Brookfield, .	7	-	-	2	12	-	-	4	-	-	-	-	4	-	-	4	1	12	13	4	4	-	-	-	21
Orange, ...	9	-	-	-	1	-	-	4	-	-	-	-	-	-	-	8	1	6	1	4	4	-	1	-	33
Palmer, ...	16	-	-	1	-	-	1	6	-	1	-	-	5	1	-	3	3	8	-	5	5	1	1	21	53
Peabody, . . .	30	-	1	-	2	4	-	8	-	-	1	1	5	1	-	10	8	23	16	8	7	2	3	-	51
Plymouth, . . .	21	-	5	-	4	-	2	1	2	-	8	-	3	1	-	10	2	20	36	21	9	-	6	18	37
QUINCY, . . .	46	-	-	-	8	1	9	5	6	-	-	-	17	3	-	27	16	37	40	4	6	1	17	3	111
Reading, . . .	7	-	-	-	1	-	-	2	-	-	-	-	3	-	1	7	-	2	2	2	2	2	2	-	40
Revere, ...	12	-	1	1	2	2	1	-	1	-	-	-	5	-	-	11	6	13	14	4	6	1	-	1	33
Rockland, . . .	11	-	-	-	1	-	2	-	-	-	-	-	1	-	1	6	-	9	4	8	2	-	3	11	16
Rockport, . . .	9	-	1	-	-	-	-	1	-	-	-	-	-	-	1	11	3	3	11	1	3	2	2	-	33
SALEM, ...	61	-	2	8	9	3	7	1	1	-	6	-	52	6	19	49	24	60	19	24	30	5	15	-	311
SOMERVILLE, . .	94	-	1	3	11	2	15	29	3	-	12	-	25	4	8	111	22	72	10	40	34	2	19	-	284
Southbridge, . .	16	-	-	-	1	2	1	-	-	1	1	-	17	-	3	18	4	13	30	10	6	1	5	47	19
Spencer, . . .	6	-	-	2	1	-	1	5	-	-	-	-	7	-	1	13	5	13	4	4	2	3	6	-	31
SPRINGFIELD, . .	121	-	5	2	55	2	15	9	9	3	21	3	54	3	3	69	24	77	53	34	42	12	30	25	228
Stoneham, . . .	4	-	-	-	1	1	2	3	1	-	2	-	2	2	1	10	6	20	18	7	10	1	1	-	21
Stoughton, . . .	9	-	-	-	1	-	1	4	-	-	6	-	3	2	-	11	-	7	4	5	2	-	4	-	41
TAUNTON, . . .	67	-	-	2	8	4	7	2	5	1	11	2	24	4	30	72	12	52	9	19	16	4	1	-	305
Wakefield, . . .	6	-	-	-	-	-	-	16	1	-	1	-	-	-	1	7	3	21	3	2	5	-	7	-	50
WALTHAM, . . .	47	-	1	1	4	-	6	-	-	2	5	-	5	1	5	42	4	39	28	12	13	-	7	3	55
Ware, ...	1	-	-	1	1	-	-	-	-	-	1	-	9	-	-	21	2	9	5	9	1	1	4	-	45
Watertown, . . .	9	-	-	1	2	1	1	10	-	-	4	-	2	2	1	17	5	14	11	6	9	-	10	13	9
Webster, . . .	15	-	-	-	4	-	1	5	-	1	-	-	16	-	2	10	5	6	12	3	1	-	5	1	55

Westborough,	9	-	-	-	-	2	8	2	-	-	-	-	-	-	4	13	3	15	53	6	6	-	8	12	7
Westfield,	25	-	2	-	8	-	8	2	-	-	3	-	13	2	2	14	6	15	8	9	6	5	8	2	71
West Springfield,	10	-	1	-	9	-	1	6	1	-	1	3	7	1	1	8	8	9	-	8	9	1	5	-	44
Weymouth,	21	-	2	-	7	1	1	6	-	1	5	-	3	1	1	17	7	33	24	6	6	-	4	16	30
Whitman,	10	-	-	1	2	-	-	2	1	-	-	-	2	3	-	9	1	13	6	4	3	2	1	1	28
Williamstown,	5	-	-	-	-	-	-	-	-	-	1	-	6	-	1	2	1	9	3	1	4	-	3	-	10
Winchester,	8	-	1	1	1	-	1	1	-	-	-	-	3	-	-	7	1	8	1	5	9	-	1	-	44
Winthrop,	1	-	-	-	-	-	1	2	-	-	1	-	1	-	1	5	1	5	2	5	6	-	6	7	10
Woburn,	34	-	-	1	2	1	2	8	-	-	-	2	12	2	-	19	7	16	6	4	3	2	11	8	99
Worcester,	218	-	5	10	40	4	19	-	3	2	29	2	108	8	15	200	39	171	281	109	72	12	49	1	412
Total,	4,063	13	149	190	904	251	525	393	113	46	356	47	1,859	227	418	4,058	1,176	3,368	2,720	1,618	1,374	242	1,180	580	18,274

Homicide.

Boston,	14
Cambridge,	1
Fitchburg,	2
Haverhill,	1
Lawrence,	1
Natick,	1
North Adams,	1
Weymouth,	1
Worcester,	1
	23

Pulmonary Actinomycosis.

Boston,	1

Ptomaine Poisoning.

Boston,	3

Tetanus.

Orange,	1
Taunton,	1
	2

Malignant Pustule.

Palmer,	1
Rockport,	1
	2

Malignant Disease of Uterus and Appendages.

Reading,	1

TABLE V.

Deaths from Specified Causes, 1899. Death-rates per 10,000 (1895–99). Deaths per 1,000 from All Causes, 1895–99.

Causes of Death.	Deaths. 1899.	Mortality per 10,000 of the Population.					Deaths per 1,000 from all Causes.				
		1899.	1898.	1897.	1896.	1895.	1899.	1898.	1897.	1896.	1895.
Consumption, ...	4,068	17.91	18.41	19.01	20.60	21.19	103.7	107.01	105.00	106.75	110.45
Measles, ...	149	0.66	0.34	0.57	0.53	0.45	3.80	1.99	3.12	2.72	2.33
Scarlet fever, ...	190	0.84	0.53	1.32	1.06	2.08	4.85	3.09	7.27	5.50	10.84
Diphtheria and croup, . .	904	3.99	2.74	5.75	7.20	7.83	23.06	15.94	31.78	37.30	41.05
Whooping-cough, . . .	251	1.11	1.43	0.72	1.01	1.04	6.41	8.28	3.96	5.22	5.42
Typhoid fever, . . .	525	2.31	2.49	2.87	2.77	2.66	13.40	14.50	13.06	14.33	13.88
Cerebro-spinal meningitis, .	393	1.73	2.12	2.50	1.54	1.81	10.03	12.35	14.31	7.97	9.44
Erysipelas, ...	113	0.50	0.33	0.44	0.52	0.55	2.88	1.94	2.44	2.70	2.86
Puerperal fever, . . .	46	0.20	0.23	0.27	0.37	0.41	1.17	1.36	1.52	1.91	2.14
Influenza, ...	356	1.57	0.68	1.10	0.52	1.73	9.09	3.93	6.09	2.67	9.01
Malarial fever, . . .	47	0.21	0.30	0.23	0.28	0.26	1.20	1.76	1.28	1.44	1.37
Cholera Infantum, . . .	1,859	8.20	10.18	9.69	13.22	10.69	47.45	50.14	53.55	68.52	55.73
Dysentery, ...	227	1.00	0.94	0.79	1.48	0.80	5.79	5.45	4.39	7.65	4.15
Diarrhoea and cholera morbus,	418	1.84	2.44	2.00	2.47	2.08	10.67	14.16	11.02	12.80	10.86
Pneumonia, ...	4,056	17.89	15.06	17.18	17.76	17.51	103.60	87.66	94.92	92.04	91.28
Bronchitis, ...	1,176	5.18	5.60	5.81	6.04	6.16	30.00	32.56	32.07	31.31	32.09
Diseases of the heart, . .	3,368	14.85	14.84	14.81	15.35	15.44	86.00	86.22	81.84	79.53	86.47
Diseases of the brain and spinal cord.	2,720	11.99	12.50	13.23	12.41	13.31	69.42	72.61	73.08	64.31	69.37
Diseases of the kidneys, .	1,618	7.13	6.57	6.42	6.87	6.96	41.30	33.17	35.43	35.02	36.27
Cancer, ...	1,374	6.06	6.32	6.04	6.12	4.47	35.07	36.70	33.35	31.73	23.29
Suicide, ...	242	1.07	1.06	0.98	1.06	1.06	6.18	6.16	5.40	5.50	5.55
Accident, ...	1,180	5.20	5.56	5.21	5.68	5.81	30.12	32.30	28.80	29.42	30.30
Unknown or ill-defined causes,	580	2.56	2.26	2.77	3.15	2.38	14.80	13.10	15.30	16.30	12.40
All causes, . . .	39,176	172.70	172.10	181.00	193.00	191.90	-	-	-	-	-

HEALTH OF TOWNS.

HEALTH OF TOWNS.

The following digest consists mainly of material selected from the published annual reports for the year 1899 of such cities and towns as have been received at the office of the State Board of Health. In addition to this information the results of such inspections as have been made during the year by the medical inspector, and having relation to the prevalence of infectious diseases, have been incorporated in the digest.

Adams.

At present the town has no sewerage system, the sewage being emptied at numerous points along the Hoosac River.

This method, during dry periods, when there is a small amount of water in the river, causes a stagnation of sewage matter at various places, thus making it extremely unhealthful for persons residing near those points of infection.

With a good sewerage system all this would be radically changed. Instead of having the sewerage matter discharged at numerous places within the residential section, as it is at present, it would all be carried by a main trunk and disposed of in a manner to be decided by the State Board of Health, somewhere outside of the thickly settled portion of the town.

Amesbury.

There have been but very few instances of violations of our regulations brought to our notice. One Lawrence firm persisted in carting through our streets, during the hot months of summer, tallow and decaying scraps of meat. They were brought into court, promised to abide by our regulations, and afterwards used tightly sealed barrels. There have been two violations of our plumbing regulations by out-of-town parties.

The inspection of cattle, provisions and milk has been most efficiently carried out. Many of the slaughters were ordered after a physical examination. Between sixty and seventy diseased cows have been killed during the official term of one of this board. There is a practice with some parties, which we deplore, but for which we are in no sense responsible, namely, the purchasing of cheap and sometimes diseased cows in New Hampshire and running them over the line, across the eastern border of our town, to towns the other side of the Merrimac River, then sub-selling them back into this town.

Andover.

The following report of inspection made by Dr. F. L. Morse, medical inspector of the board, relates to a limited epidemic of typhoid fever which occurred at Andover in the spring of 1899: —

July 20, 1899.

During the latter part of March and the first of April the presence of an unusual number of cases of typhoid fever at Andover was called to my attention, and at the request of the local board of health an investigation as to the origin of the cases was commenced. From the 20th of March to the 4th of April, fifteen days, 11 cases had been reported, and a visit was made to each patient, the sanitary condition of the premises observed and inquiry made in regard to their milk and other supplies. Seven of the eleven cases were children of sixteen years of age or under, and of the remaining 4 there were 2 males and 2 females, each pair aged twenty-five and eighteen respectively. With the exception of 1 male (case No. 4) none of the patients had been away from Andover for a period of time longer probably than the incubation period of the disease, and consequently this circumstance limited the origin of infection to some local cause, and as the investigation progressed this proved to be the case, as 10 of the 11 cases were exposed to a common source. Disposing of case No. 4 first, which is the exception in this epidemic, we have a male twenty-five years of age, a spinner by trade, living at Andover and working nights in the factory at North Andover, travelling to and fro by the electric cars, and taking his dinner with him to his work. It was his custom at times to visit Lawrence during the day, and as typhoid fever had been particularly prevalent there during January, it seems to be admissible that he may have become infected on a visit to the city, as he admits taking meals and drinking water while there. Aside from his visits to Lawrence, he seems to have led a regular life, and as far as is known was not exposed to the disease in any other way. The milk supply of the family was not in common with that of the other typhoid cases.

As the inquiry in regard to the origin of the other cases progressed, and their milk supply was investigated, it was found that all of them, without exception, had access to a single man's milk; 6 of the patients taking milk of him directly and the remaining 4 obtaining it from a store supplied by him. The patients supplied from the store also had a regular dealer, and only sent to the store when necessary, but all of them admit sending to the store for milk within a period corresponding to the incubation period of the disease. The regular milkman of these families was not the same, except where more than one case occurred in the same family.

Attention having thus been drawn to the milk supply, a visit was made to the milkman and his different sources investigated. He obtained his milk from six different farms, in amounts varying from one to six cans of eight quarts each. Inquiry was made at each of these different places, but the history of any case of sickness was wanting, and the dairies, with one exception, appeared to be in good sanitary condition. The exception was his own farm, where he obtained about six cans daily, and which was located about three miles from the town, towards North Andover, the milk being brought to his house at Andover daily. At this farm the cows were in a filthy condition, the floors and stalls improperly cleaned, and, although not actually producing the disease, these conditions in themselves were favorable for its development, once having become infected. The proprietor himself was mildly ill about the 10th of March, and his sickness increased in severity until the 17th, when he was obliged to give up work and call a physician. His sickness, which was diagnosed as influenza, kept him from work until the 30th of the month, when he was again able to drive his team and deliver the milk. The coincidence of these cases of typhoid fever, all with one exception having the same milk supply, and the owner of the route being sick at a time from ten days to three weeks previous to the occurrence of all of the cases, is certainly suspicious, and when it is considered that mild cases of the disease do occur and are more apt to give rise to an epidemic than a severe case, on account of their ability to associate with other inhabitants, the occurrence of these cases may be more clearly understood.

Two other cases developed, one on April 26 and one on May 15, but they appeared to be in no way directly connected with this supply.

These suspicions having been made known to the milkman, he wished it explained how, if he was the source of the disease, it was possible for no cases to develop in his own house, where about twenty boarders were taken, but on enquiry it was found that the milk used at the house did not come from this farm, but came from two of the other sources and was left at the house without his touching it, and if any surplus was left this was distributed by him from his house. The conditions at the house for washing the cans and bottles seemed to be adequate for a small business, and as these cases were limited to a definite period it is probable that the infection was not one of long standing. The condition at the farm was made known to the local board of health and a change in the conditions there advised.

F. L. Morse, M.D.,
Medical Inspector.

Arlington.

Within the year many houses have been connected with the sewer, thereby generally improving the sanitary condition of the town. It is urgently recommended that *all* dwellings be connected at the earliest possible date. Measures have been taken rendering it possible for cesspools to be promptly emptied at a moderate expense by applying to the clerk of the board of health.

The entire water service of the town has been replaced by the Metropolitan, which promises water of an almost unlimited quantity and exceptional purity.

Athol.

We have been fortunate during the past year as regards contagious diseases, there having been no epidemic in town, and the few cases of contagious diseases that have occurred have been of a light character, no fatal cases having occurred during the year.

Attleborough.

During the year 41 cases of diphtheria were reported to the board of health, 37 of them in the months of October, November and December. Nearly all occurred in the Farmers school district. As soon as it was apparent that the health of the pupils attending the school was imperilled, the board purchased an improved formaldehyde gas generator, the school-house was closed and thoroughly fumigated, as were also the homes of the pupils where cases existed. Later the Pleasant Street school-house was closed and fumigated. By such means, and by the almost universal use of antitoxin by the attending physicians, the spread of the disease was checked.

We again desire to express our most hearty approval of the course adopted by the State Board of Health of furnishing antitoxin for the free use of physicians. With this agent many lives are saved and epidemics prevented.

Ayer.

The occurrence of several cases of typhoid fever during the last few years among the people employed at the railroad station led to an investigation of the sanitary conditions at the station. It was found that pond water was in use at various places about the railroad yard and station, being accessible for use as drinking water. After a conference with officials of the Boston & Maine Railroad Company, town water was introduced for all purposes about the station. The toilet rooms were renovated and the drainage improved.

Boston.

[The health report of the city of Boston had not been issued at the time of publication of this report.]

Brockton.

The board would recommend the establishment of a bacteriological laboratory and an appropriation made therefor. Our experience the past year has demonstrated the need of this work being done in our own city. The work is at present done by the State Board of Health. While they have been very obliging, the work could be done much more quickly and conveniently if we had a laboratory where the work could be done without sending it out of the city.

The board has adopted the plan of taking charge of the final disinfection of houses where there have been contagious diseases, using formaldehyde; also of requiring a negative culture in a case of diphtheria before releasing the patient from quarantine.

The following table shows the death-rate for the past ten years:—

1890,	17.12	1895,	14.65
1891,	15.73	1896,	18.11
1892,	13.05	1897,	13.19
1893,	15.30	1898,	12.28
1894,	14.17	1899,	11.81

Brookline.

The number of deaths from all causes between Jan. 1, 1899, and Dec. 31, 1899, inclusive, was 255, as against 264 in 1898, 220 in 1897, and 239 in 1896. Deducting the still-births, 18 in number, leaves 237 deaths during the year. Two hundred and thirty-seven deaths gives a mortality of only 11.63 per one thousand inhabitants for 1899, as against 13.05 for the previous year.

During the outbreak of diphtheria the board of health hospital had unprecedented demands made upon it, but with two exceptions every request of a physician for hospital isolation of a scarlet fever or diphtheria patient was promptly granted, the reasons for the two exceptions being lack of room at the time. The large number of diphtheria patients and convalescents that occasionally had to be provided for taxed severely the capacity of the inadequate hospital buildings, and made very hard the work of the attendants. It is easy to infer what serious consequences the absence of an isolation hospital during our local epidemic might have entailed. Though the cost of maintenance of such hospitals is necessarily considerable, the board considers that money spent for the prevention of suffering and death from the more or less preventable diseases is money wisely expended. Of the 89 patients admitted to the hospital during 1899, 68 had diphtheria and 21 scarlet fever. Of the 68 diphtheria patients, all except 3 recovered (a mortality of 4.4 per cent.), and of 21 scarlet fever patients, the whole number recovered. To the use of antitoxin, generously provided by the State Board of Health, the very small death-rate in the diphtheria hospital is in large part due. The experience of the past year has clearly shown the present and future need of more adequate hospital accommodations.

The free bacteriological examinations provided by the board for the early diagnosis of typhoid fever, diphtheria and consumption have been much more extensively taken advantage of the past year than in previous years, and with great benefit to both patients and their families. The obvious advantages of a local laboratory, among others the securing of earlier reports from diphtheria diagnosis examinations, are so great that the board took the necessary steps, and on Feb. 1, 1899, had its temporary laboratory in operation. During the year 1,242 diphtheria cultures, 91 specimens of sputum, suspected to be tubercular, and 25 typhoid tests (Widal's) were examined.

Formaldehyde disinfection of rooms, bedding, etc., after scarlet fever and diphtheria has been continued, and proves to be effective. After cases of these diseases the disinfection is done by the disinfector appointed by the board, and is done free of expense where the householder is unable to pay for it. During the year ending Jan. 31, 1900, formaldehyde disinfection has been done after 122 cases of diphtheria, 49 cases of scarlet fever, and, by special request, after 13 other cases of infectious disease; for example, consumption, measles and typhoid fever. Infected books and other articles are now disinfected by formaldehyde in a cabinet specially constructed by the board and tested by the bacteriologist.

Intermittent fever (malaria) has been less prevalent than in previous years, and it is believed this may be attributed in part to the draining of certain districts.

The appreciation of the value as a health measure of frequent bathing continues to be shown by the experience at our public bath house, where 49,391 baths were taken the past year, a good increase over the attendance of any previous year.

Cambridge.

Number of inspections made,	4,571
Number of subsequent inspections,	6,617
Total,	11,188

The diseases discovered in the schools during 1899, and the number of cases of each disease, were as follows: —

Chicken-pox,	18	Diseases of ear,	11
Diphtheria,	4	Diseases of eye,	38
Measles,	24	Diseases of skin,	36
Mumps,	18	All other diseases,	150
Pediculosis,	57		
Scarlet fever,	5	Total,	372
Whooping-cough,	11		

The number of cases reported shows an increase of 147 over the number reported in 1898.

During the past year the city has suffered severely from the prevalence of certain infectious diseases, and in particular from diphtheria.

It became apparent to the board of health at an early date that active measures must be taken to protect the public health. A number of stations, where cultures of suspected cases of diphtheria could be taken, were established for the convenience of physicians, and a laboratory was instituted in the city hall. All physicians were notified that their co-operation was expected, and that in return the board would give them every assistance by the prompt examination of cultures deposited at the designated stations.

Throat Cultures. — During the two months 505 cultures were examined. They may be classified as follows: —

	November.	December.	Total.
New cases, positive,	43	69	112
New cases, negative,	47	68	115
New cases, no growth,	3	4	7
Total new cases,	93	141	234
Re-examinations,	93	178	271
Total examinations,	186	319	505
Cultures for diagnosis,	57	118	175
Cultures for release,	129	201	330
	186	319	505

It is to be regretted that the physicians do not avail themselves more fully of the opportunity of taking cultures. During November and December 176 cases of diphtheria and 6 cases of membranous croup were reported to the board of health. Cultures for diagnosis were made in only 65 of these cases. Many of the remaining cases were reported as recovered, and cultures were found negative within a week from the beginning of the attack, and it is probable that a certain proportion of these cases were not true diphtheria at all.

Widal Tests for Typhoid. — The blood of 31 cases of suspected typhoid was examined for the Widal reaction, with the following results: —

	November.	December.	Total.
Positive,	5	4	9
Negative,	11	11	22
	16	15	31

Sputum Examinations. — Samples of sputum from 34 cases of suspected pulmonary tuberculosis were examined, — one case being tested twice, — with the following results: —

	November.	December.	Total.
Bacteria of tuberculosis present,	10	7	17
Bacteria of tuberculosis absent,	11	7	18
	21	14	35

The report of the milk inspector contains some excellent suggestions upon the subject of milk standards and the sale of milk.

Number of samples collected and analyzed,	4,459
Number of milk samples collected and analyzed,	4,225
Number of vinegar samples collected and analyzed,	172
Number of butter samples collected and analyzed,	62
Number of milk samples below the standard,	367
Number of vinegar samples below the standard,	19
Number of butter samples not genuine butter,	-
Number of warnings sent out for sale of poor milk,	217
Number of warnings sent out for sale of poor vinegar,	12
Number of complaints made,	13
Number of convictions,	10

Chelsea.

Receiving many protests against the indiscriminate slaughter of chickens, the board, in February, provided a building at the corner of Maple and Second Streets, especially arranged for this purpose, and ruled that all such slaughter should be here confined and subject to its inspection.

The main structure is 14 by 32 feet. It has a cement flooring with a gutter along one side, which is constantly flushed and drained into the common sewer during the slaughter. Along the wall and suspended over this gutter are arranged a number of funnel-shaped tins, into which the chicken is placed to bleed after being killed. Along the opposite wall is a bin to receive the feathers plucked at the time of killing. These are later collected, dried in the loft above and sold; the proceeds being a part of the city's profits on this novel investment.

There are two out-buildings, accommodating about 2,500 chickens. A charge of two cents and three cents per chicken killed is made, one-half which goes to the rabbi officiating.

Under this system, which has met with considerable favor, the board is able to report an abatement of a nuisance which was a source of considerable dissatisfaction in various sections of the city.

The board wishes to emphasize the fact that it still feels the necessity of a suitable isolation hospital, for the care and treatment of small-pox and allied diseases. It would suggest for serious consideration the advisability of prompt action, tending to an agreement with one of the neighboring towns for the acquirement of a location for such an establishment.

In a city as thickly populated as Chelsea, the practical impossibility of successfully isolating a case in the home has been shown, we believe, in these last few cases of small-pox, and until a hospital is built that will be suitable for the reception of those suffering with a contagious disease, without subjecting them to discomfort, there will always be a serious danger of a widespread and fatal epidemic.

The report of Medical Inspector Morse upon an epidemic of typhoid fever in Chelsea follows: —

JULY 31, 1899.

During the early part of April the daily reports received at this office showed an unusual number of typhoid fever cases in Chelsea, more, in fact, than had occurred during the whole of last year, and in a communication to the local board of health, dated April 12, I inquired if the cause had been found, and if not, if they desired any assistance. Under date of April 14 the agent informed me that the cases were being investigated, but that no assistance was desired at that time. The number of cases continuing to increase, however, the agent wrote to me on April 27 that they would be glad of my services, and on the following day an investigation of the cases commenced.

The cases reported to the local board of health were supplemented by cases ill at the hospital and by others obtained by interviewing other doctors who had failed to make the reports required by law. In this manner 27 cases were collected and plotted on the map, to see if they corresponded to any definite locality or had any apparent common origin. This showed a certain number of cases in a definite locality, near the junction of Broadway and Washington Street, and the others variously distributed over the more thickly populated part of the city.

A visit was then made to each case and careful inquiries made in regard to the sanitary conditions of the premises, and the source of their milk supply in particular. The study of these cases had not proceeded far when it was observed that an unusual difficulty presented itself, for obviously no common relation existed among the several cases. All had different milk dealers, grocery and provision supplies, and there was no history of the patients being away from Chelsea for any length of time preceding the attack. On more careful inquiry it was learned that occasionally it was necessary for some of the families to supplement their daily milk supply by sending out to near-by grocery stores and bakeries, and following out this discovery these different stores were visited and the source of their supply learned, which many times proved to be a common one.

As in past reports, the date of the patients going to bed being most reliable, the patients were grouped accordingly, and it was found that the height of the epidemic was reached during the first ten days of April, when 21 cases were reported, and only 4 in the following six days. Here again appeared to be an infected milk supply, supplying these people indirectly, through the stores, and the infection being one of comparatively short duration. Thirteen of the cases occurred in females and 12 were in children under fifteen years of age. At about the same time it was learned through the Boston board of health that a large number of cases of typhoid fever had occurred in this city, but as their board was busy with small-pox at the time, they were unable to pursue the investigation, but would furnish data for this purpose.

Accordingly the list of cases reported to the board was procured, supplemented by the cases admitted into the Massachusetts General, Boston City and Carney hospitals. The homes of these patients were plotted upon a map, and groups could be thus located in South Boston, the North, West and South Ends, and in Charlestown. With the knowledge gained by the study of the cases in Chelsea, these patients were investigated in the same way, with the following results: —

Of 25 cases in South Boston, 22 procured milk indirectly through stores from the same man supplying the stores in Chelsea, and 5 out of 7 in the West End, 6 out of 8 in the South End, 7 out of 11 in the North End, and 4 out of 12 in Charlestown, developed under similar circumstances, making a total of 64 out of 90 cases, or, omitting Charlestown, which apparently did not receive its infection from the same source, 60 out of 78 cases. Careful inquiry was also made when these patients were visited in regard to other sources of infection, and although the sanitary conditions were not always satisfactory, still, the milk supply was considered the probable source of infection.

Attention was next directed to the probable source of the infection, viz., the milk supply. The conditions present are a contractor receiving milk from 458 different dairies situated in Massachusetts, New Hampshire and Vermont, the milk being brought into Boston daily in milk cars over the Fitchburg Railroad. Strict inquiry was made by the men coming with the cars in regard to the occurrence of any cases of typhoid fever, but in every case a negative report was returned. At about the same time it was learned that typhoid fever was prevalent at Ayer, through which town the Fitchburg Railroad passes, but on inquiry from the local board of health it was learned that of the railroad employees having the disease all were employed by the Boston & Maine Railroad.

Attention was also turned to the men employed at the depot in Charlestown, where the milk was received, and also to the drivers of the teams. The milk received here is first tasted and then mixed in a large mixer holding fifty gallons. It is then drawn off in cans and set away in the refrigerator until the following morning, when it is loaded into the fourteen different teams and distributed to all parts of the city, together with a part of Everett and Chelsea. The teams arrive at the depot in no regular order, and do not have the same milk on successive days, the team arriving first in the morning getting the milk nearest the door and so on. The business of the company being strictly wholesale, and delivered to stores and bakeries, compels the drivers to handle only the cans, the *milk* itself not being emptied and handled until sold by the storekeeper, and as the cases of the disease arising were not limited to a single storekeeper, the infection must have taken place before it was delivered to them. At the depot, the taster and the man running the mixer are the only ones who handle the milk. Neither one had been ill with any disease whatsoever, nor had they had any sickness in their families. On further inquiry it was learned, however, that one of the drivers had been ill with typhoid fever last November, and being particularly ill with the disease had not been able to return to work until March 20. At this time he was still so weak as to be able to do almost no work whatever, and his work at first consisted in running errands. As he gained in strength, however, he did some work about the milk depot, and he himself admits pouring milk into the mixer, just to try his strength. Here appears a possible source for the development of the disease, for it is well known that the typhoid bacilli do in some cases remain in the urine and fæces for a number of weeks after convalescence has been established, and the cases developing in this case are such as would arise from a small portion of the milk being infected for a limited time. The examination of this man's blood for the Widal reaction and the urine for the typhoid bacilli was, however, negative.

Again there is the possibility of an unrecognizable case at one of the dairies infecting the milk, and subsequently, as it was mixed with other supplies at the depot, infecting a larger amount, and thence distributed over the city, but in view of the fact that this man did have typhoid, that he subsequently handled the milk, and that the cases began to develop within ten days of such occurrence, it seems that this was the most probable source of the disease.

F. L. MORSE, M.D.,
Medical Inspector.

CHICOPEE.

The condition of the city as regards health was never better than it has been this year. We have had no epidemic of any contagious disease.

It is a pleasure to know that our city has never before experienced such a degree of cleanliness, which is largely due to a better service rendered in the collection and removal of house offal, over which a strict supervision has been kept, while all complaints have received immediate attention, and any negligence on the part of the collectors rectified, though in some cases the blame would rest upon the house occupants in failing to comply with our regulations. In houses containing a number of families our rules are not always regarded, and it is a difficult matter to detect those who violate them at such places.

CLINTON.

In April, 1899, in consequence of the epidemic of scarlet fever, every school-room and all school-books were disinfected during the spring vacation, and afterwards, as soon as a case of scarlet fever was reported, the school-room where the person went to school, if a scholar, was at once disinfected, and in every case the rooms of the house and all infected clothes, furniture, etc., were disinfected. In a month from the inauguration of school-house disinfection the epidemic was practically controlled.

A contagious ward should be built in our town, as we have now no place for the proper care and isolation of such cases where isolation cannot be properly enforced in their own homes.

CONCORD.

This year has been an average one in the amount of work required of the board, except in the matter of examination of plumbing, which was increased largely upon the completion of the sewer system, and this will undoubtedly be still more increased the coming year.

DANVERS.

During the year a recommendation was made to local boards of health by the State Board, urging the importance of providing free vaccination for the people, because of the beginning of an epidemic of small-pox in Boston and vicinity. Your board, believing it to be a wise measure, provided the people with free vaccination accordingly, at considerable expense to the town, as 696 people availed themselves of the opportunity thus offered.

DEDHAM.

For the last five years the board has called attention to the fact that a system of sewerage is, perhaps, the most urgent need of the town. Our centres of population have been filled to overflowing with cesspools, in many places two or three of these unsanitary receptacles being found upon one small house lot. Perhaps four-fifths of the complaints which come to the board are from overflowing cesspools and bad drainage. It becomes the duty of the board to insist that the owners shall put the same in a proper sanitary condition, frequently, at no small expense. This can be entirely obviated by the construction of sewers.

The Neponset valley sewer, built by the State as a relief for Dedham and other towns, has been ready for connection since 1897. The town is annually paying a considerable sum towards the construction and maintenance of this sewer. We may liken ourselves in this respect to parties holding a lease to a building, forced to pay a yearly rental and making no use of the advantages.

FAIRHAVEN.

The following is a report of Medical Inspector Morse upon an epidemic of typhoid fever at Fairhaven : —

OCT. 30, 1899.

On October 4 a physician of Fairhaven came to the office of the State Board of Health and reported that a large number of cases of typhoid fever existed in that town. He also stated that a certain milkman, whom he considered in no way connected with the cases, either through prejudice or otherwise had been mentioned by another practising physician there as having sold milk which undoubtedly produced the unusual number of cases, thus ruining the man's business. Feeling sure that an error of judgment had been made, he brought with him some of the milk to be examined, and expressed the opinion that the disease, on account of the distribution of the cases, was due rather to meteorological conditions than to a particular man's milk supply. The analysis of the milk showed a sample of good quality, but was negative in regard to the absence or presence of the typhoid bacilli.

On the following day I went to Fairhaven, obtained a list of the reported cases of the disease from the board of health, and made a visit to each patient. I found 21 cases existing, and after analyzing them came to the following results : —

Case No. 1 was taken ill on August 4. He was forty years of age, used condensed milk and drank well water obtained from a well situated in the centre of the town. It is impossible to state definitely just where he obtained his infection.

Case No. 2 was a male thirty-one years of age, also living in the centre of the town and drinking water from a well which shows by analysis much pollution. He obtained his milk from Gillette.

Case No. 3 was a child three years of age, who undoubtedly received his infection from another child visiting at the house, who was convalescing from the disease.

Case No. 13 was a female nineteen years of age, drinking water from a well in the centre of the town and taking milk from Gammons. Source of infection not apparent.

Case No. 20 was a male twenty years of age, a farmer, making his own milk. The water was obtained from a well. No history of exposure to another case.

Of the remaining 16 cases, all of them had milk from the same man who, as Dr. ——— stated, he considered in no way connected with the cases. These patients came down with the disease from September 10 to October 6, 6 of them appearing on the 10th and the remaining 10 being scattered through the rest of the month. All of them admit drinking milk, and, with three exceptions, had access to no other man's milk. As visits were made to those different patients, it was found that some of them used well water in preference to the public supply. These were cases Nos. 6, 8, 10 and 13, and the wells were so situated as to be easily contaminated by the surface drainage. Samples of water were taken from these wells, and all showed much pollution.

The milk farm, situated about two miles from the centre of the town, was next visited. Six cows are kept, making about fifty quarts of milk daily. The hired man does all of the milking and also distributes the milk to the customers, and as no other man's supply is brought, he apparently is the only one who handles the milk. The cans are washed in the house by a girl, and she stated that all of them are thoroughly scalded. The well is situated almost directly under the pump at the edge of the house, and an analysis of a sample from it shows it to be polluted. Careful inquiry revealed no sickness about the farm during the month of August, but going farther back it was learned that the farm hand himself had been sick with typhoid fever a year ago,— so ill with it, in fact, that he had not come back to work until the middle of January, since which time he had been perfectly well. In view of the fact that the typhoid bacilli remain, in some cases, in the urine and fæces for many months after recovery, we may conclude that at some time during the month of August the milk was infected by him.

The analyses of the different well waters showing pollution were made known to the local board of health, and they were advised to close the wells and prevent the water from being used for domestic purposes.

F. L. Morse, M.D.,
Medical Inspector.

Fitchburg.

The poor sanitary condition of a number of our school-houses seems to warrant another urgent appeal from the board of health that something be done in the way of modern sanitary arrangements to replace the present systems of privies and overflowing cesspools. Good health is as essential as knowledge, and to obtain the best results from instruction the scholars should be supplied with pure air and healthy and wholesome surroundings.

The number of contagious diseases has increased this year, largely on account of the poor isolation of the patients from other members of the family. This state of affairs could be greatly improved and the number of cases reduced to a low figure had we the means for isolating them. This thought is worthy of consideration. To do this work effectively a contagious disease hospital is very much needed, and we would earnestly urge the necessity of providing a suitable building for that purpose.

There were 1,513 cases of measles reported to this board during the year. This is a larger number than occurred in the epidemic of 1897.

Not a little feeling was indulged in at the height of this epidemic among those who did not take in the gravity and the wide spread of the disease, and the board was mildly censured for its endeavor to stem the tide of it, but they have the satisfaction of knowing that their work was rational and in the interest of the public generally, and as a result of it our schools, with the exception of one for a very short time, were not closed; and in this respect we were vastly better off than some of our neighboring cities, who were obliged to close the schools entirely during the progression of the disease.

Great Barrington.

During the prevalence of diphtheria a part of the public schools were closed for a short time, the step being deemed a wise one by the school committee and board of health, inasmuch as the anxiety of parents would have resulted in a small attendance had the sessions continued.

Greenfield.

During the earlier months of the year the usual number of cases of scarlet fever were reported. During the summer, however, two or three cases were reported where it was exceedingly difficult to maintain strict quarantine, and to these few cases the board feels that the mild epidemic of the past few months can be traced. As the summer began to wane cases were being reported regularly, so that all of the time there were a few cases of scarlet fever in, or supposed to be in, quarantine. In the month of November 19 cases were reported, an unusually large number. The early weeks of December brought the same proportionate number of cases reported. The continued increase was in a measure accounted for by the fact that nearly all the cases were of a very mild type, many of them seeming hardly ill enough to be seen by a physician. As a result one or two cases were found during the stage of desquamation mingling with other children. The question of closing certain or all schools came up for decision about the middle of December, and while the board of health could see no benefit from such a plan in such a small epidemic, it felt that a public expression of opinion would perhaps be of value, so an invitation was extended to all physicians in active practice to meet the board of health, with the chairman of the school committee and the school superintendent, and discuss the best methods to pursue in combatting the further progress of the disease. This meeting was held and it seemed to be the concensus of opinion of nearly all those present that the spread of the disease could be better prevented in so small an epidemic, not by closing the schools, but by systematic daily school inspection.

This was done for the two weeks preceding the Christmas recess, and on the re-opening of the schools again, following the Christmas recess, all the children were required to be examined before re-entering school. The cost of this examination was about $230, but without doubt this measure acted very powerfully toward quieting popular excitement and preventing more extended spread of the disease; a few cases occurred during January but by the end of January the epidemic was at an end. In all, up to Jan. 1, 1900, for the entire year, 62 cases were reported, and of these 1 only proved fatal. The board feels that the town is to be congratulated, not only upon the mildness of the epidemic, but upon the fact that it has practically come to an end so quickly in contradistinction to the course of most scarlet fever epidemics occurring during the cold season of the year.

The board has continued the practice of having all disinfecting done by an agent of the board, properly instructed in his work. A few cases of recurrences have occurred following the board of health disinfection, but the board feels satisfied that they are much fewer than would have occurred under the old plan of individual disinfection.

Typhoid fever has been seen but three times this year and one of these cases was reported from the Franklin County public hospital, the patient being sent to that institution from a neighboring town. Of the three cases reported one proved fatal.

Haverhill.

Notices have been sent to the owners of all wells shown by analyses to be polluted advising against the further use of these waters for drinking purposes. For a city as large as Haverhill, supplied with surface water, and surrounded with thickly settled suburbs, it is a difficult problem, and an expensive one, to keep its water-sheds free from pollution; but notwithstanding the difficulty, measures should be taken to guard against it, no matter how great the expense.

The board of health and the department of the public schools have, as in previous years, worked in unison through the year in the interest of the school children. In every instance there has been an immediate and hearty response to all requests and suggestions addressed to the superintendent of schools and the teachers, and much of the success that has attended our efforts at the restriction of scarlet fever and diphtheria may be attributed to the faithful enforcement of the statutes and the regulations of the school board. Our notes show that mistakes by some practitioners in the diagnosis of diphtheria and scarlet fever, and the neglect of some parents to have any medical attendance, were the causes of at least two outbreaks in the schools.

Unquestionably, our schools should have some system of medical inspection. The greatest damage is done by children being in school during the infection and development of contagious disease, and by too early return to school after convalescence. There should be a daily inspection of at least all the schools in the city proper by qualified physicians, whose duties should be to trace sources of infection, to examine suspicious cases and to guard a class-room of children when any contagion has developed. This would reduce to a minimum the spread of contagious diseases in our schools.

An appropriation should also be made for chemical and bacteriological work. The number of physicians in the city availing themselves of the facilities provided by the State Board of Health for a bacterial diagnosis in cases of diphtheria has steadily increased. This is in itself the best proof of the usefulness of the method and confidence it has already acquired. But to depend wholly upon the State Board of Health for bacteriological examinations is at best but a half-way, slow and uncertain method. We ought to have a bacteriologist of our own, with the necessary apparatus for his use. All well-regulated cities are provided with such necessities for the carrying on of such work, and we would recommend that your honorable body consider the matter seriously and make provision for the same in the near future.

In conformity with the Acts of 1896, chapter 418, which places all bakeries under the supervision of boards of health, the board caused the usual inspection of them to be made. An examination of the agent's report shows that at the time these inspections were made there were 19 bakeries; of this number but 4 were reported as "clean and in good condition," 12 were reported as "filthy," 3 as "fairly clean," while 2 had filthy water-closets and apartments ventilating into the bake-rooms close to the mixing troughs. In some of the bakeries, the conditions which are described as "filthy" are fully justified by the remainder of his report.

The report of Medical Inspector Morse upon typhoid fever in Haverhill follows: —

JAN. 5, 1899.

The continuance of cases of typhoid fever in Haverhill during the past year to a somewhat greater number than should be expected in a city of that size, but to a less degree in point of numbers than for the two preceding years, has led to a further investigation of the cases with the hope of finding the source of infection. These cases have been collected by the clerk of the board of health of Haverhill. Although the epidemics of 1896 and 1897 pointed to Crystal Lake as the probable source of infection, rather than to any other water supply, still a chemical examination of the water failed to show the presence of the contamination. In addition, a careful consideration of the milk and ice supplies showed no possible means of infection.

During the past year, dating from Dec. 1, 1897, to Dec. 1, 1898, there have been

93 cases of typhoid fever reported to the board of health of Haverhill, being 28 less than in 1897 and 24 less than in 1896, indicating that although the cause of the infection still exists, the virulence of the organism is somewhat impaired or it is resisted more successfully.

During the ten years from 1885 to 1895 there were 470 cases of typhoid fever in Haverhill, being an average of 47 for each year, and taking the population of 1890 as an average, one case to each 583 inhabitants would be obtained. The population for this year is estimated at 36,986 and with the average obtained for these ten years the city would expect 63 cases in place of 93.

Nineteen have occurred in children under fifteen years of age and 74 in those over fifteen years; 54 were males and 39 females, showing that if Crystal Lake is still to be considered as the source of infection, the preponderance of males over females became infected at their work where Crystal Lake water was supplied. There were 9 deaths, a rate of 9.6 per cent.

A careful study has been made of the water supply with reference to this unusual prevalence of illness.

Of the 93 cases in question, 5 were ill when they came to the city and 21 others were in all probability infected from sources outside the public water supply, as follows: —

First. — Thirteen from wells or springs. Of these cases, 5 were supplied from one well from which well cases probably developed last year, as an examination of the water showed much pollution and the cesspool collecting the sewage from the house is only ten feet distant from the well. Four of these 5 cases were residents at the house, while the fifth was the nurse who came to care for them, and she was taken ill a few days after arriving, either from drinking the well water or from direct infection from the patients themselves. Another case was one where the cesspool was only twenty feet from the well from which the patient obtained water; another from a well known to have been infected in 1894, and 2 more cases from another well which was the cause of a case last year, the well being a public one on the street, and an analysis showing much pollution of the water. The remaining 4 cases are from three wells and one spring, not known to have been infected, while the patients themselves claim that these were the only sources of their water supply.

Second. — Eight others comprise those cases which had been out of town for a number of days, and, having returned to Haverhill, were taken ill with the disease within fifteen days of the date of their return.

Of this number 3 were probably infected by visits to Salisbury Beach; another after returning from a vacation of two weeks, which was spent in "camping out;" another was taken ill thirteen days after returning from Natick; another eleven days after coming from Nashua, N. H., where her son was ill with the disease; and the 2 remainder were taken ill thirteen and fifteen days, respectively, after returning from Effingham and Gloucester. Of the five imported cases, 3 were soldiers returning from the south, and the other cases came from Brockton and Chocorua, N. H., ill with the disease.

Deducting these 26 cases of outside infection, *i.e.*, those not to be considered in connection with possible infection from the city water, there remain 67 cases to be accounted for, as compared with 63 which has been shown to be the average number for the city per year. The water supply of Haverhill is derived chiefly from Crystal and Kenoza lakes, a limited portion by Pentucket Lake, and the district of Bradford by Johnson's Pond. Having these variable supplies complicates the tracing of an epidemic of typhoid fever to any one supply, for a man working in one of the factories may have Kenoza Lake water at home and Crystal Lake water at his work, or a person living in Bradford and having Johnson's Pond water there will have Crystal Lake water at his place of business in Haverhill proper.

By an analysis of the various cases, however, it has been observed that 32 cases, or 47 per cent., had access to Crystal Lake water and that supply alone, 6 had only Kenoza Lake water and 3 had Johnson's Pond water alone. Of the remaining 26 cases, 12 had Kenoza at home and Crystal Lake at school or at their place of business, 3 had Johnson's Pond at home and Crystal at the place of occupation, 2 had Pentucket at home and Crystal Lake at their work, 2 had Pentucket and Kenoza together, 2 each had Crystal and a well, Kenoza and a well and Johnson's and a well, while the remaining 1 had access to both Pentucket water and a well.

Grouping these cases together it will be seen that 51 of them, or 76 per cent., had access to Crystal Lake water at one time or another, while only 22 cases, or 32 per cent., had access to Kenoza Lake water at one time or another.

By figures obtained from the Haverhill water board it was found that 3,671 families were supplied from Crystal Lake water, 3,434 from Kenoza Lake, 208 from Pentucket Lake and 955 from Johnson's Pond. These figures, averaged with the population, give approximately 4½ persons in each family, and, therefore, 16,569 inhabitants to Crystal Lake, 15,453 to Kenoza Lake, 936 to Pentucket Lake and 4,297 to Johnson's Pond. It was further seen, however, that all of the shoe and other factories, nearly all of the stores and shops, hotels and saloons, and most of the public buildings were supplied by Crystal Lake water, and some of the inhabitants, although living in the Kenoza Lake district, were exposed to Crystal Lake water at their place of business. On this account all of the cases of typhoid fever occurring and having been exposed to Crystal Lake water for drinking purposes have been grouped together and thus plotted upon the map, while the remainder, *i.e.*, those drinking Kenoza, Pentucket or Johnson's Pond water and that only have been so grouped, the preponderance of cases thus clearly showing some important connection with the drinking of Crystal Lake water. The last analysis of the water shows no unusual amount of contamination, the infection being probably in a very dilute form and only developing under very favorable conditions.

The milk and ice supplies of these cases have also been considered as possible means of infection but a study of the cases fail to implicate any of the dealers.

Concerning the milk dealers, with the exception of three dealers, not one of them supplied more than two cases having typhoid fever where the origin of the disease was unknown, and in many instances the milkman was as variable as the cases themselves. The three men in question supplied six, six and three cases, respectively, but as they each had large milk routes, and no history of the disease appearing in connection with their supply, it was decided that the larger number of cases on their routes were apparently on account of the larger number of people supplied by them.

The ice of Haverhill is gathered from Lake Pentucket and is considered of good quality. If the cases of typhoid fever were due to an infected supply we should expect them more closely connected with a particular supply and occurring in the summer time, and not continuing into the fall of the year, as is the case.

A further analysis of the cases occurring from August, 1895, to Jan. 1, 1897, shows that *at their homes* 79 of the cases were supplied by Crystal Lake water, 54 by Kenoza Lake, and 10 by either Round Pond or Lake Saltonstall. Even in this group of cases the proportion points very suspiciously toward Crystal Lake supply, and if a proportionate number of these cases which derived their home supply from Kenoza Lake and Round Pond, and who at their place of business had Crystal Lake water to drink, is added to the 79 cases in question it becomes almost an assured fact of the source of pollution. The data in regard to these cases from August, 1895, to January, 1897, cannot be obtained, however, and the cases cannot be studied as carefully as these are at the present time.

The five camps upon the shore of Crystal Lake are in much the same condition as stated in the last report, and have been occupied occasionally for pleasure parties during the summertime. Of the persons having typhoid fever, however, none have been known to have gone to the lake at any time, but it is possible that of persons living outside of Haverhill and who have been at the lake one of them may have been ill with the disease. The Haverhill water board have caused notices to be placed at the most frequented localities prohibiting the disposal of garbage and refuse matter upon the shores of the lake. This regulation has been enforced to a certain degree, for two persons have been arrested and fined in court for violation of it. With proper precautions it is apparent that about 20 per cent. of these cases could be prevented. Three of the wells infecting eight persons were known to have been infected and had previously caused cases of typhoid fever, and the sanitary conditions surrounding some of the remainder of the wells where cases developed were in an unhealthful condition. The local board of health should take measures to suppress any further development of the disease from these sources. The evidence still points to some dilute contamination of Crystal Lake water of unknown origin, and as the conditions about the lake are much the same as were present one year ago, it is advisable for the water board to prohibit picnic parties from gathering upon the shores and to keep the watershed in as uninfected a condition as possible.

FRANK L. MORSE, M.D.,
Medical Inspector.

The following communication was sent to the sanitary authorities of the city: —

FEB. 3, 1899.

To the Board of Health of the City of Haverhill.

GENTLEMEN: — The continuance of cases of typhoid fever in Haverhill during the past year has led to a further investigation of the cases, in which this Board has been ably assisted by the clerk of your local board.

During the year commencing Dec. 1, 1897, there were 93 cases of typhoid fever. This number is less than the number of cases in each of the years 1896 and 1897, but is nearly 50 per cent. greater than occurred with the same population in the ten-year period previous to the excessive outbreak of those two years.

Of these 93 cases, 5 were ill when they came to Haverhill and 21 others may have been infected from sources outside the public water supply. Of these latter cases 5 were supplied by water from a well shown by a previous examination to have been polluted. The cesspool in these cases, as also in another case, was within twenty feet of the well, while 3 other cases developed in houses where water was obtained from wells also known to have been polluted.

In addition to these cases 8 others may have become infected from out-of-town sources; for, having been absent from Haverhill for a number of days and returning, they were taken ill with the disease within fifteen days.

Deducting these 26 questionable cases, there are 67 remaining who probably received their infection while in Haverhill. A careful examination of their water supplies, both at home and at place of business, shows that 51 of them, or 76 per cent., had access to Crystal Lake water at one time or another, while under the same conditions only 22 cases, or 32 per cent., had access to Kenoza Lake water. A further inquiry was made into the milk and ice supplies of the patients, but no one supply was suspected of infection.

The present examination confirms the conclusions reached last year, with the addition that a larger percentage of cases may be attributed to the water of Kenoza Lake than at that time, and it so intimately associates several wells which are evidently polluted, situated upon Bateman Street, Eastern Avenue, East Broadway and Ferry Street, Bradford, that the Board recommends that the use of these wells be immediately prevented and repeats its advice of Jan. 21, 1898, as follows: —

"In view of all the circumstances, the Board would advise that it is their judgment that the recent excessive sickness and mortality from typhoid fever have been due to the pollution of the water supply, principally of that from Crystal Lake, and it becomes necessary that all possible sources of pollution within the water-shed of Crystal Lake and of all other sources of public water supply of the city be cut off, and that hereafter all access to the shores of the lakes and ponds from which the supply of any portion of the city is drawn be under the supervision and control of a board having authority if necessary to exclude all persons, and that such measures be taken that the city authorities can feel sure that all danger of contamination from visitors or others has been provided against."

By order of the Board,

S. W. Abbott, M.D.,
Secretary.

Holyoke.

The following is a report of Medical Inspector Morse upon an epidemic of dysentery at Holyoke: —

April 4, 1899.

On March 20, 1899, the State Board of Health received a communication from the water registrar of Holyoke conveying information of the presence of a large number of cases of dysentery in that city, and on the following day an investigation was commenced. Upon interviewing eight of the leading practitioners of that city, it was found that 91 cases of dysentery and 95 cases of diarrhœa had occurred in their practice during the preceding eight days. The cases classed as dysentery were characterized by vomiting, a temperature of 103° to 105°, marked prostration, diarrhœa followed by a bloody mucous discharge, considerable pain and tenesmus, and lasting from three to five days in duration. The cases of diarrhœa were marked by milder symptoms, with some abdominal pain and tenesmus, looseness of the bowels, headache, slight rise in temperature and general feelings of malaise. Many of the later cases were up and about daily and consulted the doctor at his office, while all of the former cases were sick in bed at their homes.

The first cases appeared on the morning of March 13, and during the three following days the greater number of all of the cases appeared. They then gradually disappeared in frequency, and on the 20th and 21st only 7 cases could be located, and those of a much milder character than those appearing in the early part of the epidemic.

The situation of the cases first appearing, with but very few exceptions, was in a definite locality bounded practically by Hampshire, Beech, Appleton and High streets, and as the cases increased in number, those not found in this locality were in its immediate vicinity in wards 2, 4 and 5. Wards 1, 3 and 7 had practically no cases which could be connected with the present epidemic.

Some of the patients were seen personally and inquiry made as to their milk supply, their grocery and provision dealer, the use of canned goods, their private water supply, and other possible common sources of infection, but with negative results. All of the cases recovered and rapidly subsided under proper treatment.

The occurrence of this large number of cases of diarrhœa and dysentery, approximately 200 cases, among a well-to-do class of people, living under proper hygienic conditions, with apparently no common source of infection with the exception of the public water supply is, indeed, somewhat confusing, but when it is observed that the locality in which these people lived is probably one of the first, if not the first, supplied by water from the Wright and Ashley reservoir, perhaps the origin of the cases may be understood.

The water supply of the city is derived from two sources, the Wright and Ashley reservoir supplying approximately two and three-fourths millions gallons daily, and the Whiting Street reservoir supplying about three-fourths of a million gallons daily, the pipes of each of which intersect the other and therefore each being capable, at times, of supplying the whole city. If the source of infection were the Whiting Street reservoir water we would expect that Ward 7 would contain the first and the larger number of cases, when, in fact, it contains few or none; while on the other hand, the inhabitants of the city first supplied by the Wright and Ashley reservoir water were the ones first attacked, and the later cases developing (which were also milder in character) were located in the districts, probably supplied from the same source but further from its centre.

The chemical analysis of the water from this reservoir throws no light upon the cause of the sickness, but there were present in the water Synura and Uroglena, with a characteristic cucumber odor present. The presence of these organisms is not conclusive as to the origin of the sickness, but more of a coincidence, for they are known to exist in other supplies without producing an epidemic, and they are even now present in this supply after the cases have all recovered and no new ones developed.

Hudson.

It should be possible to ascertain from a well-organized board of health the number and causes of the deaths which have occurred in any given house or section of the town, the kinds of the diseases that have prevailed in it, and the character and location of its drainage and sewer connections. Such records would be valuable, not only in investigating the outbreak of a disease, but to one proposing to buy or rent a house it would be more important than a record of title. The healthfulness of a house should be judged in part from this history of the diseases and deaths that have occurred in it and in part from a careful examination of its premises and drainage; also its fresh-air supply. The numbering of houses is a great aid to such a record, and it is hoped that all the physicians — as most do already — will kindly assist in perfecting the record by giving the number of the house in making out their certificates of deaths and contagious diseases.

Hyde Park.

The question of garbage collection has been brought to our attention several times during the past year in connection with numerous complaints in regard to the general custom prevailing in the town of dumping refuse matter in any convenient place or places that may be found about the town. There are probably twenty or more such places in and about the town, and as the matter usually dumped on them is not such as to create noisome odors by decaying, there is no present remedy if the owners of the land desire to use the same as a dump. However, if suitable provisions were made for the collection of house and store dirt, ashes, etc., and a dump properly cared for or the waste matter destroyed, the town would present a much cleaner appearance.

The method of quarantine in contagious cases has been the same as in former years, and the disinfection and fumigation by formaldehyde gas has been continued by the board with very gratifying results.

During the summer we had cause to investigate several cases of typhoid fever that seemed to show common cause or causes for infection. It was found that the trouble could be attributed almost wholly to the milk supply in the families. The milkmen were instructed as to the proper methods for the care of their product, and since then there have been no cases that could be traced to that source.

Leominster.

This board feels that at last one source of danger to the health of this town has been removed. Monoosnock Brook, which runs directly through the centre of the town and which for years has been a sewer into which the sewerage of many factories, houses and stores lining its banks has emptied itself, has at last been freed from this condition of things and rendered as pure as it is possible to make it. The shops and factories which line its banks have all been compelled to withdraw their sewerage from it and empty into sewers which have been put in for this purpose. The same applies to the houses which formerly made the same use of this brook.

Cases of contagious diseases reported have received the same attention as in previous years, the houses quarantined or placarded as the case required, and proper fumigation resorted to afterwards. The board, recognizing the fact that formaldehyde gas is at the present time considered to be the proper destroyer of germs and bacilli, and that it is used to-day by nearly all the larger cities and towns in fumigating, to the exclusion of all other methods, has this past year purchased a formaldehyde generator, which is used in all cases requiring fumigation, as after cases of diphtheria and scarlatina.

This board would suggest that every family in which there is a case with a sore throat, or with any eruption or redness of the skin whatever, should immediately call in some physician and ascertain what the nature of the trouble may be. If it be a simple case, no harm is done by so doing, while on the other hand there may be the danger that either diphtheria or scarlet fever may be present. Families are sometimes too apt to let these cases go and allow them to mingle with others until the nature of the disease becomes apparent to every one. In such cases it is impossible to estimate the damage done, or the number who have been needlessly exposed. There has been one, and we are quite sure more, cases the past year which have thus been allowed to go on and no physician called. These cases are, in our minds, in a measure responsible for a larger number of cases reported than should be. With care on the part of families in this direction the contagious diseases should diminish in numbers and much unnecessary sickness and some deaths perhaps prevented. It might be well were there a penalty imposed for being careless in this direction.

This board would also suggest that the physician who has been called to attend the case be notified when the three weeks have elapsed in cases of scarlet fever, in order that he may send in a recovery card, with which he is supplied by the board of health, so that the board may know when it is possible to fumigate the premises. Cases which go on peeling for a longer period should wait until they have apparently finished, and then call in the physician for the proper examination. No case of either diphtheria or scarlet fever is fumigated until the attending physician sends in the recovery card.

Lexington.

Until otherwise ordered, all persons are prohibited from driving, or causing to be driven, any diseased cattle within the limits or upon any of the streets of the town of Lexington from other towns or cities, under penalty of arrest.

The board of health hereby adjudges that the exercise of the trade or employment of keeping swine within the limits of the town is a nuisance, and hurtful to the inhabitants thereof and dangerous to the public health. No person, firm or corporation shall engage in, or exercise within the limits of the town of Lexington, the trade or employment of keeping swine without having first obtained a permit thereof in writing from the board of health, and such permit may be revoked at any time by said board.

The board of health hereby adjudges that the exercise of the trade or employment of slaughtering cattle, swine, sheep or other animals, or conducting a melting or rendering establishment, is a nuisance, and hurtful to the inhabitants of the town and dangerous to the public health. No person, firm or corporation shall engage in, or exercise within the limits of the town of Lexington, the trade or employment of slaughtering cattle, swine, sheep or other animals, or of conducting a melting or rendering establishment; but this regulation shall not apply to any person, firm or corporation who may be engaged in such business or employment within the limits of the town of Lexington at the date of the adoption hereof.

Lincoln.

Early in the year a report reached the board that certain parties contemplated the establishment of extensive slaughtering houses in the south part of the town of Lincoln, and that they had bonded lands for that purpose; the experience of the past, as well as the fact that the parties had been urged to leave their former location because of the offensive character of the business, led this board to take active measures against this innovation. A meeting of the citizens of the town was called to consider the proposition, which was promptly vetoed by a large majority of the voters present. The slaughter-house that has stood in the south part of the town for several years was within the line of the water-shed of the Cambridge water works, and was so conducted as to induce the Cambridge authorities to purchase and destroy the same. Later, petitions from two different parties in the north part of Lincoln were presented to the board of selectmen, praying for licenses to conduct slaughter-houses in that part of the town. Both parties were refused, as being inconsistent with the higher interests of the town, as well as the rules established by the board of health.

Lowell.

In order to escape from the constant embrace of death, five long years and large expenditures of money have been made in experimenting with a driven-well supply of water that would supplant the necessity of allowing the fatal poison contained in the Merrimack River from being distributed in our mains as a drinking supply to our citizens, and we have looked forward with the hope that the yearly visitations of suffering and disease might be prevented and controlled by the substitution of some other source of water supply.

The exhibit for the year, in relation to typhoid fever, is extremely gratifying to the department, as the mortality is the smallest since 1865, thirty-five years.

Deaths from Small-pox since 1837.

1837,	7	1860,	1
1840,	1	1861,	1
1841,	2	1862,	1
1846,	4	1864,	2
1847,	1	1865,	3
1848,	17	1866,	18
1849,	41	1870,	3
1850,	4	1871,	178
1852,	1	1872,	1
1853,	2	1873,	1
1854,	18	1877,	5
1855,	20	1880,	1
1856,	1	1894,	3
1859,	12	1899,	1

Cost of Small-pox, 1871-1899.

	Cases Reported.	Deaths.	Cost.
1871,	–	178	$22,794 27
1877,	–	5	6,246 88
1885,	4	–	1,603 54
1894,	8	3	7,850 86
1899,	2	1	1,038 52

Garbage and Market Refuse burned at Cremator Jan. 1 to Dec. 31, 1899.

Tons swill,	105	Mattresses,	367
Tons market refuse,	485	Pigs,	17
Dogs,	205	Loads bedding,	6
Cats,	320	Calf,	1
Bags rags,	237	Carpets,	3

The swill from the hospitals (105 tons), the market refuse from meat and fish markets (435 tons), with the miscellaneous articles enumerated in the above table, have been burned at the cremator, thereby preventing the foul odors that would surely have been a source of complaint and danger to those living near the various dumps used by the department for the waste material of the city, if the amount burned had been thrown on them during the year.

If no other use is made of the cremator than to take care of such refuse, it will more than compensate for the cost of disposal. The cremator has been in commission nine years, and with a small outlay for repairs, with the work it is now called upon to perform, it ought to last as many more years.

LUDLOW.

The following is the report of Medical Inspector Morse upon typhoid fever at Ludlow: —

OCTOBER, 1899.

On September 25 the chairman of the board of health of Ludlow came to this office with the report that a large number of cases of typhoid fever had existed there throughout the summer, and that it was still quite prevalent. It was his opinion that the public water supply, which is the same as that supplied to the city of Springfield, might be the cause of the sickness, and he requested an investigation as to the origin of the epidemic. I immediately went to Ludlow for that purpose, and found 50 cases of the disease which had occurred since July 8; none of these had been reported to this Board and only a very few to the local board, as required by the laws of the State. Thus there was nothing authentic to start with, and it was necessary to interview the doctors of the town and also those living at Indian Orchard to get reliable information in regard to the cases. This was given frequently from memory, and, therefore, at the beginning a certain handicap was attached to the study of the cases.

Such a list having been prepared, visits were made to the houses where cases existed, and as such houses were investigated, other cases were found ill with the disease, or information was obtained of cases existing in other houses. On account of the character and nationality of most of the patients — they being for the most part Poles — it was necessary to have an interpreter, and an intelligent young man was obtained from the mill who did his work quite satisfactorily, in view of the difficulties present.

The disease was confined principally to the tenement-houses on Joy Street, a large house on North Street near the railroad track, and across the Chicopee River at Indian Orchard. The cases existing at the house on North Street were 7 in number, extending over a period of time from July 8, when probably the original case appeared. Several families live in this house, aggregating about 100 people, most of whom work in the mills. It is stated that 18 were seen sleeping in one room at night. The house is supplied with the city water and the milk is from one man, who supplies most of the Polish families in the village. The privies are back of the house, about 40 feet distant, and are most offensive, both regarding odor and sight, and a foul smelling stream could be seen sluggishly running from underneath them. There was also evidence that the tenants had not on every occasion used the privies.

On Joy Street, six houses had cases of typhoid fever in them, in numbers of from 1 to 6. The conditions existing here were of much the same nature as at the North Street house, and with two exceptions were owned by the same man. It was further learned that these people had formerly lived in tenements owned by the mill people, but on account of their filthy habits had been ordered to move and had sought refuge in these tenements. The facilities for taking care of the patients were of the meanest kind, many, I believe, had no medical attendance during their illness, and most, if not all of them, little or no nursing, being obliged to wait upon themselves usually; and I saw many of the sick ones with their clothes on and lying on the bed or lounge. The sanitary conditions existing at these houses, together with the lack of any precautions whatsoever, seemed to me sufficient to propagate the disease for an indefinite time, and I so informed the chairman of the local board of health.

Another locality where cases had developed was across the river at Indian Orchard. Three houses were involved here, with a total of 8 cases. The families here were of a somewhat better class and their houses, although much the same in general appearance, were more tidily kept. On account of not having the public water supply, the tenants are obliged to use well water, which apparently had been used since the time of the first inhabitant. Two of these houses had wells from which the water was obtained by means of a bucket and rope, and samples from them showed the foulest pollution; one, in fact, showing that it had been polluted to an extent twice as great as crude Natick sewage, but had subsequently purified itself somewhat by its passage through the ground. Another well was midway between the back of the house and privy, hardly ten feet from either, and a sample taken also showed much pollution.

On account of many of the patients working at the mills, a visit was made to them and their condition studied. The drinking water was taken from two driven wells situated in the mill yards. One was found of questionable purity, but not sufficiently polluted to warrant it being condemned. The well existing at Mill No. 5 was much polluted and should not be used for drinking purposes. Another driven well, at Mill No. 4, also showed pollution, but had long ago been abandoned, although water could be pumped from it.

The mills, with the exception of the machine shop, have both Springfield water and Chicopee River water running in pipes throughout the buildings, and either is available for drinking purposes. The Springfield water is used in the fire sprinklers and in the hydrants, the river water in the sanitaries, and for washing and manufacturing purposes the pipes connecting one with the other; but a valve is so placed as to shut off either supply, and usually no Springfield water is used except for fire purposes, thus leaving the river water in the pipes where it is available although not customarily used for drinking purposes. There is also a pump at the mills which can be used in times of fire to pump river water into the street mains about the town; in fact, to supplement the Springfield water should such an occasion be necessary. Last October, about a year ago, such a test was made for fifteen minutes, and the river water got into the service pipes of the town, but it is alleged that when the pumps stopped the river water would, by gravity, flow back to the river and be replaced by the Springfield water, which seems to be perfectly possible. On June 6 of this year another fire test was made. The pump was run fifteen minutes, but the valve was closed so that no river water could get into the service pipes.

In view of these facts it seems possible that river water can at any time be introduced for drinking purposes, and therefore the inhabitants of the town are at the mercy of the mill owners. Such a condition ought certainly to be remedied.

Samples of water from other springs and wells which were used publicly for drinking purposes were taken and analyzed, and where they were found polluted the local board of health were advised to close them.

In view of these facts it seems probable that most of the cases of typhoid fever existing at Ludlow were caused by the poor sanitary conditions existing at such houses where cases of the disease were present rather than to any specific infection of the milk or water, and in a communication dated October 6 the board of health of Ludlow were advised to remedy these existing conditions by compelling such houses to connect with the sewers. This has been partially accomplished at the present time, and with more satisfactory sanitary arrangements only four new cases have developed in the Joy Street district during the month.

F. L. Morse, M.D.,
Medical Inspector.

Boston, Oct. 6, 1899.

Chairman Board of Health, Ludlow, Mass.

Dear Sir: — In connection with the investigation of the cases of typhoid fever recently occurring in your town, several samples of water were collected from wells and springs which people of the town were known to have used for drinking purposes. The analysis of these samples shows some of doubtful purity and others which ought not to be used under any conditions. The wells supplying the houses where Mrs. M——— and Mrs. McH——— lived are most foully polluted and should be immediately abolished. As there are also other wells in the same neighborhood, samples should be taken to determine their purity.

Well at Ludlow Mill No. 2 is of questionable purity, although not sufficiently polluted to warrant its being condemned at the present time.

Well at Mill No. 4 is very much polluted and should be abolished.

Well at P's and S's house much polluted and should be abolished.

Well at Mill No. 5 much polluted and should be abolished.

Well on Whitney Street is probably safe to use for drinking purposes.

Well at Poor House is of doubtful purity and another analysis should be made later.

Spring near railroad track much polluted and should be abolished.

From a further study of the cases it is evident that the patients were not all exposed to a common origin, but that the later cases developed by infection from those first having the disease, and the conditions existing at most of the houses are consistent with this theory.

In view of these facts your board should confer with the agent of the mills, and those wells under their control and showing pollution be immediately closed. The conditions about the houses where cases have occurred, particularly on Joy Street, should be immediately remedied by proper sewer connections.

Respectfully,

F. L. Morse, M.D.,
Medical Inspector.

Malden.

During the year the city has enjoyed full immunity from epidemic of any and every character, notwithstanding contiguous territory was less fortunate. During October the attention of the board was called to an instance of infection by small-pox of a child, resident of a neighboring city, but attending a private school within our borders. The board's action was the prompt closing and disinfection of the school and vaccination of the attending pupils.

At the suggestion of the board, the school committee proceeded to ascertain how many of the pupils of our public schools had been duly vaccinated, disclosing the fact that 28 per cent. were without this protection. As a matter of precaution, free vaccination was established, and 1,331 availed themselves of this privilege.

To the physicians of the city the board has freely furnished culture tubes for the determining of diphtheria, and antitoxin for its subsequent treatment where not within the means of the patient to provide it, and we express our gratitude for hearty co-operation. By order of the board, it is now compulsory in all cases of diphtheria for the physician in charge to secure a negative culture before quarantine restrictions can be removed from the patient and premises.

For several years past the board of health in its annual reports has called the attention of the city government to the urgent need of a contagious hospital. During the year several instances have been brought to the attention of the board of contagious diseases occurring among the servants of families, boarders in boarding-houses and transient visitors to the city, causing great inconvenience, suffering and financial loss to some of our citizens, where the prompt removal of the cases to a proper hospital would have avoided such loss and inconvenience, at the same time diminishing the chances of the spread of the contagion through the city.

Milford.

The board made a thorough work of visiting every school and examination of every scholar. Over one thousand were vaccinated and the results were very satisfactory.

Milton.

The annual tour of the piggeries was made in June, and all but two were found in excellent condition. Permits were granted to eight persons to keep 245 pigs. But a single complaint was made against a piggery during the entire year. There is now very little swill carted into the town from Boston, and the number of pigs kept here is diminishing every year.

We have been fortunate in escaping severe epidemics of the preventable diseases, but the number of cases must certainly increase, and we are liable to have serious trouble in the more thickly settled portions of the town unless there is adequate provision made for the disposal of sewage. We would also urge all property holders, on streets where sewers have already been constructed, to connect their plumbing with the sewer as soon as possible.

New Bedford.

The death-rate of children in this city under one year of age has been excessive the past year. From an investigation as to the cause we are led to believe, inasmuch as the greater percentage of such deaths have been in families where the heads are employed in mills, that the little ones are not properly nurtured. Cow's milk has been the principal food and while the board has succeeded in a measure in bettering the condition of cow stables maintained in the city, yet we are unable to reach many deliveries of the product which come from out of town.

We believe that the inspector of milk should license only such producers and dealers as are acceptable to the board, and that legislative action should be taken to more fully control this food supply.

Last year in our annual report we called attention to the need of a contagious disease hospital. At the time it will be remembered we did not urge the building of an elaborate structure, but the occupancy of a suitable place for the isolation of such cases of scarlet fever and diphtheria as cannot be treated in the families where discovered. During the year just ended we had two emphatic illustrations of the wisdom of maintaining such a hospital. In one case scarlet fever was discovered in a family occupying a public building in the centre of the city, a building in which hundreds enter every day of the year, and had it not been for the kindness of the relatives of the patient, this building would of necessity have been closed to the public, which would have caused great inconvenience.

The use of the culture in assisting in the diagnosis of diphtheria we are pleased to say increased during the year, and is now very general throughout the city, although a few physicians decline to make use of this recognized method. There were taken last year 186 cultures.

During the past year there have been 513 vaccinations, of which number 101 were revaccinations.

Newton.

During the summer there was a large number of cases of dysentery, which caused some alarm in certain sections of the city. As no reports of this disease are required by the board, it is impossible to state how many cases occurred, but the existence of the disease was recognized by the board and steps taken to prevent its spread. The greater number of cases occurred in the southern part of the city, and in one locality where a number of cases occurred a very unsatisfactory condition was found. Steps were at once taken to improve the sanitary condition of this locality, and changes were ordered to be made in some of the houses, while others, whose condition was such as to preclude all hope of improvement, were ordered vacated.

A new departure in the method of taking cultures for diagnosis in diphtheria was inaugurated in November, swabs being substituted for the wire loop. This is a step looking towards a more rapid diagnosis, always most valuable in cases of suspected diphtheria. By the use of swabs, a positive diagnosis can be made in a few moments after the culture is received at the laboratory. This is a gain of twelve hours over the old method in cases where the disease is present. If the examination of the swab proves negative, it is necessary to wait the usual time, *i.e.*, twelve hours, in order to make sure that the disease is not present.

The total number of cases sent to the hospital by order of the board was 142, divided as follows: diphtheria, 102; scarlet fever, 28; measles, 12.

During the epidemic of diphtheria in the latter part of the year the hospital was of the greatest possible value in combating the disease. One hundred and two cases, or 55+ per cent. of the total number reported, were removed to the contagious wards, which were several times taxed to their fullest capacity. There can be no doubt of the very great value of these wards to the board in the handling of an outbreak of infectious disease.

The board believes that Newton sends a larger percentage of her infectious cases to the hospital for treatment with less difficulty than any other city in the Commonwealth. This is due in great measure to the hearty co-operation of the physicians, who have always most heartily seconded the efforts of the board in removing patients to the hospital.

It was necessary on several occasions to use all of the apparatus at one time for disinfecting a large school-house, and when this was the case, disinfection of private dwellings was unavoidably delayed. Should it be necessary to disinfect the school-houses often, the board would recommend the purchase by the city of one of the larger and more expensive forms of generator, which delivers a large quantity of gas in a comparatively short time. This could be kept exclusively for use in the schools if thought best, and would allow the smaller generators to be used in private houses. It would also prevent the unavoidable delay which occurred several times during the year. It is only fair to a family which has been held in quarantine for several weeks to disinfect and discharge them from quarantine at the earliest possible moment, and to be compelled to keep them shut up for twenty-four hours or longer after they could be released causes unfavorable comment, and makes others less willing to submit to the requirements of the board. It is true that persons must submit whether they wish it or not, but the less obnoxious the rules are made, the more quietly the public will submit to them, and they will soon learn that the rules are not made especially to discommode them but for their own protection and that of their families and friends. When the public once learns this fact, the work of the board will be much easier and people will assist it in its work instead of looking upon it as an evil, as is now too often the case.

The low death-rate for the year is undoubtedly due in great measure to the prompt use of antitoxin. The board has distributed 305 bottles of antitoxin to the physicians of the city and to the hospital, all of which was furnished by the State Board of Health.

Bacteriological Examinations.

	Primary Examinations.		Secondary Examinations.
Positive,	118	Positive,	85
Negative,	152	Negative,	127

The board has continued in its established policy of requiring all houses on the line of a common sewer to become connected with it. Its work in this direction has been more general than heretofore, and instead of confining its consideration to any particular section, an effort has been made to complete the work heretofore begun in various parts of the city.

The milk farms have been inspected each month by the agent, and a report of their condition made to the board. An effort has been made to improve the sanitary condition of the cow barns and their surroundings on these farms. For the most part the proprietors have been prompt to carry out the orders and suggestions of the board. Absolute cleanliness has been insisted upon, and improved methods of caring for the drainage of the stables have been adopted in several instances at the suggestion of the board.

The report of Medical Inspector Morse is as follows: —

Aug. 2, 1899.

About ten days ago information was received at this office that an unusual number of cases of dysentery had occurred at Newton Centre, and an inquiry was made among the local doctors in order to see if there was any common origin.

All of the cases seemed to have occurred in the three weeks preceding the report, and as the cases were investigated they were apparently limited to two localities, viz.: (1) a district known as Cork City, and (2) a limited number of cases residing along the Boulevard in Newton Centre. No other suburb of Newton was affected.

One physician had reported 15 cases of both diarrhœa and dysentery, mostly among children, and in his opinion the cases could be attributable to something which had been eaten, but not of common origin. There were no deaths among his cases.

A second physician had 8 cases, with one death, a child.

A third had 8 cases in Cork City and one in the Boulevard district.

A fourth had 6 cases in the Boulevard district.

A fifth had 13 cases, with 3 deaths, all children. Five of the 13 were in Cork City and the remainder near the Boulevard.

Cork City is a district of Newton Centre in the rear of the power station of the street railway company, comprising a small number of houses. Back of these houses is a small brook, the water of which is used by some of the inhabitants to wash both dishes and clothes. The conditions about the houses were also unsanitary, and in view of the present number of cases of the disease existing here, the board of health took measures to have them improved.

The Boulevard district comprises a number of well-built houses occupied by people living under good sanitary conditions.

The specific cause of these cases could not be definitely located, few or none of them having the same milk supply, or in fact anything in common which many other people did not also have. The ice is supplied by the Crystal Lake Ice Company to all of the inhabitants of Newton Centre, but the cases of the disease arising were limited to two definite districts.

The water is supplied to the whole city of Newton; and in regard to the milk, although the Elm Hill farm supplies more people than any other one dealer, still, all of those who were affected did not have this supply.

In view of the fact that a majority of the cases occurred among children, and of the fatal cases all of them were children, it is reasonable to infer that possibly these cases were cholera infantum of a severe type, while among the adults some predisposing cause existed which was aggravated by some injudicious article of diet.

F. L. Morse, M.D.,
Medical Inspector.

North Adams.

All the bakeries in the city have been inspected, and a continued improvement in regard to sanitary condition has been insisted on and effected. The same report will apply to meat and fish markets.

All the stables in the city in which more than four horses are kept have been inspected and, so far as practicable, the changes and improvements required by the stable ordinance have been effected.

The stables of all dealers selling milk or milk products in the city have been inspected, as required by the milk ordinance. The dealers have practically complied with the requirements of the same, and the board believes this has materially reduced infantile diseases and disorders. There were 76 stables inspected and the reports and orders for changes and improvements filed with the city clerk, as required by the ordinance.

Northampton.

The number of cases of infectious disease has been less than the average, and the deaths resulting therefrom have been few. An epidemic of typhoid fever occurred at the Northampton Insane Hospital, beginning early in September and continuing into November. In all there were reported from the hospital 63 cases, and the number of deaths resulting from the epidemic, including those who died after being removed to their homes or elsewhere, was 5. The cause of the outbreak was thought to be celery from a bed that may have been fertilized with compost containing the germs of the disease.

The report of Medical Inspector Morse follows: —

October, 1899.

On Sept. 27, 1899, I received information of the presence of an epidemic of typhoid fever at the Northampton Insane Hospital, and at once commenced an investigation as to the origin of the disease.

Previous to September 10 of this year there had been only two characteristic cases of typhoid fever and 2 other suspicious ones at the hospital in the past ten years. On Feb. 3, 1889, a suspicious case appeared (a definite diagnosis of the disease was never made) and no further results occurred from the sickness. During October, 1898, one of the assistant physicians at the hospital, a few days after returning from his vacation began to have the prodromal symptoms of the disease. They were not thought of in their true light, however, and his dejections went undisinfected into the sewage and continued to do so during the larger part of his illness.

The next case, a suspicious one, appeared in March, 1899. A positive diagnosis was never made and the dejections went untreated into the sewage. The fourth case was another assistant physician, who was taken ill on April 1, and probably received his infection by working over culture tubes upon which the typhoid bacilli were being cultivated. His sickness was recognized early and he was removed to the city hospital for treatment, where he remained during the rest of his illness.

The sewerage system deserves special mention, for it was probably by this means that the disease was developed. The sewage for the whole hospital is conveyed through a large iron pipe several hundred yards from the hospital and deposited upon one of two filter-beds which are side by side. While one is being used the other is drained and subsequently cleaned. The sewage last fall and winter went on to bed which may be called No. 1, and consequently contained the discharges of one, and perhaps two, typhoid fever patients in an undisinfected condition. The liquid portion of the sewage drains off into an adjoining brook and subsequently into Mill River, while the solid part remains upon the filter-bed itself. During the latter part of the winter the current of sewage was turned from bed No. 1 to bed No. 2, and the former bed allowed to drain off entirely. Still later the bed was scraped and the contents spread upon the adjoining grass ground and the celery bed.

About September 10 the cases commenced to appear to an alarming degree, and in five days 15 cases had been reported. During the following five days 10 cases appeared, in the next five days 14 cases, and in the next five days 12 cases. By this time, suspicion having become attached to the celery as the cause of the disease, orders were issued to prevent its further use, and some which had already been gathered was locked up in the store-house. Synchronously with the stopping of the use of the celery the cases diminished in number, and during the first ten days of October only 4 cases were reported.

A systematic study was made of all of the cases and it was found that patients, nurses, farm help and kitchen help were affected with the disease, but in regard to the patients all (with but four exceptions) were of a certain definite class In explanation of this statement it should be said that in this hospital, as is customary with many others, two classes of patients are received, paying and non-paying. In the main, all receive much the same class of food and treatment, but in addition the paying class receive certain articles of food which, although not necessary for their subsistence, are supplied to them rather as extra articles of diet. All patients throughout the hospital have the same milk, water, etc., and their food is all handled by the same help in the kitchen, and necessarily what would infect the paying class of patients would also infect the non-paying class; but when the cases were more carefully analyzed it was found that the paying class, together with the help, were affected with the disease, and, with but the four exceptions mentioned above, no cases had appeared among the non-paying class (who, however, exceeded twice in numbers the former class), so necessarily the question resolved itself into what article of food had the paying class used which could cause the development of this unusual number of cases.

The different articles of food constituting the extra articles of diet were, for the most part, fruits and vegetables raised on the farm, but either from the time that they were used or from the manner in which they were prepared all were eliminated as to their being a factor in the cause of the disease with but one exception. This exception was the celery, and from further developments it was finally decided upon as the cause of the disease.

It will be remembered that when the filter-bed No. 1 was cleaned last winter it was stated that the solid portions were taken to fertilize the grass ground and celery bed, and that these solid portions did contain the undisinfected stools of a typhoid fever patient. On account of the method used in cultivating celery by banking the stalk of the plant with earth, it appears to be a very favorable medium for the transmission of the disease, particularly if it is not most carefully cleaned. The use of celery on the table was commenced during the month of August, and particularly in the latter part of the month was quite a common article of diet among the paying class of patients, and it was also served to the nurses and farm help, and consequently was accessible to the kitchen help who prepared it.

At this hospital some of the non-paying patients are employed about the building in the serving-room, dining-room, etc., and these patients had access to the celery and are consequently included among the other class.

Of the four exceptions noted above, all were taken ill on the 27th of September and had been attended by nurses who were ill with the disease, thus probably receiving the disease directly from them. It is a significant fact, and perhaps somewhat of a confirmatory nature, that one of the farm hands, probably not realizing the danger of using the celery even after instructions had been issued to that effect, did eat some and in eight days was taken ill with the disease.

The water at the hospital is for the most part obtained from a spring situated on the farm. It is pumped continuously to a tank in the top of the building and thence distributed over the hospital. At times during the day when the consumption is large the supply from the spring is not sufficient and then it is supplemented by the city supply, but only to such an extent as to make up the deficiency. The examination of the spring water shows evidence of pollution and, together with the sewage disposal, is being considered at the present time.

F. L. Morse, M.D.,
Medical Inspector.

Northfield.

The report of Medical Inspector Morse is as follows upon a limited epidemic of typhoid fever at Northfield: —

October, 1899.

In the latter part of September, 1899, I received information in regard to several cases of typhoid fever at Northfield, supposed to be in some way connected with the water supplied to the seminary in that town, and on September 29 I commenced an investigation of the cases. On my arrival there I found that 5 cases existed. The first one, a girl of nineteen years of age, was taken ill on August 10. She had attended school here during the preceding year, and during the latter part of June and the first of July went away to Mount Hermon for two weeks' vacation. After returning, she had not been out of the village at any time, and was employed at the school in doing work about the buildings. Just in what way she received her infection it is impossible to say, hers being the only case which has developed on the seminary grounds.

On September 8, A. B., a boy five years of age and living on the opposite side of the street from the grounds, was taken ill. The house was rather old-fashioned in appearance, the well supplying the house with water being directly under the sink and kitchen floor. The sink water was carried by means of an earthen pipe a distance of about ten feet from the well and then allowed to soak into the ground. A sample of water was taken from the well and showed much pollution. A few days previous to the boy's illness, however, on account of the unpleasant odor and taste of the water it was discontinued, and water was obtained from the house on the other side of the street, which was furnished with the seminary supply. The drain pipe in the meantime had been dug up, and on examination was found to be filled nearly entirely with grease, accumulating for years from the sink-drain water.

On September 10, two days later, and on September 15, 2 other cases developed in the house adjoining. These 2 cases were children thirteen and nine years old, respectively, who had been down to Mr. B.'s house repeatedly, drank of the water of the polluted well and played with his boy. The well supplying their house with water was located under the piazza, and a sample taken showed evidence of pollution, but to a less degree than the first well.

On September 21, the fifth case appeared, and was a younger child of the second family. This child was known to have used the same chamber vessel as his older sister, and probably received the infection directly from her.

On account of the fact that one of the cases (the first one) had appeared on the seminary grounds, and that Mr. B. had used seminary water for a few days preceding his boy's illness, a visit was made to their water supply and the following conditions found: —

The original supply is obtained from a natural spring about one-quarter of a mile from the grounds on a small knoll. At times the quantity of water from this spring alone is sufficient for the needs of the seminary, but about five years ago, during a dry summer and at a time when a large number of people were at the grounds, it became insufficient and was supplemented by the water from a near-by brook. In about two weeks nearly 30 cases of typhoid fever developed among the users of the water, and on further investigation the brook was found to have been polluted higher up in its course by a patient probably having typhoid fever. It still being necessary to have an additional supply, two dams were constructed on the course of the brook for the purpose of settling the water, and before it was mixed with the natural spring water it passed, not intermittently, however, through about five feet of sand and gravel and collected in a small reservoir from which it was subsequently mixed with the natural spring water. Samples of water were taken from the spring and also from the reservoir containing the filtered water. The former showed a water of good quality; the latter showed some pollution. The manager of the school was notified of these facts, and the water supply is being further investigated at the present time.

Although these facts in regard to the seminary supply exist, I do not think the water was the cause of the disease, but rather that it was produced by drinking water from a polluted well at Mr. B.'s.

F. L. Morse, M.D.,
Medical Inspector.

Plymouth.

As the present board of health entered upon its duties without a single member who had previously served the town in that capacity it was somewhat hampered at first, but a working knowledge of methods and its own powers came with experience.

As is customary, the rules and regulations adopted by the board were published in the local newspapers and posted in a number of places in town.

During the year there have been thirty-two complaints of nuisances made, and nearly all of them have been personally investigated by members of the board. In some of the cases, as the conditions complained of did not menace the public health in any way, no action was taken. In fifteen cases owners were ordered to connect their houses with the sewer, and all of them complied. Among the more serious complaints was that of a house on the Sandwich road, owned by the Plymouth Woolen and Cotton Company. The place was deemed unfit for habitation and ordered vacated. The house has been torn down. Complaint was made that the water of Brewster Spring was unfit for drinking purposes. The State Board of Health was requested to investigate and report on the matter. One of its engineers visited the spring, and as a result of his investigation the State Board sent a letter of advice, dated July 7, 1899. (A copy of this letter may be found on page 37.)

The board needs better accommodations. Besides a place where its books and papers may be kept and its business transacted, there should be facilities for making simple tests of water or other matter which may be under suspicion.

Complaints are frequently made which involve a question as to whether water appearing upon certain premises is derived from springs or from a cesspool, privy, sewer or other unwholesome source. A few laboratory conveniences would place the board in a position to decide the matter quickly and scientifically, without delay or expense. Perhaps the greatest present need of the board is the hearty co-operation and support of the community. Although invested with certain power and authority, its success depends upon the willingness of the people of the community both to report unwholesome conditions and to act promptly and conscientiously when notified.

Quincy.

It is the opinion of the board and those members of the school committee with whom we have talked that some provision should hereafter be made so that a system of medical supervision of the school children could be carried out more extensively in the future than has been done in the past. Parents do not exercise sufficient care in keeping their children out of school when they show any symptoms of a contagious or infectious disease that is prevalent in their neighborhood.

Revere.

The number of infectious diseases reported shows a marked increase over last year. The cases fortunately have been scattered, and no connection was apparent between any two households affected, showing the usefulness of thorough disinfection.

A severe epidemic of small-pox visited Chelsea during the year, and we entertained grave fears for Revere, which led us to offer free vaccination, which was availed of by between seven and eight hundred persons.

Salem.

About 864½ cords of swill have been collected. This is an increase of 285½ loads more than last year.

There have been 11,534 loads of ashes and rubbish collected, an increase of 1,623 more than last year.

Inspection of milk is becoming more important each year, and some measures should be taken not only to have more than a perfunctory inspection, as exists at present, but the sources of supply should be known and carefully watched. The office of inspector of milk should be under the supervision of this board, conducted in an up-to-date manner, and rigidly enforced. This matter is of great importance, and will well repay the city to consider a change from present methods.

Shirley.

The report of the medical inspector is as follows: —

Dec. 29, 1899.

On December 6 a letter was received from the chairman of selectmen of Shirley containing the information that a large number of cases of scarlet fever and a few of diphtheria existed in that town, and as complaints had been made to that board about the river which flows through that village being the cause of the disease, he desired an investigation made.

I accordingly went to Shirley the following day and found that since the 3d of September 19 cases of scarlet fever had appeared, with one death, and since November 8 6 cases of diphtheria, with one death. The cases were plotted upon a map of the town, and visits were made for the purpose of carrying on the study of the cases.

The first case of scarlet fever appeared on September 3, in a girl six years of age, living about one-half mile from the middle of the village. She with her mother and another child had been to Hollis, N. H., during the last part of August on a visit, and returning she was taken ill with the disease in eight days. Two other children in the same family attended the primary school and one other the intermediate, both of which schools commenced at the time of her illness.

The next cases appeared fourteen days later, in two children, both of whom attended the primary school and probably received their infection from the sister of the first case attending the same school. On the 29th of September 3 more cases appeared, 2 among children attending school and all living in the centre of the village. The selectmen conferred with the school committee at this time and all schools were closed temporarily to prevent the spread of the disease. Whether this measure really did or did not prevent any further cases it is impossible to say, but it is a fact that for over three weeks there were no new cases.

On October 22 a boy nine years of age and attending the intermediate school was taken ill, and up to November 12 11 other cases developed in succession, some of them appearing in the same families where previous cases had existed. Since that date only 2 new cases have been reported.

The first case of diphtheria was reported on November 8, in a man sixty years of age, working in the cordage mill. The same day a boy twelve years of age, and living directly across the street, was taken ill. Where they received their infection it is impossible to state, for neither had been away from the village for some time. Of the 4 remaining cases, 2 attended the same school as the boy just referred to and the other 2 were infants living in the same neighborhood, and only a short distance from the infected houses. The last case appeared on December 1.

Complaint having been made to the board of selectmen that the river was in some way connected with the development of the disease the existing surroundings were investigated. The river has its source in the Shirley reservoir, about three miles above the village. It flows down to the village, where it is dammed, to supply a cotton mill with power. This mill employs 14 hands and no disease of an infectious nature had appeared among them. In the process of manufacture in this mill the cotton and wool are separated by a chemical process, the wool being saved and the cotton reduced to a fine brown powder. During the first part of the month of October this cotton refuse was put into the raceway and allowed to go into the next mill-pond, where it eventually blocked the screen of the raceway supplying the next mill. The owner objected and since then it has been discontinued. The privy of this cotton mill is on the edge of the stream, the contents passing into it unmodified. The next mill-pond supplies a saw-mill with power. On the bank of this pond is situated the Edgarton suspender factory, employing about 45 people. There is little refuse from manufacturing, but the contents of the water-closets all over the factory are poured unmodified into this pond. At times the odor is considerable and has been objected to, but nothing has ever been done to restrict the nuisance. After supplying the saw-mill with power, the water continues in a natural channel through an old mill-pond, which was formerly used before its factory was burned. Some complaint had been made last summer on account of the odors arising from the bottom of the pond, but at the present time nothing objectionable could be seen or smelled. Still lower down are two more ponds, supplying the Sampson cordage works, employing 150 people with power. Nothing objectionable was present about these works although during the summer time it was stated that considerable odor was present on account of the low water. This river eventually flows into the Nashua River.

As far as could be seen the condition of this stream was in no way the cause of the diseases present, although it may have influenced their development.

As a case of typhoid fever existed in the town, a visit was made to the hotel where it existed and the sanitary surroundings noted. The hotel accommodated about 50 people, most of whom were boarders who worked in the mills. As there is no public water supply, a driven well is used for sanitary and domestic purposes, but on account of the dry summer no water has been available from this well since last August. As a result, it has been necessary to carry water from an adjoining house to the second and third floors of the hotel, where the water-closets are located, and the bowls are flushed by pouring the water from the pails into them. This practice has certainly been very unsuccessful, for the traps have been repeatedly clogged and the contents of the closets have leaked through to the ceiling underneath. When the closets are working satisfactorily the contents are carried by sewer pipes out of the hotel to a large brick cesspool cemented on the inside. The liquid part of the sewage overflows through another pipe a distance of about fifty feet and leaches into the ground. The solid parts remaining in the cesspool are removed twice a year and sold to the farmers for fertilizing purposes. On account of this arrangement, the local board of health were advised to inform the owner of the hotel that on account of the danger of using this sewage for fertilizing purposes this practice would not be allowed, and such a notice was accordingly sent to him.

Conclusions. — The 19 cases of scarlet fever and 6 cases of diphtheria were not caused by the sanitary condition of the river flowing through the town of Shirley but were caused by the introduction of a case from an adjoining town, which subsequently spread itself by direct infection, the schools being the probable medium.

The sanitary conditions of the river and those existing at the hotel are very objectionable, but this matter is one which should be remedied by the local board of health, which has power to abate such nuisances.

F. L. Morse, M.D.,
Medical Inspector.

Somerville.

Number of nuisances abated,	925
Number of nuisances referred to board of 1900,	112
Number of nuisances complained of,	1,037
Number of complaints (many covering more than one nuisance),	569
Number of notices mailed,	568
Number of notices served by constables,	2

In addition to the above, 175 dead animals have been removed from the public streets, and many nuisances have been abated on verbal notice from the agent, without action by the board, of which no record has been made. Each spring the whole city is examined, and cellars, yards and alleyways where rubbish and filth have collected are required to be cleaned.

This board has adjudged that the diseases known as small-pox, scarlet fever, diphtheria, membranous croup, typhus fever, typhoid fever and cholera are infectious or contagious, and dangerous to the public health and safety within the meaning of the statutes. Physicians are required to report immediately to the board every case of either of these diseases and all cases of measles coming under their care, and postal cards conveniently printed and addressed are supplied to them for the purpose. On receipt of a card from a physician, the superintendent of schools, the principal of the school in the district in which the patient resides, and the librarian of the public library are notified.

Springfield.

On the 13th of July 3 cases of typhoid fever were reported to the city physician, and he found that the three families reported had a common milk supply. Upon investigation it was learned that a privy vault had been cleaned out on the 30th day of June upon one of the farms supplying milk to these families, and that the work was done by one of the men having care of the cows. Within a few days following the 13th of July more cases developed on the suspected milk supply, so there were in all some 22 cases, of which 2 proved fatal.

Advice was given to the milk peddlers and farmers regarding the care of milk, and no other infection took place. It is probable in this case only one day's supply was infected.

A system of daily medical inspection of the public schools would exclude from our school-rooms some mild cases of diphtheria and scarlatina, for not infrequently persons so infected are able to attend school during the entire period of infection, the disease not being recognized.

The fact that the bacilli of diphtheria remain in the throat of an infected person long after the symptoms of disease have disappeared is evidence that convalescents may be more dangerous to the community than those suffering from the invasion of diphtheria. It has been the duty of our bacteriologist to determine the time when convalescents from diphtheria were no longer capable of transmitting the disease.

Isolation Hospital. — This hospital, which provides for the reception and care of persons suffering from infectious diseases, was opened for use April 4, since which time 47 persons have been admitted. Of these, 38 had diphtheria, 2 scarlet fever, 5 erysipelas and 2 were not ill.

The hospital was built to accommodate 24 patients and will be ample for our purpose for some time to come. The hospital is valuable for the treatment of those taken ill in boarding-houses or hotels, and for the care of certain families who cannot provide for themselves proper care at home.

Stoneham.

The report of the medical inspector upon the prevalence of typhoid fever in Stoneham is as follows: —

Oct. 27, 1899.

On August 24 I received a communication from the town clerk of Stoneham informing me of the presence of an unusually large number of cases of typhoid fever in that town, with the request for an investigation. It was further stated that the public water supply was considered the cause of the disease, and it was also requested that samples of the public supply be taken and analyzed.

I immediately went to Stoneham and from the cases reported to the local board of health, supplemented by others obtained by interviews with the doctors, such cases not having been reported, however, I was able to find a total of 25 cases of the disease. I then commenced a house-to-house canvass of the cases, with the result of finding 20 of the 25 obtaining milk, without any doubt, from one and the same milkman, at the same time also making other inquiries as to other possible sources of infection.

The histories of the exceptional 5 cases are as follows: —

Cases 7 and 13 are two children, aged respectively 9 and 11, who were taken ill on the 9th and 12th of August, which were dates corresponding exactly to dates consistent with the other 20 cases which could be traced to the milk. These children lived on the same street, had not been out of town during the whole summer, derived their milk from the same milkman, and used the same public water supply. Should the supply of milk at either house run short, however, different stores were visited for an additional supply, but none of the milk dealers supplying these two families had access to the milk supplied by the first dealer mentioned, *i.e.*, the one on whose route the other 20 cases developed. It is fair to suppose, however, both on account of the fact that the cases developed in the midst of an epidemic and also because they were children playing at other children's houses, which were supplied by the suspected milkman, that in one way or another they drank some of his infected milk.

The third case (case No. 12) was that of a female, twenty-six years of age, who was also taken ill on August 12. No direct connection can be established in her case as to her having access to the infected milk, and, in addition, we have the history of her being away on a vacation to Maine and returning on July 19. She then began to feel poorly about July 29, ten days after her return, but was not ill enough to go to bed until August 12. Whether she returned ill with the disease or at some time unknowingly drank some infected milk it is impossible to state.

The remaining 2 cases, Nos. 11 and 16, are sisters who were taken ill on August 11 and 14. Both were out of town in June and did not return until July 10 from New Hampshire. On June 23 they both were known to have drunk polluted well water from which 3 other cases of typhoid fever are supposed to have developed. They did not knowingly have access to the infected milk, and the mother in addition states that *all* milk is scalded before being used. In view of the fact that they were feeling poorly for three or four weeks previous to the time they were taken ill, they may possibly be considered as having received their infection from the polluted well. But, on the other hand, the date on which they went to bed corresponds to the date of the epidemic, and the possibility also exists of them receiving their infection by the milk in some unknown way.

Of the 20 cases remaining, all having milk from the same man, 8 appeared in a large boarding-house. It was at this house that particular complaint was made concerning the public water supply, it being alleged that it was foul tasting and smelling. Accordingly a sample of water was taken here and another one from a building in the centre of the town. There was practically no difference in the analyses nor was any expected. Both showed microscopically the presence of vegetable organisms which probably caused the unpleasant features noted above.

The 12 remaining cases dated over a period extending from the 17th of July to the 21st of August. A visit was next made to the milk farm of Mr. X., which was located about one mile out from the centre of the town. He obtains his milk from four different farms besides his own, selling altogether about eighty-five cans daily. No history of any illness whatever appeared at any of the farms with but one exception, which will be mentioned later. The milk is collected twice daily and also distributed twice, but the afternoon delivery is much smaller than the morning one. Two wagons are used over two different routes, supplying two different localities in the town. With but two exceptions all of the cases appeared on the route which was supplied by the team driven by Mr. X. himself. The other team was driven by a man who had worked at the farm for the past three years, during which time he had never lost a day's work on account of sickness until August 17. On that day, having been feeling poorly for three days previous, he gave up work and went to bed, where he remained until the 27th. He was attended by a physician who pronounced the disease appendicitis. An examination of his blood taken by me at the time of my visit did not respond to the Widal test. Aside from this one case, no other case of sickness had appeared with anybody connected with the handling of the milk, and as the date of this man's sickness was August 17, it does not seem possible, even if he had typhoid fever, for him to have caused other cases, but, on the other hand, he may have received the disease in the same manner and from the same source by which the other cases were infected.

The first case of this epidemic appeared on July 17; one week before this patient was taken ill he was known to have visited Revere Beach and perhaps been exposed in some unknown way to the disease. At any rate he was ill and subsequently died of typhoid fever. During his illness milk was obtained from Mr. X., and at times when the supply was exhausted an additional amount was procured from a store, also supplied by X. The habits of the family were apparently of such a character that infection could be easily transmitted, and perhaps by the milk cans or pitcher as readily as by any other source, and when by further investigation it was found that 16 of the 20 patients ill with the disease procured milk at one time or another from this store, it is apparent that a very close relationship exists. The remaining 4 cases (Nos. 3, 6, 19 and 25) had access to X.'s milk directly from the farm only, but it was possible, although not probable, for them also to have received their infection through unclean cans. The facilities for washing cans at the farm were good. The city water was used and each can was said to be thoroughly scalded before again being used. No further cases have developed, and apparently with the death of case No. 1 the source of the disease was stopped.

F. L. Morse, M.D.,
Medical Inspector.

Wakefield.

All cases of diphtheria and scarlet fever the past year have been, and will be in the future, thoroughly fumigated by a member of this board, which we hope will minimize the chances of spreading said diseases.

We have turned our attention to the purification of Lake Quannapowitt, and have caused notices to be served on several parties directing them to discontinue emptying sewage into the lake. All the notices were acted upon promptly, and the drains were cut off, cesspools being put in to take care of the sewage. This work will be continued by the board as soon as the weather permits.

Waltham.

During the year the statute relative to bakeries entered into effect, and copies of the statute were printed in the daily papers and posted in the different bakeries throughout the city. This statute has been the means of bringing about some important changes in the sanitary construction of bake-houses, and in order to know that the law was being complied with the board recommended a quarterly inspection of all the buildings in which bakeries were located.

Beginning with the opening of the school year in September an epidemic of scarlet fever began which was of a very mild type, so mild in fact that the children attended school without attracting the attention either of the parents or teachers to the fact that these children were victims of the disease, and not until some other member of the family was taken down and a physician called was it discovered that one or more of the same family were desquamating and had been in regular attendance in school. In this manner the disease spread over the city and made it very difficult to control.

During the year 627 cultures have been taken and examined for the presence of the diphtheria bacillus. Of these, 195 were positive and 432 negative.

The type of the disease has been quite severe, but except in those cases that were neglected the early use of antitoxin has been found of inestimable value in stopping the course of the disease.

Ware.

A general inspection of all the premises throughout the town was made last spring, and a list of facts bearing upon the sanitary condition of each place obtained. These are kept on file for reference and to facilitate the future work of the board in this direction. In reference to the use of the public sewers the inspector found in this examination as follows: —

Number of houses connected with sewer and water-closet,	220
Number of houses connected with sewer without water-closet,	156
Number of houses not connected with sewer or water-closet,	145
Number of houses in bad condition,	88

Of those in bad condition many old waste pipes were found to be without traps, and this evil was remedied as rapidly as possible by the board.

Our board petitioned the State Board of Health for advice in reference to the source of ice supply of the town, and an examination of the water of Wesson's pond and Muddy Brook at Snow's pond was made by its chemist, and the surroundings of the two sources of supply examined by one of its engineers. The analyses of the waters were satisfactory, showing them to be of good quality and free from contamination, and the examination by the engineers indicated that the only source from which the pond might be polluted was the cow-yard on the farm just above the Wesson Pond. We had this yard removed and filled in with new earth, which does away with any possibility of foul drainage getting into the brook at that point.

Watertown.

The town's sanitary condition is very good and the death-rate is 1 per cent. less than that of last year. The town has been remarkably free from contagious diseases.

Westfield.

One hundred and forty-seven complaints have been attended to during the year.

A bacteriological examination is made in all reported cases of diphtheria, and will be made for typhoid fever and malaria on application of a physician.

Weston.

Twelve houses in which there had been cases of contagion were thoroughly fumigated. One box car and one carriage were also treated with formaldehyde gas.

In January, there having been 6 cases of diphtheria reported within a short time, and with the knowledge that the disease was prevalent in other towns, the medical adviser and the board of health, after due deliberation, decided to close the schools for a few days and disinfect the buildings. The school committee heartily endorsed this decision and on January 10 the schools were closed.

Westport.

The report of the medical inspector upon the prevalence of scarlet fever at Westport is as follows: —

Dec. 30, 1899.

On December 19 a letter was received from a physician of Adamsville, R. I., containing the information that cases of scarlet fever existed at Central Village in the town of Westport, Mass., that the local board of health had taken little, if any, precautions for the purpose of stopping the disease, that no disinfection had been attempted, and that children in the same families where the sickness existed were allowed to go to school as usual. Furthermore, as a result of their carelessness 5 other cases had occurred across the boundary line in Rhode Island by direct infection from the cases at Central Village, and as one of the local doctors called his cases measles and not scarlet fever he wished something done to prevent the further spread of the disease.

I accordingly went to Central Village on December 21 and investigated all of the available cases.

The first cases of which any definite information could be obtained appeared last October. On the fifth of the month the first child was taken ill, and within the following two weeks 4 other children in the same family were also ill with the disease. The description which the mother gives of the character of the eruption is more consistent with the rash of scarlet fever rather than that of measles, and as the mother said she was acquainted with the characteristics of the disease and as all of the children desquamated, it is fair to consider the possibility of the affection being scarlet fever. On the other hand, the attending physician who made only occasional visits at the house, because the children were not particularly ill, stated that the illness was German measles. With that diagnosis no quarantine was placed on the house and the other children in the family were allowed to go to school, where they associated with other children.

On October 26 and the few remaining days of that month 6 children in another family were taken ill with unquestionable scarlet fever. These children, with the exception of the youngest one, all attended the same school as the children in the first group and came necessarily in close contact with them. These cases were reported to the local board of health and a card was placed upon the door, but at that point the board of health evidently thought that their labors ended, for no restrictions were placed upon the occupants of the house and when recovery had taken place no disinfection was even attempted. The card was simply removed and with it, I suppose, it was thought the disease vanished. Such was not the case, for the nurse who attended the children went to an adjoining town in Rhode Island to take care of a woman in confinement, and within ten days 3 of the children in that family were taken ill with scarlet fever.

The next cases appeared among three members of the family of ——— ———. They were taken ill on November 17, 21 and 27, respectively. The attending physician pronounced the disease German measles, but even at the time of my visit the child, a girl of four years of age, was desquamating on her hands, the character of it being similar to that of scarlet fever, and the subsequent history, I think, is confirmatory of that diagnosis, for upon November 30 a cousin of this family, having visited at the house three days previously, was taken ill with undoubted scarlet fever, and upon December 7, Alice D———, a domestic in Central Village, was taken ill with the disease after exposure to the same source. The next cases to appear were Charles and Gertrude W———, five and three years of age, and living in a house directly opposite that of the family just mentioned. Alice D———, the domestic just mentioned, worked for this family, and these 2 children were taken ill three and eight days after the date of her going to bed. Two other cases, one at Little Compton and the other at Tiverton, R. I., were said to have developed from exposure to these cases. In five houses at Central Village where the disease was present only two of them had a notification card of the presence of the disease, and that was the only official notice or act by the local board of health.

The following letter was sent to the chairman of the board of health of Westport. With the letter was sent the circular of scarlet fever issued by this board for their instruction in regard to the way the disease is disseminated and the proper methods of controlling it.

F. L. Morse, M.D.,
Medical Inspector.

Dec. 23, 1899.

Chairman Board of Health, Westport.

Dear Sir: — This Board has not received from you the reports of infectious diseases required by chapter 302, Acts of 1893, and upon learning that cases of scarlet fever were present at Central Village I have recently made a visit there to investigate them.

I find that a total of 17 cases have appeared since the first of October in that place, and that 6 other cases have appeared in other adjoining towns as a result of your improper and negligent manner of isolating those patients ill with the disease.

By referring to chapter 469 of the Acts of 1898 you will find the law states that "no child who is a member of a household in which a person is sick with small-pox, diphtheria, *scarlet fever* or measles shall attend any public school during such sickness," etc. On inquiry I find that this law has been violated to a considerable extent, as 6 cases have apparently contracted the disease by attending school where other children came from such a household.

Section 102, Acts of 1890, requires that the rooms and articles therein which have been subjected to infection shall be disinfected. As you well know, nothing in regard to disinfection has even been attempted by your board, and hence every house where the disease has appeared is a focus for the spread of the sickness, and although no serious cases have as yet developed, the next one to appear may be a fatal one, which if ordinary measures of isolation and disinfection had been observed would have been prevented.

At the present time there are at least two houses having cases of scarlet fever in them which are under no restrictions whatever and are consequently a menace to the public health. In such a case as you have at Central Village every house in which a disease dangerous to the public health exists should be rigidly quarantined, and after recovery from the disease should be thoroughly disinfected. As a help to you, I forward also a circular in regard to scarlet fever.

Yours respectfully,

FRANK L. MORSE.

WINCHENDON.

At times the schools were very carefully examined every morning by physicians detailed for the purpose, in order to prevent, if possible, the spreading of scarlet fever and diphtheria. The board of education was requested to enforce the law requiring school children to be vaccinated. Over 700 children were thus treated.

The number of cases of typhoid fever has been very largely reduced, from a usual number of 20 to 30 down to 6; we attribute this fact largely to the introduction of town water.

The conditions attending the production and sale of milk have been very greatly improved during the last two years. The professional milk men, those who really make a business of milk selling, have all put their barns and apparatus in admirable condition. It is now a pleasure to visit their establishments. The clean white walls and well-cared-for cows are a credit to the owners.

WINTHROP.

There has been an increase in typhoid cases for the past two years. For five years previous to 1898, the largest number of typhoid cases in any one year was 7; in 1898 there were 11 cases, and in 1899, 15.

A careful investigation has been made both last year and the year previous as to the source or origin of the various cases, but it has not been possible to connect the cases in any way.

In 1898 the increase in the number of typhoid cases was largely due, no doubt, to the return to our town, and to Boston, of many soldiers suffering with and convalescing from attacks of typhoid fever.

It is more difficult to locate the source of the disease in a great city suburb, like Winthrop, where so many residents go back and forth to business, taking one meal and perhaps two meals away from home, and intermingling during the day with perhaps a score or more of people.

Quite a percentage of typhoid cases were very likely contracted elsewhere.

About the time of the closing of the schools, in June, the board received a circular letter from the State Board of Health relative to vaccination.

Included in the circular letter were extracts from the existing statutes relating to small-pox and vaccination.

Immediately upon receipt of this notice from the State Board the schools were visited by the physician of the board and over 800 pupils were examined. Two hundred and nineteen pupils were notified to be vaccinated, either by the board of health or by their regular family physician.

The board has vaccinated 180 children and 9 adults. Twenty children were vaccinated the second time and 2 were vaccinated the third time. Out of this number, so far as the board has been able to get a report, there were 139 successful vaccinations. These were primary and secondary cases together.

In a number of cases there has been negligence on the part of parents to have their children report whether the vaccination has been successful or not, but, as a whole, parents have very willingly co-operated with the board in this work, and the results have been very satisfactory and without force or unpleasantness.

The resident physicians have reported 54 vaccinations, 40 of which were known to be successful.

The glycerinated lymph in capillary tubes is the only virus which has been used by the board, as recommended by the State Board, and vaccination has been performed in the most approved manner, and the utmost care and attention has been given to each and every case.

Out of all the vaccinations made by resident physicians and the board there has not been a single instance where harm has resulted from it.

The persistence of the diphtheria germs in the throat of persons who have recovered from the disease has been frequently demonstrated, and because of these facts the board adopted the past year the following health regulation: —

"In all cases of diphtheria the isolation of the patient shall be continued until two cultures shall have been taken, following the disappearance of the membrane, the results of which shall be negative. The first culture to be taken by the physician in attendance, the second culture to be taken a week later by the physician of the board of health."

WORCESTER.

The number of deaths during the year, exclusive of still-born, was 1,800, a mortality of 15.89. This is considerably lower than that of last year (16.84) of which we said that "it is the lowest death-rate of which we have any record." Consumption, as usual, heads the list, with 213 deaths, which is 8 less than in 1898. Tuberculosis in other forms added 19 deaths, a total of 232. This is 12.08 per cent. of all the deaths during the year. Lung and throat troubles caused 523 deaths, 20.9 per cent. of the whole number of deaths. Pneumonia is second, with 200 deaths; heart disease is third, with 168 deaths. There were 59 deaths less from preventable diseases than in 1898. These include diphtheria, scarlet fever, typhoid fever, measles, whooping cough, membranous croup and cholera infantum.

Seven hundred and seventy-three plans of plumbing were filed at the office during the year.

Seventeen hundred and twenty-five cultures were examined in all; 986 were first primary cultures, 352 of which were positive and 634 negative; 49 were second primary cultures, 9 being positive and 40 negative; 11 were third primary cultures, 2 being positive and 9 negative.

The bath-houses were opened to the public June 5 and closed September 16; 17,774 men and boys used the bath-house set apart for them during the season.

This was the first year the women and girls had the exclusive use of a bath-house for the entire season; 3,048 women and girls made use of the house during the season.

The isolation hospital has completed its third full year of existence, and the results continue to be very satisfactory. Two hundred and three cases were treated during the year, more than double that of the year previous, thus unmistakably endorsing the position the board took at the beginning, that it would not force any patient to enter, preferring to let the hospital do its own work in obtaining the confidence and good-will of physicians and public.

This year's experience has shown conclusively that our accommodations are too small. We have been obliged to refuse patients for lack of room, and this, too, without any epidemic prevailing. We are handicapped, also, by lack of accommodations for cases of mixed infection, that is, patients who are suffering with both scarlet fever and diphtheria, a very common complication. It is dangerous to keep mixed cases in either the diphtheria or scarlet fever wards, because of the liability of infecting the patients suffering with either of these diseases singly. In our opinion the most economical way to meet this demand would be to raise the wards one story, making them two stories in height each instead of one, as they are at present. This would double our accommodations and would at the same time give us room for the mixed infection cases. We are informed that this can be done at a cost not exceeding $12,000.

We earnestly recommend that this matter receive early attention, believing that it is better to be prepared to meet any epidemic which may arise and thus be the means of checking its spread and saving many valuable lives.

We have relied more and more upon antitoxin in the treatment of diphtheria, and still place the utmost confidence in its efficacy. We are indebted to the State Board of Health for our supply, and during the past year have administered 340,000 units. The largest amount given to any one person was 12,000 units; 6,000 units are given to very septic cases for an initial dose, 3,000 to an ordinary case, and for a patient who has little or no membrane and no constitutional symptoms 1,500 units are deemed sufficient. The dose is occasionally repeated in ten or twelve hours, but it has been our experience that if there is no response to the first and second doses a third seldom benefits.

Inspection of Summer Resorts.

In the reports of 1896 and 1897 reference was made to the rapid increase of summer resorts, picnic and camp grounds in the State, chiefly on the lines of new electric railroads, and to the evident disregard of sanitary precautions which were noticeable in many of them.

An inspection of these places was then made under the direction of Professor Sedgwick, and a report upon their condition was made to the Board.

During the past year, in consequence of a continued increase in the number of these places, further inspection has been made of them by Dr. F. L. Morse, medical inspector of the Board, whose report is herewith appended: —

During the month of August, 1899, the inspection of summer resorts was continued, but to a less extent than during the year 1897, when the work was quite extensively done. Seventeen cities and towns were, however, visited, and 32 different resorts investigated, as follows: —

Salisbury Beach.

The Hotel Cushing, accommodating 150 guests, obtains its drinking water from two springs located on a hill about midway between Salisbury centre and the beach, and is brought to a tank located on the beach through an iron pipe, which, during a portion of its course, lies on the surface of the ground. From this tank the water is supplied to the hotel and some other houses on the beach. The hotel is equipped with a sewerage system, the contents being carried to a creek back of the hotel and thence into the ocean. No objection could be learned as to this method of disposal. In addition to this water supply there is also a well in the cellar from which water is used for bath and fire purposes only.

The Seaside House is located just across the street from the Cushing. The drinking water is obtained from a well in the square at Salisbury centre, and two barrels are brought daily to the hotel for table use. The water for bath and domestic use is obtained from a well in the yard, and the ice is obtained from Buzzell's Pond. The sink and bath drainage is conveyed through a pipe to the barn cellar, some 100 feet distant, where it percolates into the ground. The privies at both the hotel proper and the annex were in a filthy condition and were apparently cleaned quite infrequently. Fifty guests are accommodated at this hotel daily.

The Cable House accommodates 25 guests. The table water for drinking purposes is obtained from Rocky Hill Spring, and the water for other purposes comes from the tank supply mentioned in connection with the Hotel Cushing. The privies connected with the hotel were in a filthy condition, and the vaults were emptied only once a year.

The Salisbury House accommodates 30 guests. The water supply is obtained from the above-mentioned tank, and the sink-drainage water flows into the sand of the driveway at the side of the house. The privies were in an offensive condition, were cleaned twice yearly and the contents buried.

The Atlantic House accommodates 25 to 30 guests. The drinking and other water was obtained from the above-mentioned tank, and the sink drainage was carried through a pipe under the house, where it soaked into the sand. Although the privies were cleaned only twice a year, they were not in a particularly offensive condition.

The Castle Mona accommodates about 30 guests. The privies were located back of the hotel, were very offensive in character, and had not been cleaned since the hotel was opened early in the summer. The water supply was obtained from a well located under the house, and the drainage was carried by an iron pipe to the marsh back of the house, where it eventually flowed into the ocean.

The sanitary conditions of five of these houses being especially bad and a menace to the public health, the chairman of the board of health of Salisbury was notified.

Rockport, Pigeon Cove.

At Pigeon Cove, which is located in the town of Rockport, are the Pigeon Cove and Linwood hotels and the Ocean View House. All of them are supplied by the public water supply of the town of Rockport and all have sewage connections, the contents of the sewers being carried directly into the ocean. No complaints have been made in regard to the sanitary conditions existing at the hotels, and to all appearances the conditions existing were first class.

GLOUCESTER.

Long Beach is situated in Gloucester, about three miles from the centre of the city, and is reached by the cars of the Gloucester street railway company. It is also controlled and managed by the street railway company. For attractions it has a vaudeville entertainment given twice daily, a merry-go-round, flying horses, and a café for the accommodation of the patrons. At times the resort is patronized by 2,000 to 3,000 people. The water supply is obtained from a dug well located upon the beach in the midst of the buildings, the water being pumped to the surface by a hand pump. The women's privy is about 200 feet and the men's 100 feet distant from the well, both on higher ground and sloping towards the beach. Both privies were in a filthy, offensive condition, and apparently not cleaned during the summer season.

On account of the existing conditions, the following communication was sent to the manager of the Gloucester Street Railway Company: —

AUG. 14, 1899.

To the Manager of the Gloucester Street Railway Company, Gloucester, Mass.

DEAR SIR: — A visit has been made to Long Beach, a summer resort in Gloucester, managed at the present time by your railway company, and the sanitary conditions there investigated.

As you may know, the water is obtained from a well situated in the midst of the buildings. The privies are situated about 100 and 200 feet distant, on higher ground, the slope of the ground being towards the well. Both privies were in an unsanitary condition and were offensive at the time of my visit In view of the fact that this resort is much frequented by visitors, it becomes necessary to advise you to improve such conditions, in the interest of the public health. Should you wish for further information, it will be given you on application.

Yours respectfully,

FRANK L. MORSE, M.D.,
Medical Inspector.

SPRINGFIELD.

Bear's Hole is a resort patronized for the most part by small parties who go there, for the day only, for a clam bake. There are no street cars to the place, and it is reached only by carriage. At this place is located the Massasoit spring, which is apparently a water of considerable purity.

Riverside Grove is located on the Connecticut River, below Springfield, and is reached only by a steamer, which is run by private parties and is chartered for picnic parties principally. The water supply is derived from a dug well, and privies exist at the place, but as far as could be learned there was little or no objection or complaint concerning them.

Forest Park is located three miles from the centre of the city, is reached by the electric cars, and is under the control of the park commissioners of the city of Springfield. It is supplied by the public water supply, and the privies at the park are cleaned daily, being in excellent condition. The park covers many acres of land, and is patronized freely on account of the beautiful scenery which it affords. There are also many varieties of animals to be seen here.

CHICOPEE CAMP GROUNDS.

These grounds are located in Springfield, on the route of the street cars running to Chicopee Falls. They are extensively patronized during the summer time by the Adventists, who hold camp meetings here, there being at times 1,000 to 1,500 people present, some of whom live here in cottages during the entire summer season. The water supply is obtained from three dug wells, walled on the inside, and located at different parts of the grounds. From their location near the several cottages, it is practically impossible to prevent them from being extensively polluted. There is no sewerage system on the grounds, and the sink drainage is allowed to run to waste, usually upon the surface of the ground. Two privies are located on the borders of the grounds. Both were in a foul, offensive condition, apparently infrequently cleaned, and in addition a large pile of stable manure was close by.

The assistant superintendent was informed of the danger existing from these conditions, and advised to remedy them before another season. Three samples of water were taken from the three wells, and the analyses are appended (see page 787).

HOLYOKE.

Springdale Park is located on the outskirts of the city and on the line of the street cars running to Springfield. Horse racing is the principal attraction, and the park is not open constantly to the public. The grounds were in good sanitary condition.

Mountain Park is located about three miles from the centre of the city of Holyoke, at the foot of Mount Tom, and is reached by the Holyoke Street Railway. For attractions it has flying horses, vaudeville entertainment, roller coaster, animals, etc., and a café is located on the grounds for the accommodation of the patrons. The water supply is obtained from a spring located on an adjacent hill, and the water is brought to the park through an iron pipe. It is apparently of good quality and not polluted. The privies were located on the grounds and were in good condition, being cleaned apparently at frequent intervals, and the grounds of the park itself were in excellent condition. The Whiting Street reservoir, one of the city's public water supplies, is located adjacent to this park, but a barbed-wire fence affords additional protection from pollution by the patrons of the park.

Mount Tom is reached from Mountain Park by a trolley car running to its top, and is also under the control of the street railway company. A building located at the summit of the mountain affords a fine view of surrounding country, and an entertainment is offered several times daily. The water supply is obtained from a spring located on the hillside, the water being pumped to a tank at the top of the building, and the sewage is conveyed down the mountain side to a cesspool. The sanitary conditions existing were exceptionally good. In addition there was a ladies' privy on the west side of the mountain, being the side opposite the Whiting Street reservoir.

Lake Pleasant.

Lake Pleasant is situated in the town of Montague, and is the public water supply of Turner's Falls; it is also the location of the Spiritualists' camp ground, which occupies the south shore of the lake, the pumping station being on the opposite side. During the summer season there are about 1,000 permanent residents, and this number is increased by many thousands daily who come to attend the lectures given under the direction of the Spiritualists. The water supply is derived from the lake, the intake being about 200 feet from the shore, and the water pumped to a tank on the grounds, whence it is distributed through pipes to the cottages. A small steamer and about 15 row boats are on the lake. The water-closets are located some 200 feet away from the shore of the lake and separated from it by a divide, so that pollution from this source is impossible. Two public privies are located still farther away and were apparently frequently cleaned, but many private ones accommodating only single cottages were filthy and offensive. Lectures and dances are the principal attractions offered.

Orange.

Brookside Park is located in the town of Orange, about midway between that town and Athol, being owned by the Athol & Orange Street Railway Company. This is a new park, opened during the present season, and offers the usual attractions present at such resorts. The water was obtained from a driven well 20 feet deep, located in the middle of the grounds, and an analysis of a sample taken at the time of my visit shows it to be unpolluted. The privies were located 100 feet distant on lower ground, and, being new, they were no guide as to their sanitary condition. The manager was instructed in methods which would keep the grounds in a good condition, and promised to follow out the suggestions offered.

Athol.

The grounds of the Worcester North-western Agricultural Society are located here, and meetings are held occasionally during the summer and fall. Horse racing and the exhibition of farm produce are the principal attractions offered. The well from which the water is obtained is located in the middle of the field, and is apparently not subjected to much pollution. The privies are located 100 feet distant from it, on lower ground, and both were in a filthy condition, apparently not cleaned for many months. As there was to be a meeting there soon, the following letter was sent to the manager: —

AUG. 26, 1899.

Manager Worcester North-western Agricultural Society, Athol, Mass.

DEAR SIR: — A visit has been recently made to the grounds of this society, and the sanitary conditions investigated. The privies were found to be in a bad condition; and, in view of the coming meeting next month, the Board advises you to take such measures as are necessary to place them in a wholesome condition.

Respectfully yours,

FRANK L. MORSE, M.D.,
Medical Inspector.

GARDNER.

Crystal Lake is the public water supply of the town of Gardner, and on the shore of the lake is located a pleasure resort. The grounds were kept in a good sanitary condition, the privies being supplied with removable boxes, which were changed daily and the contents removed. The water supply is obtained from a dug well located on the grounds about 20 feet distant from a stable accommodating about twenty-five horses, but, as it is on a higher level, it is not probably polluted from that source. For entertainment, a merry-go-round, bowling, dancing and refreshments are supplied. Several hundred people attend this resort daily, the street cars running to the grove nearby. About twelve or fifteen row boats were on the lake, and sticks and tin cans were seen in the water near the boat landings. In addition to this resort, there were a number of private cottages located on the lake.

FITCHBURG.

The principal pleasure resort near Fitchburg is at Whalom Lake, which is located in Lunenburg, and is controlled by the Fitchburg & Leominster Street Railway Company. The grounds of the resort were found to be clean, well kept and in excellent condition, and several thousands visit here daily. For amusement there is boating, dancing, bowling, and a vaudeville entertainment given in a temporary theatre erected in the woods. The water is obtained from the Leominster public water supply and from one well located on the grounds. A sample of water from this well was analyzed and found to be polluted. Two good water-closets are located on the grounds, both emptying into cesspools 10 feet distant, the latter being cleaned frequently as occasion requires. The superintendent of the street railway company was notified of the pollution of the well, and, as there was already a good water supply on the grounds, advised to close it at once, and this was done.

ESSEX.

Centennial Grove is located on the shore of Chebacco Lake in the town of Essex, on the Essex branch of the Boston & Maine Railroad. The water is obtained from a dug well located in the middle of the grounds, and both men's and women's privies are on the shore of the lake hardly 20 feet from the water. Both privies were foul smelling and apparently not cleaned for many months. The grove is not open to the public continuously, and is only patronized by picnic parties on special occasions. Considerable ice is cut from the lake in the winter season, and two of the ice houses are located quite near the picnic grounds. On account of the unsanitary conditions present, the following letter was sent to the proprietor: —

AUG. 26, 1899.

Proprietor Centennial Grove, Essex, Mass.

DEAR SIR: — A visit has been recently made to this grove, and the sanitary conditions investigated. The privies were found to be in a filthy condition, and apparently not cleaned for some time. In view of the large number of people who visit this grove, the Board advises you to have the privies immediately cleaned, and the contents removed to a locality so that they will not pollute the waters of the lake, from which much ice is obtained.

Respectfully yours,

FRANK L. MORSE, M.D.,
Medical Inspector.

HAMILTON.

Asbury Grove is located in the town of Hamilton, well known as one of the Methodist camp grounds, and is reached by the street cars of the Lynn & Boston Railway and the steam cars of the Boston & Maine Railroad. The water supply is obtained from three dug wells located at different parts of the grounds, but in the midst of the cottages. The privies, four in number, are located from 200 to 400 feet distant from the cottages. The deposits are not removed during the summer season, but are daily covered with earth, and hence the conditions are not especially disagreeable.

LOWELL.

The principal pleasure resorts near the city of Lowell are located at Tyng's Pond, on the line of the Lowell & Suburban Street Railway Company.

Lakeview is on the shore of Tyng's Pond, in the town of Dracut, and is owned and managed by the street railway company, having the usual attractions found at such places. The water supply is obtained from six driven wells located in the meadow back of the theatre, and is pumped to a tank located on the grounds, and then distributed about them. No water is taken from the pond. The women's water-closet is located on the shore of the pond, the cesspool into which the sewage is discharged being within 10 feet of the water, and apparently filtering into it; the men's privy is 20 feet from the shore of the pond and adjacent to a large ice house. The vault is cleaned once in two months, and at the time of my visit was in good condition, having been cleaned the previous week. Two other privies were located on the opposite side of the road, and were in a filthy condition, the one located near the theatre apparently draining towards the wells. One pump, with a well, was located in the midst of the grounds, and about 30 feet from the stable. The grounds in general were in good condition. The following communication was sent to the manager of the street railway company, on account of the danger of pollution to the lake from the men's privy.

AUG. 26, 1895.

Manager Lowell & Suburban Street Railway Company, Lowell, Mass.

DEAR SIR: — A visit has been made recently to Lakeview, and the sanitary conditions investigated. The grounds were found clean and in good condition. On account of the fact that ice is obtained from the pond for domestic use, and that the men's privy is within a few feet of one of the large ice houses, it is advisable for you to have this privy in as clean a condition as possible, and the contents removed frequently to a place so situated that the pond could not possibly be polluted from it.

Respectfully yours,

FRANK L. MORSE, M D.,
Medical Inspector.

WILLOWDALE.

Willowdale is also located on the shore of Tyng's Pond, in the town of Tyngsborough. The street cars run to the shore of the pond, and the grove, about one-half mile distant, is reached by a path through the woods or by a small steamer, which runs frequently. The principal amusements offered are boating, vaudeville entertainments and refreshments. The domestic water is obtained from the pond, the intake pipe being about 30 feet from the shore, and is pumped to a tank at the top of the building, from which place it is distributed about the grounds. The drinking water was said to be obtained from a well located under the ell of the house some 100 yards away. A pipe carried the water from this well to the picnic grounds, but the water in the well was so low at the time of my visit that it could not be conveyed in that way, and it was said to be carried in barrels to the grounds as often as was necessary. The men's and women's privies were located on the shore of the pond about 20 feet from the water, and were said to be cleaned once a week. Their condition at the time, however, was rather offensive. The possibility and danger of using lake water for drinking purposes was pointed out to the owners, and they were advised to find a proper water supply, in order to avoid using the pond water.

GROVELAND.

"The Pines" at Groveland is located on the bank of the Merrimac River, and is owned and managed by the Haverhill Street Railway Company. Dancing, vaudeville entertainments, refreshments and the exhibition of animals are the principal attractions. The water supply is obtained from two wells on the grounds, but so situated that pollution is improbable. The privies are located on the river bank, and apparently had not been cleaned for some time, for they were in a very foul condition and had an exceedingly objectionable odor. The sewage from the restaurant was conveyed through an iron pipe into the river. On account of the existing conditions at the grounds the following letter was sent to the superintendent of the street railway company: —

Aug. 26, 1899.

Superintendent Lowell, Lawrence & Haverhill Street Railway Company, Haverhill, Mass.

Dear Sir: — A visit has been recently made to "The Pines," and the sanitary conditions investigated. The privies were in a filthy and foul-smelling condition, and the contents apparently had not been removed for some time. In view of the fact that large numbers of people congregate here almost daily, it is advisable for you to have these privies immediately cleaned, the contents removed, and the surroundings placed in a wholesome condition.

Respectfully yours,

Frank L. Morse, M.D.,
Medical Inspector.

Pittsfield, Pontoosuc Lake.

Point Pleasant is located on the shore of the lake, and is managed by the street railway company. The water is obtained from the public supply, which is considered of good quality. The privies were found to be in a foul condition, located on rather higher ground than the buildings and draining towards the lake. The grounds were kept in a clean condition. The manager of the street railway company and the local board of health were notified of the existing conditions and advised to remedy them.

Hoedecker's Grove is located at the other end of Lake Pontoosuc, in the town of Lanesborough. The drinking water is obtained from a spring in the lake, the spring having been found at the bottom of the lake, a barrel placed over it and the top of the barrel covered. An iron pipe conveys the water to the pavilion. The privies were in fair condition, with but little odor. An analysis of the water shows it to be of good quality (see page 788).

These are the two principal public grounds located at the lake, but there are numerous private cottages located on the shores, some of which drain their cesspools directly into the lake.

Westfield.

Woronoco Park is located about two miles out from the centre of the city, and is owned by the street railway company. Dancing, refreshments, horse racing and athletic sports are the principal attractions. The water is obtained from the Montgomery public supply, and in addition Crystal Spring is located on the grounds, from which water is accessible. The grounds were in good condition, but the privies were foul smelling, dirty and apparently not cleaned for some time. The street railway company and the board of health of Westfield were notified of this condition, and advised to have it changed.

PALMER.

Forest Lake is located on the line of the Palmer & Monson Street Railway Company. The water supply is in part obtained from the lake, the intake pipe being located about 200 feet from the shore. The water is then pumped to a tank, and then, after passing through a charcoal filter, is distributed to the pavilion. The drinking water is obtained from a well located on the grounds about 200 feet from the lake, the drainage from several cottages being towards the well. The sewage from the pavilion is carried by a wooden trough to the lake. The privies were both in an offensive condition. Many other cottages were located on the shore of the lake, and from their location would drain into it. Samples of water were taken, and the results are appended (see page 788).

Water Analysis. — Wells in Orange, Fitchburg and Springfield.

[Parts in 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance. Turbidity.	Appearance. Sediment.	Appearance. Color.	Odor. Cold.	Odor. Hot.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.
	1899.									
28280	Aug. 19	Aug. 21	Decided.	Cons., earthy.	.04*	None.	None.	5.80	.0000	.0024
28294	Aug. 21	Aug. 22	Decided, milky.	Cons., sandy.	.09†	Faintly musty.	Faintly musty.	12.30	.0600	.0126
28328	Aug. 22	Aug. 23	Decided, iron.	Cons., iron.	.08*	None.	Faintly unpleasant.	3.60	.0000	.0024
28329	Aug. 22	Aug. 23	None.	None.	.00	None.	None.	3.10	.0008	.0008
28330	Aug. 22	Aug. 23	None.	None.	.00	None.	None.	2.20	.0000	.0008

* Filtered. † Iron filtered out.

Water Analysis. — Wells in Orange, Fitchburg and Springfield — Concluded.

[Parts in 100,000.]

Number.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.	Remarks.
28280	.12	.0550	.0000	.09	0.5	.1600	Orange — driven well.
28294	.86	.1040	.0007	.07	3.6	.3400	Fitchburg — well, Whalom Park, Advent Camp Ground.
28328	.43	.0000	.0000	.06	1.0	.2250	Springfield — well, north side.
28329	.47	.0000	.0000	.05	0.5	.0080	Springfield — well, south-east corner.
28330	.27	.0020	.0000	.05	1.0	.0110	Springfield — well, north-west corner.

Water Analysis.— Palmer and Pittsfield.

[Parts in 100,000.]

Number.	Date of Collection.	Date of Examination.	Appearance: Turbidity.	Appearance: Sediment.	Appearance: Color.	Odor: Cold.	Odor: Hot.	Residue on Evaporation: Total.	Residue on Evaporation: Loss on Ignition.	Residue on Evaporation: Fixed.
	1899.									
28498	Sept. 5	Sept. 6	V. slight.	V. slight.	.01	None.	None.	7.00	-	-
28644	Sept. 15	Sept. 19	V. slight.	Slight.	.14	Faintly vegetable.	Faintly vegetable.	3.50	1.60	1.90
28783	Sept. 27	Sept. 28	None.	V. slight.	.01	None.	None.	17.50	2.90	14.60

Water Analysis.— Palmer and Pittsfield— Concluded.

[Parts in 100,000.]

Number.	Ammonia: Free.	Ammonia: Albuminoid: Total.	Ammonia: Albuminoid: In Solution.	Ammonia: Albuminoid: In Suspension.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen Consumed.	Hardness.	Iron.	Remarks.
28498	.0018	.0014	-	-	1.72	.0030	.0000	.04	1.6	.0350	Well on the grounds at Forest Lake.
28644	.0036	.0234	.0206	.0028	0.18	.0000	.0000	.35	1.0	-	Forest Lake.
28783	.0000	.0006	.0006	.0000	0.14	.0670	.0000	.02	14.5	.0040	Spring in Hodecker's Grove.

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SIXTH ANNUAL REPORT

OF THE

BOARD OF REGISTRATION IN MEDICINE.

JANUARY, 1900.

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Commonwealth of Massachusetts.

BOARD OF REGISTRATION IN MEDICINE,
STATE HOUSE, Dec. 31, 1899.

To His Excellency ROGER WOLCOTT, *Governor*.

SIR: — In compliance with the requirements of chapter 458 of the Acts of the year 1894, the Board of Registration in Medicine submits the following report for the current year.

The number of persons examined by the Board during the year is 481, the number registered is 346, the number rejected 135.

Besides the three regular meetings provided for by the registration act, one in March, one in July and one in November, the Board has held two special meetings for the examination of applicants, one in May and the other in September.

The results obtained in the several examinations are shown in tabular form as follows: —

	Examined.	Registered.	Rejected.	Percentage rejected.
March examination,	101	59	42	40
May examination,	68	41	27	40
July examination,	193	154	39	20
September examination,	24	24	–	–
November examination,	95	68	27	28
	481	346	135	28

Each meeting for the examination of applicants occupies the time of the full Board two days in the class room, and from three to six days in rating the written work submitted. Ten questions are given in each of the subjects on which the examination is conducted, and two hours allowed in which to answer the same. Each applicant is required to designate his papers, not by signature, but by the number which designates his application. This requirement assures an incognito rating of all papers. When the general average of the ratings of the several papers of an applicant falls below 70, his examination is regarded as unsatisfactory, and registration is refused. Applications for examination must be made upon blanks furnished by the Board, and must be accompanied by the required fee, which is twenty dollars. Certificates of registration in other States, or diplomas of graduation from medical colleges, do not exempt from examination.

Applicants refused registration by reason of an unsatisfactory examination may return for a re-examination at any regular meeting of the Board, without paying an additional fee, within two years from the date of their first examination. Referring in the last annual report to such recurring opportunities for a re-examination, the Board said: —

Undoubtedly it was the intention of the Legislature in 1894 to provide in the registration act for but one re-examination of a rejected applicant without additional payment; but it is held that the law, strictly interpreted, entitles a rejected applicant to a re-examination at any and every regular meeting of the Board within the two years next following the date of his first unsuccessful examination. It happens, therefore, that a considerable number of rejected applicants appear at each regular meeting, just, as they say, to try their luck. In the opinion of the Board, such frequent re-examinations do not result advantageously to the individual. They may indeed prove disastrous to him, from the fact that he may rely upon the possibilities of success as a chance result from frequent attempts, rather than on further study to equip himself for the test. To provide for one re-examination would be a just and a reasonable provision of the law. The Board recommends that the law be so amended.

The above and all other recommendations made in the last annual report and referred to or reprinted in this report are deemed important, and should receive the careful consideration of the Legislature.

The law requires that the examination shall be of an "elementary and practical character, and shall embrace the general subjects of surgery, physiology, pathology, obstetrics and the practice of medicine;" but, inasmuch as the law also requires that the examination shall be "sufficiently strict to test the qualifications of the candidate as a practitioner of medicine," the Board could not discharge its duty fully should it limit its list of questions to the particular branches mentioned. A thorough knowledge of anatomy is indispensable; without it no one can be considered qualified to practice medicine.

At the examination in November, the last held, 95 applicants were present. The questions submitted were the following: —

Surgery.

1. Discuss abscess of the antrum of Highmore, — diagnosis and treatment.
2. Discuss hemorrhoids, — varieties, causes and treatment.
3. Discuss operation and after-treatment for amputation of leg at any point of election.
4. What structures would be severed in amputation of the thigh in the middle third?
5. Name two causes of ulcer of the leg, and treatment of each.
6. Discuss symptoms and treatment of aneurism.
7. State in detail the technique of cerebral operations.
8. Differentiate acute prostatitis from acute cystitis.
9. Acute iritis, — diagnosis and treatment.
10. Strictures of the male urethra, — causes, symptoms and treatment.

Physiology.

1. Describe the nervous mechanism of respiration.
2. State the functions of the red blood corpuscles.
3. Describe the eustachian tube, and state its functions.
4. Name the three distinctive forms of digestion, and state the function of each.
5. State the appearance of bile; also its source, normal quantity secreted in twenty-four hours in the adult, and its function.
6. What is peristalsis, and its purpose?
7. How is the nutritive portion of food taken up during digestion?
8. Define chyme, also chyle. Where is the latter found?
9. Name the acid constituents of gastric juice, and their source.
10. How is the sense of smell excited?

Pathology.

Give a brief synopsis of the pathology of the following diseases: —

1. Diphtheria.
2. Rubeola.
3. Pneumonia (acute croupous).
4. Pericarditis.
5. Addison's disease.
6. Gout.
7. Rachitis.
8. Filariasis.
9. Erysipelas.
10. Pott's disease.

Obstetrics.

1. Name the articulations of the pelvic bones.

2. Name the pelvic organs, and their anatomical relations.

3. What conditions would prompt you to induce premature labor?

4. State briefly etiology, pathology and treatment of phlegmasia dolens.

5. In breech presentation, what obstacles hindering delivery are likely to be met with?

6. Write a page on icterus neonatorum, — stating briefly etiology, pathology, treatment and prognosis.

7. Differentiate ovarian cyst from pregnancy.

8. Differentiate infanticide from fœticide.

9. How would you manage a case of infantile colic? Describe best substitutes for a mother's milk.

10. Discuss eclampsia in the lying-in-period, — causes, treatment and prognosis.

Medicine.

1. State the symptoms, diagnosis and treatment of carbolic acid poisoning.

2. Define scarlet-fever, — stating varieties, etiology, diagnosis and sequelæ.

3. Define lithæmia, and give dietetic treatment.

4. Differentiate diphtheria from follicular tonsillitis.

5. State the characteristic symptoms and most serious sequelæ of lead poisoning.

6. Give etiology, symptoms, dietetic treatment and prognosis of diabetes mellitus.

7. State the period of incubation of any three contagious diseases.

8. Define and diagnose progressive bulbar paralysis.

9. State symptoms and diagnosis of pericarditis.

10. State dietetic and hygienic treatment of chronic interstitial nephritis.

In several of the States under the existing laws any one is permitted to practise medicine who holds a diploma from a legally chartered medical school. Under such statutory regulations many incompetent persons, on securing a so-called diploma, either by an out-and-out purchase *in absentia*, or "after a mere formal attendance at lectures" in some weak, poorly equipped medical school, find their way into the profession. Under the wise provisions of the law in this Commonwealth, the holder of a diploma, irrespective of the standing of the medical school granting the same, is not permitted to register without an examination by the State Board.

Ten per cent. of the graduates examined this year have been refused registration. The following excerpts from their examination papers may be of interest. In every instance the answer is exact as to spelling, punctuation, capitalization and phraseology, and no one is quoted more than once.

Q. Acute iritis, — diagnosis and treatment.

A. With this trouble there is trouble in the sight owing to the inflamation which causes a blur of the sight the treatment would be to treat the system internally and then send to an optician and have the eyes fitted with the proper glasses.

Q. Give a brief synopsis of the pathology of pericarditis.

A. Is an acute inflamation of the covering of the Heart. in which we have hyperaemia and swelling and a little later infiltration through the tissues which may become purulent and form abscesses and pluricy.

Q. In the second stage of labor what conditions would require the application of forceps?

A. I think a transverse position would require the use of forceps.

Q. Differentiate infanticide from fœticide.

A. The first is an instance in which the mother kills the new born, the next is an instance in which the child is born alive, but immediately upon birth dies as a result of its own strange conduct.

Q. State symptoms and diagnosis of pericarditis.

A. In Pericarditis Pain, tightness of chest, fullness fever, difficult breathing. shortness of breat, irregular action of heart, all signs of inflamation Diagnosis fullness of chest, patient lies on the effected size, face is anxious pale. Fluid draw by aspiration.

Q. Describe emphysema of the lung.

A. Emphysema of the lung is air in the pleural cavity, we get the barrel shaped chest.

Q. Describe operation and after treatment for amputation of the leg at any point of election.

A. In operating the leg at the middle of the thibia I will first put my rubber band little below the knee, made a circular incision to cut the skin, made my flap, saw the thibia and ulna attach the thibial and ulnal arteries, stop the others little hemorrhages by compression and made an antiseptic dressing with iodoform gauze.

Q. Give a brief synopsis of the pathology of gout.

A. Gout Synopsis is a disease. charactize by a lesion that attack the Serous membrane of the joints, throught the circulation of the Blood.

Q. State the functions of the red blood corpuscles.

A. The red blood corpuscles are the oxygen carriers of the Circulation. It takes it from the lungs to the Heart, then to the Lymphatics and from their to the capillaries, and from there it is carried all over the body.

Q. Give a brief synopsis of the pathology of rubeola.

A. There is an enlargement of the capillaries, and an increase of epithelium, also increase of corpuscles. Hyperiamia and congestion of the parts, due to infiltration.

Q. State symptoms and diagnosis of pericarditis.

A. Precordal distress, bulging of the left side. Apex beat in to the Left of sternum and transmited round to left Shoulder.

Financial Statement.

Receipts.

Fees from applicants received and paid into the treasury of the Commonwealth since Jan. 1, 1899,		$6,910 00

Expenditures.

Services of members of the Board,	$4,580 00	
Incidental expenses of Board,	482 01	
Clerical service,	669 00	
Printing and material,	38 20	
Detective service,	158 95	
Books and other office supplies,	165 84	
Postage and messages,	180 44	
Balance credited to the Board,	635 56	
		$6,910 00

Commonwealth v. St. Pierre.

This is a case in which a person in Fall River was accused of practising medicine without registration. His professional sign was that of an "eye specialist." He was sentenced in the municipal court to three months' imprisonment and to pay a fine of five hundred dollars, the maximum penalty. The case was carried to the superior court, where sentence was sustained; but certain exceptions were taken by the defendant's counsel to the rulings of the court. The exceptions were finally disposed of in the following opinion of the supreme judicial court, rendered on the thirteenth day of December, 1899: —

Loring, J. The exception to the exclusion of testimony offered by the defendant on cross-examination must be sustained. The government had introduced in evidence testimony of a number of persons to the effect that they had visited the defendant at various times; that he gave to them medicines, and advised them how to use them; that at these times they had conversations with him about the nature of their complaints; that he afterwards visited some of them at their houses and treated them there, and that they paid him money, and the bottles and packages, which the witnesses testified were given to them, had been put in evidence.

The defendant offered to prove that "on each and every occasion at the time the parties were told by the defendant that he was not a doctor, and that he did not charge anything for his services." This evidence was excluded.

If the defendant sold the medicines, receiving payment therefor, and gave advice gratuitously as to the use to be made of them, he was not, so far as those instances were concerned, holding himself out as a physician; his declarations accompanying the acts and showing the character of them were admissible as part of the *res gestæ*.

Of course it was open to the government to contend that in these instances he was really acting as a physician, and was paid as such for his services, and that these statements were efforts to evade the statutory provisions here in question.

But when the Commonwealth put in testimony to the effect that he had given directions and advice as to the use of the contents of the packages and bottles sold by him, and had been paid by the persons to whom the contents were sold, it was the right of the defendant to prove that in each instance he was paid not for the advice but only for the drugs, and that he declared that he was not a physician; and in that way to raise the question whether, so far as these instances were concerned, he was selling the drugs and giving information gratuitously as to their use, and therefore not thereby holding himself out as a physician, or whether he was really acting as a physician, taking payment therefor, and was seeking by such declarations to evade the effect of his actions. This question was a question for the jury, under all circumstances, and the testimony offered should have been admitted.

As the questions involved in the other exceptions may arise in a new trial, they may be briefly disposed of here: —

2. The burden was on the defendant to show that he was a registered physician, if he relied on such a justification. Pub. Sts., c. 214, § 12; this applies in cases where the absence of a license is made part of a description of the offence. Commonwealth *v.* Kelly, 10 Cush. 69. Commonwealth *v.* Tuttle, 12 Cush. 502. Commonwealth *v.* Barnes, 138 Mass. 152. Commonwealth *v.* McCarthy, 141 Mass. 420.

3. Proof that the defendant acted either as a physician or surgeon was sufficient to support the complaint, which charged him with holding himself out as a physician and surgeon. There is but one offence, and that may be committed by the defendant's holding himself out as a physician or a surgeon; if the complaint charges that the offence is committed by the defendant's holding himself out both as a physician and surgeon, the whole offence is proved if he is shown to have held himself out as either. Commonwealth *v.* Dolan, 121 Mass. 374.

4. The ruling that, if the defendant held himself out as an eye specialist, he held himself out as "one who devoted himself to a branch of the healing art which is the profession of the physician and surgeon," and that "if the defendant held himself out as an eye specialist, he held himself out as a physician and surgeon within the meaning of the statute," was correct.

New trial ordered.

Recommendations.

The following recommendations are quoted from the last annual report of the Board: —

Referring in the last annual report to the passage of the registration act in 1894, and to the fact that prior thereto there were no statutory provisions in this Commonwealth for the protection of the people from incompetent practitioners, the Board said: —

In no other direction, or affairs of State, can the police power be exercised more in accordance with an intelligent sense of public duty than in the enforcement of laws enacted for the protection of health and the alleviation of disease. To require, of persons who desire to practise medicine, certain qualifications, or knowledge of the human body in health and disease, is indeed most reasonable. . . . In most of the other States such laws are far in advance of ours in their restrictive provisions, and in their requirements regarding preliminary education, medical instruction and examination tests for fitness to practise. The Board believes that the time has arrived for this Commonwealth to consider further in what directions the scope of the registration act should be extended so as to afford still further protection along the lines originally contemplated.

Since the passage of the act in 1894 some minor perfecting amendments have been made; still, the law is unsatisfactory in many important respects. It should be provided in the law that persons holding certificates of registration should be required to record the same in the clerk's office of the city or town in which they reside or practise. Such a provision would prevent imposition by itinerants and other unregistered persons.

More definite provisions than the present should be made regarding the practice in our border towns by physicians residing in, and qualified to practise in, the adjoining towns in other States.

Section 10, in its amended form in chapter 412 of the Acts of 1895, is liable to different interpretation in different courts as to the intended meaning of its text, also as to its bearing on the last clause of section 11. It should therefore be amended by a new draft. In view of such imperfections and deficiencies in the present statutes, the Board submits recommendations as follows: —

Section 9 of chapter 458 of the Acts of 1894 should be amended so as to provide as follows: —

The examinations for registration as physicians or surgeons under the provisions of chapter four hundred and fifty-eight of the acts of the year eighteen hundred and ninety-four, shall be, in whole or in part, in writing in the English language, and shall be of a scientific and practical character, and sufficiently thorough to test the applicant's fitness to practise medicine. They shall embrace the general subjects of surgery, physiology, pathology, obstetrics and gynecology, practice of medicine, anatomy, and such other subjects as the board may determine.

Section 10 of said chapter should be amended so as to read substantially: —

Any person who, not being then lawfully authorized to practise medicine within this Commonwealth, and so registered according to law, shall hold himself out to the public as a practitioner of medicine, whether by appending to his name the title Dr., or M.D., or any other title or designation implying a practitioner of medicine, or attempting to practise medicine, in any of its branches, within the limits of this Commonwealth, shall be deemed guilty of a misdemeanor, and shall be punished by a fine of not less than one hundred nor more than five hundred dollars for each offence, or by imprisonment in jail for three months, or both; and in no case where any provision of this law has been violated, shall the person so violating be entitled to receive compensation for services rendered.

Section 11 of said chapter should read substantially as follows: —

Nothing in this act shall be so construed as to discriminate against any particular school or system of medicine, or to prohibit service in a case of emergency, or the domestic administration of family remedies; and this act shall not apply to a commissioned medical officer of the United States army, navy or marine hospital service, in the discharge of his official duty; nor to a physician or surgeon from another state, who is a legal practitioner in the state in which he resides, when in actual consultation with a legal practitioner of this Commonwealth; nor to a physician or surgeon residing in another state and legally qualified to practise therein, whose general practice extends into the border towns of this Commonwealth, provided such physician does not open an office nor designate a place in such towns where he may meet patients or receive calls; nor to a physician duly authorized to practise medicine in another state, called as the family physician to attend a person temporarily abiding in this Commonwealth.

Section 4 of said chapter, as amended in chapter 196 of the Acts of 1897, should be amended in the second sentence thereof, so as to provide that: —

Any applicant failing to pass an examination satisfactory to the board, and therefore refused registration, shall be entitled within one year after such refusal to another examination at a meeting of the board called for the examination of applicants, without the payment of an additional fee; and one such re-examination shall exhaust his privilege under his original application.

The law should provide that: —

Authority to practise medicine in this Commonwealth under said act, or the several later acts relating thereto, shall be a certificate issued by the board of registration in medicine; and it shall be unlawful for any person to practise medicine in any of its branches, within the limits of this Commonwealth, who has not registered in the city or town clerk's office of the city or town in which he resides or maintains an office, his authority for practising medicine; and the person so registering shall subscribe and verify, by oath before such clerk, an affidavit containing the number of his certificate of registration and the date of its issue, which if false shall subject the affiant to conviction and punishment for perjury.

In Appendix A will be found a copy of the laws relating to registration, and in Appendix B the names of all the practitioners registered in this Commonwealth.

Respectfully submitted,

C. EDWIN MILES, *Chairman.*
EDWIN B. HARVEY, *Secretary.*
WALTER P. BOWERS.
SAMUEL H. CALDERWOOD.
AUGUSTUS L. CHASE.
NATHANIEL R. PERKINS.
AUGUSTUS C. WALKER.

APPENDIX.

Appendix A.

[Chapter 458, Acts of 1894.]

AN ACT to provide for the Registration of Physicians and Surgeons.

Be it enacted, etc., as follows:

Section 1. The governor, with the advice and consent of the council, shall appoint seven persons, residents in this Commonwealth, who shall be graduates of a legally chartered medical college or university having the power to confer degrees in medicine, and who shall have been actively employed in the practice of their profession for a period of ten years, who shall constitute a board of registration in medicine. Such persons shall be appointed and hold office for terms of one, two, three, four, five, six and seven years, respectively, beginning with the first day of July in the present year, and until their respective successors are appointed, and thereafter the governor, with the advice and consent of the council, shall appoint, before the first day of July in each year, one person qualified as aforesaid, to hold office for seven years from the first day of July next ensuing. No member of said board shall belong to the faculty of any medical college or university. Vacancies in said board shall be filled in accordance with the provisions of this act for the establishment of the original board, and the person appointed to fill a vacancy shall hold office during the unexpired term of the member whose place he fills. Any member of said board may be removed from office for cause by the governor, with the advice and consent of the executive council, and not more than three members of said board shall at one time be members of any one chartered state medical society.

Sect. 2. The members of said board shall meet on the second Tuesday of July next, at such time and place as they may determine, and shall immediately proceed to organize by electing a chairman and secretary, who shall hold their respective offices for the term of one year. The secretary shall give to the treasurer and receiver general of the Commonwealth a bond in the penal sum of five thousand dollars, with sufficient sureties to be approved by the governor and council, for the faithful discharge of the duties of his office. The said board shall hold three regular meetings in each year, one on the second Tuesday of March, one on the second Tuesday of July and one on the second Tuesday of November, and such additional meetings at such times and places as it may determine.

SECT. 3. It shall be the duty of said board immediately upon its organization to notify all persons practising medicine in this Commonwealth of the provisions of this act, by publication in one or more newspapers in each county, and every such person who is a graduate of a legally chartered medical college or university having power to confer degrees in medicine, and every person who has been a practitioner of medicine in this Commonwealth continuously for a period of three years next prior to the passage hereof, shall upon the payment of a fee of one dollar be entitled to registration, and said board shall issue to him a certificate thereof signed by the chairman and secretary.

SECT. 4. Any person not entitled to registration as aforesaid shall, upon payment of a fee of ten * dollars, be entitled to examination, and if found qualified by four or more members of said board shall be registered as a qualified physician, and shall receive a certificate thereof as provided in section three. Any person refused registration may be re-examined at any regular meeting of said board, within two years of the time of such refusal, without additional fee, and thereafter he may be examined as often as he may desire, upon the payment of the fee of ten dollars for each examination. Said board, after a conviction before a proper court for crime in the course of professional business has been shown, and after hearing, may by unanimous vote revoke any certificate issued by them and cancel the registration of the person to whom the same was issued. All fees received by the board under this act shall be paid by the secretary thereof into the treasury of the Commonwealth once in each month.

SECT. 5. The compensation, incidental and travelling expenses of the board shall be paid from the treasury of the Commonwealth. The compensation of members of the board shall be ten dollars each for every day actually spent in the discharge of their duties, and three cents per mile each way for necessary travelling expenses in attending the meetings of the board, but in no case shall any more be paid than was actually expended. Such compensation and the incidental and travelling expenses shall be approved by

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* See amendment, chapter 196, Acts of 1897.

the board and sent to the auditor of the Commonwealth, who shall certify to the governor and council the amounts due as in case of other bills and accounts approved by him under the provisions of law: *provided*, that the amounts so paid shall not exceed the amount received by the treasurer and receiver general of the Commonwealth from the board in fees as herein specified, and so much of said receipts as may be necessary is hereby appropriated for the compensation and expenses of the board as aforesaid.

SECT. 6. The board shall keep a record of the names of all persons registered hereunder, and a record of all moneys received and disbursed by said board, and said records or duplicates thereof shall always be open to inspection in the office of the secretary of the Commonwealth. Said board shall annually report to the governor on or before the first day of January in each year, the condition of medicine and surgery in this Commonwealth, which report shall contain a full and complete record of all its official acts during the year, and shall also contain a statement of the receipts and disbursements of the board.

SECT. 7. It shall be the duty of the board to investigate all complaints of disregard, non-compliance or violation of the provisions of this act, and to bring all such cases to the notice of the proper prosecuting officers.

SECT. 8. On and after the first day of January in the year eighteen hundred and ninety-five the board shall examine all applicants for registration as licensed physicians or surgeons. Applicants must give satisfactory proof of being twenty-one years of age and of good moral character; and every applicant who is a graduate of and has received a degree of doctor of medicine from a legally chartered medical college or university having power to confer degrees in medicine in this Commonwealth, shall be entitled prima facie to be registered under this act, upon the payment of the fees herein provided.

SECT. 9. Examinations shall be, in whole or in part, in writing, and shall be of an elementary and practical character. They shall embrace the general subjects of surgery, physiology, pathology, obstetrics and practice of medicine, and shall be sufficiently strict to test the qualifications of the candidate as a practitioner of medicine.

SECT. 10.* Whoever not being registered as aforesaid shall advertise or hold himself out to the public as a physician or surgeon in this Commonwealth, by appending to his name the letters

* See section 10, as amended, chapter 412, Acts of 1896.

"M.D." or using the title of doctor, meaning thereby a doctor of medicine, shall be punished by a fine of not less than one hundred nor more than five hundred dollars for each offence, or by imprisonment in jail for three months, or both.

SECT. 11. This act shall not apply to commissioned officers of the United States army, navy or marine hospital service, or to a physician or surgeon who is called from another state to treat a particular case, and who does not otherwise practice in this state, or to prohibit gratuitous services; nor to clairvoyants, or to persons practising hypnotism, magnetic healing, mind cure, massage methods, christian science, cosmopathic or any other method of healing: *provided*, such persons do not violate any of the provisions of section ten of this act.

SECT. 12. For the purposes of the appointment of said board, and of registration of persons by it hereunder, this act shall take effect upon its passage, and shall take full effect on the first day of January in the year eighteen hundred and ninety-five. [*Approved June 7, 1894.*

[CHAPTER 412, ACTS OF 1895.]

AN ACT relative to the Registration of Physicians and Surgeons.

Be it enacted, etc., as follows:

Section ten of chapter four hundred and fifty-eight of the acts of the year eighteen hundred and ninety-four is hereby amended by striking out in the third line, after the word "Commonwealth", the words "by appending", and inserting in place thereof the words: — or appends, — also by striking out in the fourth line, the word "using", and inserting in place thereof the word: — uses, — so as to read as follows: — *Section 10.* Whoever not being registered as aforesaid shall advertise or hold himself out to the public as a physician or surgeon in this Commonwealth, or appends to his name the letters "M.D.", or uses the title of doctor, meaning thereby a doctor of medicine, shall be punished by a fine of not less than one hundred nor more than five hundred dollars for each offence, or by imprisonment in jail for three months, or both. [*Approved May 10, 1895.*

[CHAPTER 230, ACTS OF 1896.]

AN ACT relative to the Registration of Physicians and Surgeons.

Be it enacted, etc., as follows:

SECTION 1. All applications for registration as physicians or surgeons under the provisions of chapter four hundred and fifty-eight of the acts of the year eighteen hundred and ninety-four, shall be made upon blanks to be furnished by the board of registration in medicine, and shall be signed and sworn to by the applicants.

SECT. 2. Said board shall examine all applicants, and only such as are found qualified and shall give satisfactory proof of being twenty-one years of age and of good moral character, shall receive certificates of registration as provided in said act: *provided, however*, that said board shall register without examination any applicant whom it may find to be of good moral character, of more than sixty years of age, and a graduate of a legally chartered medical college having power to confer degrees in medicine, and who has been a practitioner of medicine in this Commonwealth for a period of ten years next prior to the passage of this act, and who otherwise complies with the provisions of this act.

SECT. 3. Said board may by a unanimous vote, after a hearing, revoke any certificate issued by it to, and cancel the registration of any person convicted of any crime in the practice of his professional business, or convicted of a felony.

SECT. 4. Any person who shall practice medicine or surgery under a false or assumed name, or under a name other than that under which he is registered, or who shall personate another practitioner of a like or different name, shall be punished by a fine of not less than one hundred nor more than five hundred dollars for each offence, or by imprisonment in jail three months, or both. [*Approved April 1, 1896.*

[CHAPTER 196, ACTS OF 1897.]

AN ACT relative to the Registration of Physicians and Surgeons.

Be it enacted, etc, as follows:

SECTION 1. Section four of chapter four hundred and fifty-eight of the acts of the year eighteen hundred and ninety-four is hereby amended by striking out in the second line, after the words "fee of", the word "ten", and by inserting in place thereof the word: — twenty, — so as to read as follows: — *Section 4.* Any person not entitled to registration as aforesaid shall, upon payment of a fee of twenty dollars, be entitled to examination, and if found qualified by four or more members of said board, shall be registered as a qualified physician, and shall receive a certificate thereof as provided in section three. Any person refused registration may be re-examined at any regular meeting of said board, within two years of the time of such refusal, without additional fee, and thereafter he may be examined as often as he may desire, upon the payment of the fee of ten dollars for each examination. Said board after a conviction before a proper court, for crime in the course of professional business has been shown, and after hearing, may by unanimous vote revoke any certificate issued by them and cancel the registration of the person to whom the same was issued. All fees received by the board under this act shall be paid by the secretary thereof into the treasury of the Commonwealth once in each month.

SECT. 2. This act shall take effect on the first day of August of the current year. [*Approved March 24, 1897.*

APPENDIX B.

OFFICIAL LIST OF PRACTITIONERS OF MEDICINE REGISTERED IN THE COMMONWEALTH TO THIS DATE, DEC. 31, 1899.

NOTE. — The following are the forms of certificates issued: —

Form A, to graduates of legally chartered medical colleges or universities having power to confer degrees in medicine, who applied for registration before the law went into full effect, on Jan. 1, 1895, graduation and residence in the Commonwealth at the time of the passage of the law being the only requirements for registration.

Form B, to those who applied for registration before Jan. 1, 1895, under the three years' practice clause in section 3, three years' continuous practise in the Commonwealth next prior to the passage of the law June 7, 1894, being the only requirement for registration.

Form C, to graduates of legally chartered medical colleges in this Commonwealth who applied for registration subsequent to Jan. 1, 1895, and previous to May 1, 1896, during which period the law permitted their registration without an examination, a diploma from such sources being by the law considered satisfactory evidence of fitness to practise medicine. This provision of the law was repealed May 1, 1896.

Form D, to graduates examined by the Board.

Form E, to non-graduates examined by the Board.

Form F, to graduates of more than sixty years of age, who, prior to the passage of the law, had practised ten years in this Commonwealth, being exempt from an examination by an act approved April 1, 1896.

Certificates D, E and F are the only forms now in use.

A	Abbe, Alanson Joseph.
A	Abbe, Edward Hooper.
C	Abbe, Frederick Randolph.
A	Abbot, Edward Stanley.
D	Abbot, Florence Hale.
A	Abbot, Samuel Leonard.
B	Abbott, Adelaide.
A	Abbott, Charles Edward.
A	Abbott, Charles Shewell.
D	Abbott, Edson Moses.
D	Abbott, Eulalie Marie.
A	Abbott, Fred Lincoln.

Official List of Practitioners of Medicine — Continued.

A	Abbott, Frederick Wallace.
D	Abbott, Howard Edwin.
A	Abbott, John Hammill.
A	Abbott, Samuel Warren.
A	Abbott, Solon.
A	Abbott, Stephen Wendell.
B	Abbott, Sylvina Apphia.
A	Abell, Paul White.
A	Achorn, John Warren.
A	Acken, Thomas Moore.
A	Adams, Charles Eli.
A	Adams, Charles Sumner.
A	Adams, Edward Hitchcock.
A	Adams, Edwin Boardman.
C	Adams, Francis Wayland.
A	Adams, George Edwin.
D	Adams, George Francis.
A	Adams, George Smith.
A	Adams, Henry Oscar.
A	Adams, Herbert Williams.
A	Adams, James Forster Alleyne.
D	Adams, James Thacher.
D	Adams, John.
A	Adams, John Quincy.
D	Adams, Walter Henry.
A	Adams, Wendell Holmes.
D	Adams, William Carlton.
D	Adams, William Gray.
A	Adams, Zabdiel Boylston.
A	Ahearne, Cornelius Augustine.
A	Ahearne, Cornelius Augustine, Jr.
A	Ahlborn, Henry Christian.
A	Aiken, Frank Jonathan.
D	Aiken, Thomas Francis, Jr.
A	Ainsworth, Frank Henley.
A	Albee, George Macdonald.
A	Albee, George Sumner.
D	Alcorn, Thomas Grant.
D	Albro, Christopher Durfee.
B	Alden, Flora Sweet.
A	Aldrich, Albert Clinton.
A	Aldrich, Eben True.
A	Aldrich, James Mott.
A	Aldrich, Nathaniel Borden.
A	Alexander, Clara Jane.
D	Alfred, James.
A	Allard, Frank Ellsworth.
B	Allard, Joseph.
B	Allen, Alfred Morton.
A	Allen, Carl Addison.
D	Allen, Clarence Jean.
D	Allen, David Edmund.
D	Allen, Edward Everett.
A	Allen, Edwin Howard.
A	Allen, Emery A.
C	Allen, Frank Neute.
A	Allen, Franklin Haley.
A	Allen, Gardner Weld.
A	Allen, George Edwin.
A	Allen, Granville Stevens, Jr.
D	Allen, James Henry.
A	Allen, Justin.
A	Allen, Lamson.
A	Allen, Louis Edmund.
D	Allen, Lyman.
B	Allen, Nathan Leverett.
A	Allen, Samuel Johnson.
D	Allen, Seabury Wells.
A	Allen, Stephen Arthur.
A	Allen, William George.
A	Allen, William Howard.
D	Alley, Ernest Jason.
A	Allison, George Freeman.
D	Amadon, Alfred Mason.
A	Amadon, Arthur Frank.
A	Amerige, Charles Wardwell.
A	Ames, Charles Edwin.
A	Ames, John Lincoln.
A	Ames, Joseph Stanford.
A	Ames, Robert Parker Marr.
D	Ames, Winfield Howard.
A	Amesbury, Ivon Cuthbert Raleigh.
A	Amesbury, Walter Raleigh.
A	Amory, Robert.
D	Amsden, Henry Hubbard.
D	Anderson, Hyrum Andrew.
A	Anderson, Martha Ann.
D	Anderson, Thomas.
A	Andrews, Brainard Alge.
D	Andrews, Edward Austin.
D	Andrews, Harold Virgil.
A	Andrews, John Burbank.
A	Andrews, Mary Annette.
D	Andrews, Oren.
D	Andrews, Robert Foster.
A	Andrews, William Henry.
A	Angell, Henry Clay.
D	Angeny, Granville Louis.
A	Anthony, Francis Wayland.
A	Anthony, Jeremiah Christopher.
A	Appleton, Lucy.
C	Appleton, William.
A	Archambeault, Charles Francis.
D	Armstrong, William Lucius.
D	Armstrong, William Willard.
A	Arnold, Horace David.
A	Aronowitsch, Anna.
B	Aronson, Harris.
A	Arthur, Asa Adgate.
C	Ash, John Henry.
D	Atkins, Francis Grant.
D	Atkins, Grace Elizabeth.
C	Atkinson, Leonard Woods.
A	Atkinson, Lizzie Daniel Rose.
D	Atkinson, Roger Trowbridge.
A	Atwater, James Billings.

Official List of Practitioners of Medicine — Continued.

A Atwood, Albert John.
A Atwood, Charles Augustus.
E Atwood, Charles Fenner.
A Atwood, Frank Sumner.
A Atwood, George Manley.
A Auger, Adolphe Alphonse.
A Auger, Henri Michel.
A Auger, Louis Lemaître.
A August, Albert.
A Austin, Arthur Everett.
B Austin, Charles Gorham Stubbs.
D Austin, James Cornelius.
A Austin, Lewis King.
D Avedisian, Avedis Der.
C Averill, George Goodwin.
A Averill, Jesse Howes.
B Averill, Mehitable Merrill.
A Ayer, James Bourne.
A Ayer, Silas Hubbard.
D Ayer, Thomas Herbert.
A Babbitt, Henry Bradford.
A Babbitt, Warren Morris.
A Babcock, Daniel Arnold.
D Babcock, Elisha Franklin.
A Babcock, Francis Lester.
D Bachand, Joseph.
B Bacon, Grenville.
D Bacon, John Lowell, Jr.
A Bacon, Jonas Edward.
A Bacon, Jonas Ambrose Patrick.
E Bacon, Newton Samuel.
D Bacon, Theodore Spaulding.
D Badanes, Ida.
D Badger, Fremont Dayton.
B Badger, George Augustus.
D Badger, George Sherwin Clarke.
A Bailey, Charles.
A Bailey, Charles Hardy.
D Bailey, Ernest Harry.
A Bailey, George Guy.
B Bailey, George Henry.
E Bailey, George Samuel.
B Bailey, Henry Plummer.
D Bailey, Marshall Henry.
A Bailey, Stephen Goodhue.
D Bailey, Walter Channing, Jr.
A Bailey, William Henry.
B Bailey, William Howard.
A Baird, Julian William.
A Baird, William Perry.
D Baker, Albert Sherburne.
D Baker, Chester Monroe.
A Baker, Flint Almena Jane.
A Baker, David Erastus.
A Baker, Frank.
A Baker, Frederick Herbert.
A Baker, Harry Beecher.
A Baker, Jane Rogers.
B Baker, Joseph Calbeck.
A Baker, Leland Madden.
D Baker, Lewis Forrester.
A Baker, Lucius Willard.
A Baker, William Henry.
D Balch, Alfred William.
A Balch, Franklin Greene.
D Balcom, Elmer Irving.
A Balcom, George Franklin.
C Balcom, John Alvin.
A Balcom, Lafayette.
A Baldwin, Frederick William.
A Baldwin, Henry Cutler.
C Baldwin, Herman Trost.
D Baldwin, Sanford Oscar.
A Ball, Charles Dickens Evans.
A Ball, Thomas Joseph.
A Ballance, William Pell.
A Ballard, George Tyler.
B Ballou, Henry Edmund.
E Bamji, Manak.
A Bancroft, Edward Erastus.
A Bancroft, George Andrew.
A Bancroft, Winfred Baxter.
D Bandiera, John.
A Banfield, Francis Loring.
A Bangs, Charles Howard.
A Bannon, Bernard James.
D Bannon, John Hugh.
A Barbrick, John Fraser.
D Bardwell, Frederick Albert.
A Baribault, William Alfred.
D Baright, Herbert Edwin.
A Barker, Emilie Jones.
A Barker, Frank Justin.
D Barnard, Belle Strickland.
A Barnard, Rebecca.
A Barnaud, Elie.
D Barnes, George.
A Barnes, Francis Henry.
A Barnes, Francis John.
D Barnes, Harry Aldrich.
D Barnes, Harry Lee.
A Barnes, Henry Jabez.
A Barnes, Ida Florence.
E Barnes, James Arthur.
A Barnes, William Ellsworth.
D Barney, Charles Norton.
A Barney, Lucy Robinson.
D Barraclough, Alfred Whitley.
A Barré, Joseph Aladin.
E Barrell, Charles Sewell.
A Barrell, George Morton.
D Barrell, Mary Elizabeth.
E Barrett, Joel Lewis.
A Barrett, William Marshall.
A Barrows, William Ezra.
D Barry, Emmet William.
D Barry, James Henry.
D Barry, John Aloysius.

Official List of Practitioners of Medicine — Continued.

B	Barry, William Copinger.
A	Barstow, Benjamin Packer.
A	Barstow, Henry Taylor.
A	Bartlett, Benjamin Webber.
D	Bartlett, Charles Watson.
D	Bartlett, Clarence Samuel.
A	Bartlett, Frederic Russell.
B	Bartlett, George Pinkham.
A	Bartlett, Oliver Leslie.
D	Bartlett, Robert Lander.
E	Bartlett, Samuel Danforth.
A	Bartlett, Solon.
A	Bartol, John Washburn.
A	Barton, Charles Herbert.
A	Barton, Chester Manley.
A	Barton, Jedediah Marcus.
D	Barton, John Alfred.
D	Barton, Walter Emery.
B	Basford, James Lendale.
A	Bass, William.
D	Bassett, Alice Haley.
A	Bassett, Elton James.
D	Bassow, George Joseph.
A	Batchelder, Frederick Prescott.
C	Batchelder, Henry Flanders.
A	Batchelder, John Couch.
A	Batchelder, Mary Ann.
A	Batchelder, William Burdett.
A	Bateman, Frank Elliot.
A	Bates, Everett Alanson.
C	Bates, Mary Elizabeth.
D	Bates, Walter Simpson.
A	Battershall, Joseph Ward.
A	Battershall, Mary Hannah Wolfenden.
A	Baxter, Edward Hooker.
A	Baxter, John.
D	Baxter, William Elihu.
D	Bayliss, Andrew.
A	Baynum, Mary Herrick.
A	Bazin, Adelard.
A	Beach, Henry Harris Aubrey.
D	Beal, Herman Alaric.
D	Beal, Howard Walter.
D	Beals, Arthur Loring.
A	Bean, Charles Pierce.
A	Bean, George Henry.
A	Bean, Jacob Walter.
A	Beane, Newell Wesley.
D	Beaton, Alexander Angus.
D	Beaton, Archibald Edward.
D	Beattie, John.
D	Beattie, Robert Fowler.
A	Beatty, Franklin Thomason.
A	Beauchamp, Aimé.
A	Beauchamp, Joseph Octave.
A	Beauchamp, Zenophide.
A	Beaudet, Napoleon.
D	Beckley, Chester Charles.
A	Bedard, Joseph Armand.
A	Beebe, George Hatch.
A	Beebe, John Belcher.
A	Beebe, Richard.
B	Beecher, John Asbury.
D	Beede, M. Josephine.
E	Beering, Frederick William, Jr.
D	Beñarrell, Sarah Elizabeth.
A	Beland, Henry Severin.
A	Belanger, David Simeon.
D	Belden, Albert Matson.
B	Bell, Christina Eunice Crawford.
A	Bell, George Parson.
A	Bell, Homer Simpson.
A	Bell, James Bachelder.
A	Bell, Robert.
D	Bell, Robert Eddy.
A	Bell, William Appleton.
D	Bellehumeur, Stanislas David.
A	Bellows, Howard Perry.
A	Bemis, Charles Albert.
A	Bemis, Charles Vose.
A	Bemis, John Merrick.
A	Bemis, Merrick.
E	Bemis, Oscar Adelbert.
D	Bender, Prosper.
D	Benjamin, Walter Robinson.
A	Benner, Burnham Roswell.
D	Benner, Herbert Orray.
D	Bennett, Ernest Walsworth.
A	Bennett, Frederick Sherwin.
A	Bennett, John Hilman.
A	Bennett, William Henry.
D	Bennett, William Hurlburt.
A	Bennitt, Francis Marion.
A	Benoit, Benjamin.
A	Benoit, Louis Raymond.
D	Benson, Charles Sweetser.
A	Bent, Gilbert Wesley Warren.
D	Berg, Tekla Amalia Josefina.
B	Bergengren, Frederick Wilhelm Alexis.
A	Bergeron, Francois de Borgia.
A	Bergeron, Seraphin Eusèbe.
D	Bergwall, Walter.
B	Berkman, David Wulf.
D	Berlin, Fanny.
A	Bernard, Barnard Lecherzack.
D	Bernard, Flocker.
D	Bernauer, Emil Constantine.
E	Bernier, Joseph Adolphe.
E	Berry, Charles Francis.
D	Berry, John Cutting.
A	Berry, Lauriston.
D	Berry, Walter Durant.
A	Bertram, William Henry.
D	Bertrand, Alexis Evariste.
D	Berwick, James Roderick.

Official List of Practitioners of Medicine — Continued.

A	Best, Enoch George.
A	Bethune, Donald John.
A	Betts, Helen Loretta.
E	Bicknell, William Horace.
A	Bigelow, Charles Edwin.
A	Bigelow, Enos Hoyt.
A	Bigelow, William Sturgis.
A	Bill, Harriet Parmenter.
A	Billings, William Chester.
A	Bilodeau, Wencelas.
E	Binford, Ferdinand Augustus.
B	Bingham, Edna Melvia.
D	Bingham, Russell.
B	Birch, Sylvanus Jutkins.
D	Birchard, George Grant.
A	Birdseye, Frederick Gould.
A	Birge, Ella Freeman.
A	Birge, William Spafard.
B	Birmingham, Lewis Haydn.
D	Birmingham, Louis Howland.
A	Birmingham, Robert Michael.
D	Biron, Joseph Frederic Rodolphe.
A	Birtwell, Charles Ebenezer.
B	Bishop, Henry Earl.
B	Bishop, Jane Emma.
D	Bixby, Ernest Pierre.
A	Bixby, Josiah Peet.
D	Black, George Luke.
D	Black, Jotham Freathy.
A	Blackmer, John.
A	Blackwood-Chamberlain, Ellen Ramsdell.
A	Blair, Arthur Walter.
A	Blair, James Franklin.
A	Blair, John.
D	Blair, Orland Rossini.
A	Blais, Pierre Gaspard.
A	Blaisdell, George Warren.
A	Blaisdell, James Edward.
A	Blaisdell, Walter Channing.
A	Blake, Charles Abbott.
A	Blake, Clarence John.
A	Blake, Harrison Gray.
A	Blake, John Bapst.
A	Blake, John George.
A	Blake, Le Grand.
B	Blake, Mary Jane.
A	Blake, Warren Perkins.
D	Blakely, David Newton.
A	Blanchard, Albert Henry.
A	Blanchard, Benjamin Seaver.
D	Blanchard, Randall Howard.
A	Blanchard, Walter Irving.
A	Blanchette, Alexander.
D	Blanchette, William Henry.
A	Bliss, George Danforth.
D	Bliss, Jesse Leonti.
A	Bliss, Wilbur Howard.
A	Blodgett, Albert George.
A	Blodgett, Albert Novatus.
A	Blodgett, Charles.
D	Blodgett, John Hammond.
D	Blodgett, John Henry.
A	Blodgett, Stephen Haskell.
A	Blood, Robert Allen.
A	Blossom, Anne Mooers.
D	Boardman, Albertus Kellogg.
A	Boardman, William Elbridge.
A	Boardman, William Sydney.
D	Bohemier, Joseph Eugene Napoleon.
A	Boland, Elisha Shepherd.
A	Bolles, William Palmer.
D	Bolster, Augustus Sargent.
A	Bolton, Charles James.
D	Bolton, William Jackson.
A	Bond, Aaron John.
A	Bond, Sarah Adams.
A	Bond, Willis George.
A	Bongartz, Walter Eugene.
D	Bonney, Charles Austin, Jr.
A	Bonney, Franklin.
D	Bonney, Robert.
C	Bonyman, Harry Evan.
D	Boodro, William Henry.
A	Boody, Charles Hayes.
A	Booth, Anthony Francis.
C	Booth, Edward Chauncey.
A	Booth, Robert.
A	Boothby, Alonzo.
A	Boom, Augustus Keefer.
D	Borden, Charles Richardson Cobb.
A	Borden, Henry Francis.
A	Bossidy, John Collins.
A	Bosworth, John William.
A	Bothfeld, James Francis.
A	Bottomley, John Taylor.
A	Boucher, George Alphonse.
A	Boucher, Joseph Adelard.
A	Bough, Irvin Gustavus.
A	Boulay, Josephus Charles.
A	Bourbonnais, Hermengilde.
D	Boutelle, Harry Clifton.
A	Bowditch, Vincent Yardley.
E	Bowen, Alfred Preston.
A	Bowen, Charles Wesley.
A	Bowen, John Templeton.
A	Bowen, Merritt Alphonso.
A	Bowen, Seabury Warren.
A	Bowers, Walter Prentice.
A	Bowker, Alphonso Varion.
A	Bowker, Charles.
C	Bowker, Everett M.
B	Bowker, Horace Leander.
A	Bowker, John Copps.
B	Bowker, Samuel Dawes.

Official List of Practitioners of Medicine — Continued.

A	Bowles, George Hall.
A	Bowles, Stephen Wallace.
D	Bowman, Anthony William.
A	Bowman, Fred Raymond.
C	Bowman, Winthrop Height.
A	Boyd, Herbert Drummond.
D	Boyd, James Van Wagner.
D	Boyce, Alvin.
B	Boyer, Joel.
D	Boyer, Joseph Napoleon.
D	Boylan, Thomas Edward.
C	Boyle, Alfred John.
D	Boyle, Frank Meagher.
C	Boynton, Edwin Dana.
B	Boynton, Edwin Moses.
E	Boynton, Henry Bullard.
B	Boynton, Stella.
A	Brace, George Welles.
A	Brackett, Elizabeth Annastatia.
A	Brackett, Elliott Gray.
A	Brackett, Humphrey Fall.
A	Bradbury, Charles Huntress.
A	Bradbury, John Elmer.
A	Bradford, Cary Carpenter.
A	Bradford, Edward Hickling.
A	Bradford, Henry Withington.
A	Bradford, Oliver Leach.
A	Bradley, Charles How.
A	Bradley, Charles Seymour.
A	Bradley, Hannah Laura.
A	Bragdon, George Albert.
C	Bragdon, Horace Elwood.
A	Bragg, Francis Adelbert.
A	Brainerd, John Bliss.
A	Braird, William Henry.
A	Braley, Henry Hudson.
D	Branch, Charles Franklin.
B	Brande, Charles Drake.
A	Brandt, William Eugene.
A	Branscomb, William Gower.
A	Bray, Amanda Currier.
A	Bray, Edward Van Deusen.
A	Breck, Samuel.
A	Breck, Theodore Frelinghuysen.
D	Breitling, Joseph Cushman.
A	Brennan, John Joseph.
E	Brennan, Joseph Thomas Louis.
A	Bresenham, Charles Wilson.
B	Breton, Joseph Henry.
D	Brett, Edward Joseph.
A	Brett, Frank Wallace.
A	Brewster, George Washington Wales.
A	Brewster, James Bartlett.
A	Brewster, Mary Jones.
A	Brick, Francis.
D	Brickett, Beatrice Hannah.
D	Bridge, Emma Frances.
A	Bridgham, Charles Burr.
D	Bridgham, Samuel Crosby.
D	Bridgman, Burt Nichols.
A	Briggs, Charles Albert.
D	Briggs, Charles Edwin.
A	Briggs, Charles Poor.
A	Briggs, Clifton Dean.
A	Briggs, Edward Cornelius.
A	Briggs, Frederic Melancthon.
B	Briggs, James Henry.
A	Briggs, Joseph Emmons.
D	Briggs, Lloyd Vernon.
D	Brigham, Clarence Sumner.
A	Brigham, Edwin Howard.
A	Brigham, Frank Fontelle.
D	Brigham, Fred Clayton.
A	Brigham, Hubbard Hammond.
D	Brightman, Helen.
A	Brimmer, Ida Lucinda.
D	Brindamour, Joseph Edmond.
A	Brindisi, Rocco.
A	Brissett, Henry Rupert.
A	Brock, Charles Fremont.
E	Brock, Laurence Ambrose.
A	Brockway, Charles Henry.
D	Broderick, Frank Patrick.
A	Broderick, Thomas Joseph.
D	Broga, William Wallace.
A	Broidrick, James Patrick.
B	Brooks, Frank.
B	Brooks, George Frederick.
A	Brooks, James Fenner.
A	Brooks, Lawton Stickney.
A	Brooks, Samuel Doolittle.
D	Brooks, Simeon Pomeroy.
A	Brooks, William Allen, Jr.
D	Brosseau, Wilfrid Arthur.
A	Brough, David Dandie.
A	Brough, Frank Thomson.
D	Broughton, Arthur Nicholson.
A	Broughton, Henry White.
D	Brousseau, William Gilbert.
A	Brown, Alden Woodbridge.
D	Brown, Alphonso Bickford.
A	Brown, Anthony Leopold.
A	Brown, Charles Robinson.
A	Brown, Daniel Eugene.
A	Brown, Daniel Joseph.
D	Brown, Daniel Rollins.
D	Brown, Edward Manning.
D	Brown, Edward Wells.
A	Brown, Edwin Coleman.
A	Brown, Electa Ann.
B	Brown, Eugene Merchants.
A	Brown, Francis Henry.
A	Brown, Frank Byron.
A	Brown, Frederick Augustus.
D	Brown, Harry Albertus.
A	Brown, Henry Rienzi.
D	Brown, Henry Rolf.

Official List of Practitioners of Medicine — Continued.

A	Brown, Henry Wilson.
B	Brown, Jacob Wales.
A	Brown, John Peaslee.
A	Brown, Marshall Lebanon.
A	Brown, Martin Millard.
D	Brown, Melvin James.
A	Brown, Milton Douglas.
A	Brown, Orestes Morton.
A	Brown, Orland Jonas.
A	Brown, Plumb, Jr.
A	Brown, Roscoe Ellsworth.
A	Brown, Wallace Everett.
A	Brown, Wilfred Gardner.
B	Brown, William Edward.
B	Brown, William Francis.
B	Brown, William Ronald.
A	Brown, William Symington.
A	Brown, Windsor Aldrich.
A	Browne, Percy Gilbert.
A	Browne, Proctor Kinsman.
A	Browne, Will Warpool.
A	Brownell, De Ette.
A	Brownell, William Ellery.
D	Brownrigg, Albert Edward.
A	Brownrigg, John Sylvester.
D	Bruce, Charles Wesley.
A	Bruce, Daniel Angus.
A	Bruce, Emily Allen.
A	Bruce, Frank Colverd.
A	Bruce, John Angus.
D	Brunelle, Pierre.
D	Brush, Frederic Louis.
A	Bryant, Alice Gertrude.
A	Bryant, Anna Mary Dorr.
A	Bryant, Edward Gilman.
A	Bryant, Giles Waite.
A	Bryant, John.
A	Bryant, Lewis Lincoln.
A	Bryant, Virginia Frances.
A	Bryant, William Sohier.
A	Bryson, Adelbert Allen.
A	Buck, Augustus Walter.
A	Buck, Charles John.
D	Buck, Edward Terry.
C	Buck, Howard Mendenhall.
D	Buck, Maurice Allen.
A	Buckingham, Edward Marshall.
A	Buckley, John Francis.
A	Buckley, Philip Townsend.
D	Buehler, George Van Buskirk.
D	Buffum, Herbert Edwin.
D	Bugbee, Marion Louise.
D	Buhrman, Ettie Ray.
A	Bulfinch, George Greenleaf.
A	Bullard, George Eli.
A	Bullard, Herbert Cutler.
C	Bullard, John Thornton.
A	Bullard, William Norton.
C	Bullock, Edwin Warren.
A	Bullock, George Dexter.
D	Bump, Lewis Nye.
C	Bumpstead, Serano Edwards Dwight.
A	Bundy, Frank Eastman.
D	Bunker, Frederic Story.
D	Bunn, Frank Caulkins.
C	Burchmore, Charles Francis Preston.
E	Burden, Ernest Druecilla.
A	Burge, William Prentice.
B	Burgess, Albert Lindsey.
D	Burgess, Charles James.
A	Burgess, Oliver Graham.
D	Burke, Ernest Gisborne.
A	Burke, James Joseph.
D	Burke, Michael Francis.
A	Burke, William George.
D	Burke, William Henry.
A	Burleigh, Charles.
A	Burleigh, Frederick Wing.
D	Burleigh, Robert Fletcher.
D	Burnell, Charles Willard.
A	Burnett, Frank George.
A	Burnett, Frank Hollis.
A	Burnett, Fred Nelson.
A	Burnett, Theodore Crètè.
D	Burnett, William Walton.
D	Burnette, John Everett.
A	Burnham, Charles Abraham.
A	Burnham, Elmond Arthur.
D	Burnham, Frederick Gray.
D	Burns, Frederick Stanford.
A	Burns, Hiram Hutchins.
D	Burpee, Carroll Colby.
D	Burque, Joseph George.
A	Burr, Charles Henry.
A	Burrage, Walter Lincoln.
A	Burrell, Benjamin Henry.
A	Burrell, Herbert Leslie.
D	Burroughs, Amelia.
D	Burt, Charles Kellogg.
A	Burt, Frank Leslie.
A	Burtch, Harry Mercein.
A	Burton, Charles William.
D	Burton, James.
A	Burton, Stephen Caspar.
D	Bush, Charles William.
A	Bush, John Standish Foster.
C	Bushee, James Anson.
A	Bushnell, Homer.
D	Buswell, Albert Currier.
B	Buswell, Arthur True.
E	Butler, Charles Shorey.
D	Butler, David Presbury, Jr.
D	Butler, George Edward.
A	Butler, John Edward.
D	Butler, Rodman.
A	Butler, Winthrop.

Official List of Practitioners of Medicine — Continued.

D	Butler, William Hodnett.
D	Buttler, Charles Voorhees.
B	Butman, William Aaron.
A	Butterfield, George Washington.
C	Butterworth, Mary Frances.
A	Buzzell, Daniel Thompson.
A	Bychower, Victor.
D	Byers, David Walter.
D	Byrne, Charles Armstrong.
A	Cabana, Louis Victor.
A	Cabot, Arthur Tracy.
D	Cabot, Hugh.
A	Cabot, Richard Clark.
D	Cadigan, John Joseph.
A	Cahill, Charles Sumner.
A	Cahill, Eliza Buckman.
A	Cahill, George Stephen.
E	Cahill, John Thomas.
A	Caiger, Albert Edward.
C	Cain, Henry Walter.
E	Cain, Maude Florence.
A	Cain, Willie George.
E	Caisse, George Emile.
D	Caithness, George Eager.
A	Calder, James Squair.
A	Calderwood, Samuel Herbert.
D	Caldwell, Albert Francis, Jr.
C	Caldwell, George Peters.
A	Calkins, Barry Howes.
A	Calkins, Cheney Hosmer.
D	Calkins, Irving Romaro.
A	Calkins, Marshall.
A	Call, Emma Louisa.
A	Callanan, Sampson Aloysius.
A	Callender, Charles Harlow.
D	Calnane, John Andrew.
D	Cameron, Charles Ernest.
A	Cameron, Ewan.
C	Camfill, Robert Emmet.
A	Camp, Charles Welford.
A	Camp, Mary Augusta.
A	Camp, Samuel.
D	Campbell, Annie Butterfield.
C	Campbell, Benjamin Franklin.
A	Campbell, Fidelia Green.
B	Campbell, Henry French.
B	Campbell, James Parker.
D	Campbell, Matthew Philip.
A	Campbell, Patrick Henry.
D	Cane, Francis Edward.
A	Canedy, Francis Joel.
A	Canedy, Fred Snow.
D	Canedy, Ransford De Los.
D	Canfeld, Ralph Metcalf.
A	Cangiano, Marco Antonio.
D	Canney, Ellen Rose.
B	Canning, John Francis.
A	Cannon, David Howland.
D	Capelle, Charles Stanislaus.
A	Capen, Samuel Ross.
A	Capen, Thomas Allyn.
D	Capps, Joseph Almarin.
D	Carbone, Giovanni.
A	Card, Frank Edwin.
D	Card, Horatio Smith.
E	Carden, Charles James.
D	Carl, Bertha Frederica.
D	Carl, Isaac Daniel.
C	Carleton, Dudley.
A	Carleton, Francis Boyd.
A	Carleton, Ralph.
A	Carleton, Charles Greenleaf.
A	Carleton, Charles Horace.
A	Carleton, Elizabeth Abbott.
A	Carlton, Charles Augustus.
C	Carlton, Mary Elizabeth.
A	Carmichael, John Hosea.
E	Carmody, William Francis.
A	Carolin, William Terence.
A	Carpenter, Charles Ormando.
A	Carpenter, Edward Annon.
B	Carpenter, George Clifton.
A	Carpenter, Helen Braddock.
B	Carpenter, Julia May.
B	Carpenter, Mary Adelaide.
B	Carpenter, Sylvester Stiles.
A	Carpenter, William Henry.
D	Carr, Bernard Joseph.
A	Carr, Frank Fletcher.
D	Carr, George Byron.
A	Carr, Lucy Stearns.
A	Carr, Walter Sherman.
B	Carroll, Elizabeth Minnette.
A	Carroll, Francis Edward.
A	Carroll, John Aloysius.
D	Carroll, John Philip.
A	Carroll, Thomas Francis.
D	Carroll, Thomas Francis.
A	Carroll, William Edward.
A	Carruth, Sidney Stetson.
A	Carson, Paul.
E	Carter, Curtis Sumner.
A	Carter, Frank Henry.
A	Carter, Mills Olcott.
A	Carter, Robert Lindsey.
C	Carter, Theron Harlow.
B	Carver, Ichabod.
A	Carvill, Alphonzo Holland.
D	Cary, Foster Harrington.
D	Casgrain, Charles Arthur.
D	Casselbury, Clarence Marmaduke.
D	Castillo, Frank Martin del.
D	Castle, Edward Beardslee.
A	Castle, James.
D	Cate, Frederick Symon.
A	Cate, George Riley.

Official List of Practitioners of Medicine — Continued.

F Cate, Shadrack Mellen.
D Caulfield, George Beresford.
C Cavanagh, Charles Russell.
A Cavanagh, Walter James.
D Cavanaugh, Loretta Katherine.
D Cavanaugh, Mortimer Thomas.
D Caverly, Charles Frank, Jr.
A Celce, Frank Frederick.
A Celce, Jean Henriette.
D Chace, Ann H.
A Chadbourne, Arthur Patterson.
A Chadbourne, Francis Watts.
C Chadwick, Henry Dexter.
A Chadwick, James Read.
D Chaffers, Joseph.
A Chagnon, Charles Emile.
A Chagnon, Joseph Samuel.
A Chagnon, Winceslas John Baptiste.
A Challfaux, Joseph Herménégilde.
A Chalmers, Robert.
A Chamberlain, George Felton.
D Chamberlain, George Elliott.
A Chamberlain, George Washington.
A Chamberlain, Myron Leon.
A Chamberlain, William Eugene.
A Chamberlin, Edward Henry.
B Chamberlin, James Prescott.
D Chamberlin, Theodore.
A Champlin, Martha Godfrey.
A Chandler, Henry Beckles.
B Chandler, Ira.
A Chandler, Luther Graves.
A Chandler, Norman Fitch.
A Channing, Walter.
D Chapin, Alva Le Roy.
D Chapin, Clifford Samuel.
A Chapin, Delia Lucretia.
A Chapin, Frederic Wilcox.
A Chapin, Walter Henry.
A Chapman, Charles Ratchford.
D Chapman, Howard Jones.
D Chapman, William Louis.
D Chaput, Henry Ernest.
A Charbonneau, Joseph.
D Charbonneau, Noe Napoleon.
A Charbonneau, Oliver.
A Charles, Orlando Warrington.
D Charron, Joseph Rosario.
D Charteris, Mary Alena.
A Chase, Arthur Brown.
A Chase, Augustus Lucius.
A Chase, Charles Edmund.
C Chase, Charles Tristram.
D Chase, Daniel Emery, Jr.
A Chase, DeForest Woodruff.
D Chase, Edwin Llewellyn.
A Chase, Eli Ayer.
D Chase, Frank Hills.
A Chase, Henry Melville.
A Chase, Heman Lincoln.
A Chase, Herbert Augustus.
A Chase, Hiram Luce.
A Chase, Horace.
A Chase, Irah Eaton.
A Chase, John Winslow.
A Chase, Joseph, Jr.
A Chase, Richard Fitch.
A Chase, William Bradley.
A Cheever, Clarence Alonzo.
A Cheever, David Williams.
A Chenery, Elisha.
A Chenery, William Elisha.
A Cheney, Frederick Edward.
A Cheney, Oscar Dustin.
B Cherrington, LeRoy Jones.
B Cherry, James B.
D Chesnutt, Arthur Allan.
B Chick, William Harrison.
C Chicoine, Isidore Hermanigilde.
A Child, Edward Moses.
A Childs, Helen Simonds.
A Chipman, Anna Mary.
A Chipman, William Reginald.
A Chirurg, Michael.
A Chisholm, William James.
A Chisholm, William Parmer.
A Choate, David.
D Choate, Horace Henry.
E Choquette, Joseph Henry.
D Chorlian, Kirkor Hovhannes.
A Chubbuck, Lurana Abbie.
A Church, Adaline Barnard.
A Church, Benjamin Taylor.
D Church, Charles Albert.
A Church, Herbert Ashley.
D Church, Mary Violet.
E Churchill, Donald.
C Chute, Arthur Lambert.
A Cilley, Daniel Plumer.
A Cilley, Orran George.
B Claflin, Anna Frances.
A Clancy, William Henry.
E Clapp, Edmund Wright.
A Clapp, Frank Horace.
A Clapp, Herbert Codman.
A Clapp, James Wilkinson.
B Clarendon, James Campbell.
D Clark, Albert Ulysses Franklin.
A Clark, Caleb Wakefield.
A Clark, Clinton Dewey.
A Clark, David.
D Clark, Ezra W.
C Clark, Frederick Lincoln.
D Clark, Frederick Timothy.
D Clark, Genevieve.

Official List of Practitioners of Medicine — Continued.

A Clark, George Henry.
A Clark, George Stillman.
A Clark, Homer.
A Clark, Henry Frederick.
A Clark, James Colby Dorr.
A Clark, James Samuel.
A Clark, John Marther.
A Clark, Joseph Eddy.
A Clark, Joseph Leonidas.
A Clark, Julius Stimpson.
A Clark, Leonard Brown.
A Clark, May Chadbourn.
A Clark, Seth Corbin.
A Clark, Sidney Avery.
A Clark, Stephen Wilson.
A Clark, Theodore Wright.
D Clark, Walter Almon.
A Clark, Walter Thomas.
D Clark, William Goodwin Chadbourne.
A Clark, William Henry.
A Clarke, Augustus Peck.
A Clarke, Edith Leavitt.
A Clarke, Edwin Augustus.
A Clarke, George Clarendon.
A Clarke, George Salisbury.
A Clarke, Henry Little.
A Clarke, Israel James.
B Clarke, John Henry.
A Clarke, Joseph Payson.
A Clarke, Louis Henry.
A Clarke, Maurice Dwight.
A Clarke, Mortimer Hall.
A Clarke, William Crocker.
C Clarke, William Johnson.
E Clarkson, Thomas Carbarns.
D Cleaveland, Daniel Atheam.
E Cleaves, Ezra Eames.
D Cleaves, Frederick Henry.
A Cleaves, James Edwin.
D Cleghorn, Allen MacKenzie.
D Clement, Allen Bell.
A Clement, George Colburn.
A Clement, George Wilmot.
A Clement, Lydia Ramsdell.
E Cleveland, Heber Howe.
D Cleveland, Theodore Parkman.
D Cliff, Alfred Addington.
A Cliff, Leander Albert.
C Clift, Joseph Wales.
A Clock, Frank Benson.
B Clough, Charles William.
E Clough, Frank Herbert.
A Cloutier, Felix Joseph.
A Coady, Patrick Francis.
A Cobb, Albert Crocker.
A Cobb, Carolus Melville.
A Cobb, Charles Henry.
A Cobb, Farrar Crane.
A Cobb, Frederic Codman.
A Cobb, Harriet Hodges.
D Cobb, Oliver Warren.
A Coburn, Henry Harrison.
A Coburn, William Franklin.
A Cochran, George Buck.
A Cochran, William James.
A Cocke, James Richard.
A Codding, Edwin Hayden.
C Codman, Ernest Amory.
A Cody, Edmond Francis.
D Coffey, Leonard James.
A Coffin, Arthur Baylies.
A Coffin, John Lambert.
A Coffin, Juliet Evelyn.
D Coffin, Rockwell Augustus.
D Coffrey, William Francis.
A Cogan, Joseph Ambrose.
C Coggeshall, Frederic.
A Coggin, David.
A Coghlan, John Nicholas.
A Cogswell, Charles Frederick.
A Cogswell, Charles Hale.
A Cogswell, Edward Russell.
A Cogswell, George Proctor.
A Cogswell, William, Jr.
D Cohill, David Young.
E Cohn, Richard.
D Colburn, Frederick Wilkinson.
D Colburn, Harry Hayford.
A Colby, Edward Porter.
A Colby, Edwin Alonzo.
D Colby, Fred Bennett.
D Colby, Gilman.
B Colby, Sarah Ann.
D Colby, William Morrill.
A Colcord, Daniel Webster.
A Cole, Charles Higgins.
A Cole, David Smalley.
D Cole, Lorenzo Waite.
A Cole, Ralph Marcus.
B Cole, Stillman Asbury.
A Cole, William Ezra.
A Coleman, Ellenwood Bunker.
A Collamore, Francis.
A Collet, Peter Achille Anaclet.
A Collier, Lawrence Henry Goodwin.
A Collins, David Aloysius.
A Collins, Edgar Clarence.
D Collins, John James.
A Collins, Orville William.
D Collins, Wallace Jason.
A Collins, William Droien.
D Collins, William James.
A Colt, Henry.
A Colton, John Jay.
B Colvin, William Henry.
A Combs, Leander Warren.

Official List of Practitioners of Medicine — Continued.

A	Comey, Perley Pierce.
D	Comins, James Brooks.
A	Comtois, Odilon Joseph.
A	Conant, Thomas.
A	Conant, William Merritt.
A	Cone, Dwight Eleazer.
A	Congdon, Lennier.
E	Congreve, James Mandeville.
D	Conkey, Caroline Root.
D	Conklin, Jay Robert.
A	Conlan, Thomas.
D	Conlin, Joseph Michael.
A	Conlon, Andrew Aloysius.
A	Conn, Henry Leon.
A	Connell, Arthur Irving.
A	Connell, Charles Walter.
E	Connolly, John Matthew.
D	Connor, Chandos Burton.
B	Connihan, Edward Joseph.
D	Connor, Charles Frank.
A	Connors, Willett Spurgeon.
D	Conroy, Edward Cornelius.
A	Conroy, Peter John.
A	Constans, Frank Elmore.
B	Contré, Pacifique.
A	Conway, James Henry.
A	Cook, Charles Henry.
A	Cook, George Andrews.
A	Cook, Mabell Melissa.
D	Cooke, Henry Arnold.
A	Cooke, Snow Parker Freeman.
D	Cooley, Abbott Lathrop.
A	Coolidge, Algernon, Jr.
A	Coolidge, David Goldthwait.
A	Coolidge, John Nelson.
D	Coon, George Bailey.
A	Coon, Marion.
A	Cooper, Almon.
A	Cooper, Hermon.
A	Copeland, Charles Ward.
A	Copeland, Elmer Humphrey.
A	Copeland, Horatio Franklin.
A	Copeland, William Henry.
A	Copp, Owen.
A	Corcoran, Luke.
A	Corey, Francis Edwin.
A	Corliss, Oscar Luzerne.
B	Cornbloom, Charles.
A	Cornish, Aaron.
A	Cornish, Theodore Osgood.
D	Cornwell, Edwin Sylvester.
D	Corr, Francis Xavier.
A	Corrigan, John Patrick.
D	Costello, John Henry.
A	Cote, Camille.
D	Cote, Honore Joseph.
A	Cotterell, Samuel Parker.
D	Cottle, Louis Albert.
A	Cotton, Frederic Jay.
A	Couch, John Francis.
D	Couch, Oscar Roberts.
A	Couch, William Anthony.
C	Coues, William Pearce.
A	Coughlin, John William.
A	Couillard, Pierre Leonard.
A	Councilman, William Thomas.
A	Courtney, Joseph William.
E	Courtney, Samuel Edward.
A	Cousens, Nicholas William.
A	Couture, Michael Horatius.
A	Cowden, J. Morrow.
C	Cowdrey, Arthur Harris.
A	Cowles, Edward.
A	Cowles, Frank Augustus.
A	Cowles, Fred Waterman.
A	Cowles, Sigourney Trask.
A	Cowles, William Norman.
D	Cox, Gardner.
D	Cox, Thomas.
A	Coy, Seth Willard.
D	Coyle, Walter Edward.
D	Coyne, James Augustine.
A	Crabtree, Addison Darre.
A	Cragin, Francis Milton.
A	Craig, Daniel Hiram.
A	Craigin, George Arthur.
A	Cram, John Wesley.
D	Cramm, William Edward.
D	Crandell, Arthur Richmond.
D	Crandon, Le Roi Goddard.
D	Crane, Carl Custer.
A	Crane, George Walker.
A	Crawford, Charles Henry.
D	Crawford, Francis Xavier.
A	Crawford, John William.
A	Crawford, Sarah Marcy.
D	Crease, Henry George.
A	Crisand, Carl.
D	Crispo, Peter Timothy.
D	Crittenden, Harrison Murray.
D	Crittendon, Rufus Asaph.
A	Croacher, Anna Wood.
A	Crocker, Benton Pulsifer.
A	Crocker, John Myrick.
A	Crocker, Susan Elizabeth.
A	Crocker, Willard Crafts.
A	Crockett, Eugene Anthony.
B	Crockett, Fred.
A	Crockett, Frederick Eugene.
D	Croft, Benjamin Pomeroy.
D	Crofts, Nicholas Matthew.
A	Cronin, Henry William.
D	Cronin, Jeremiah Augustus.
D	Cronin, Joseph John.
D	Cronin, Michael John.
D	Cronin, Thomas Joseph.
D	Crooker, Hiram Henry.
D	Crosby, Frederic Chandler.

Official List of Practitioners of Medicine — Continued.

A Cross, Grace Ella.
A Cross, Hiram Bliss.
D Cross, Louis Kent.
D Cross, William Patrick.
A Crossman, Frank Albert.
A Croston, John Francis.
D Crotty, Thomas Henry.
C Crowell, Hannah Hall.
A Crowell, Samuel.
A Crowell, Willis E.
D Crowley, Ambrose.
A Crowley, Jeremiah Francis.
D Crowley, John Michael.
B Crowninshield, Phoebe.
A Crozier, Thomas.
C Cruikshank, Herbert Wyche.
A Culbert, Robert Ronayne.
A Culbertson, Emma Valeria P. B.
A Culver, Jane Kendrick.
D Cummin, John White.
A Cummings, Charles Stearns.
A Cummings, Edwin Francis.
D Cummings, Frederick Russell.
A Cummings, Irving Oscar.
D Cummings, John Joseph.
A Cummings, Maria Louisa.
A Cummings, Michael Aloysius.
A Cummings, Mott Alvah.
B Cummings, Willard Corydon.
A Cumston, Charles Greene.
A Cundall, Charles Carol.
B Cuneo, Augustus.
A Cunningham, Benjamin Frazier.
A Cunningham, Joseph Henry.
A Cunningham, Thomas Edward.
D Curley, Clarence Proctor.
D Curley, George Frederick.
A Curran, Charles Henry.
A Curran, Charles James.
A Currie, John Zebulon.
A Currier, Mary Barnard.
A Currier, May Carrie.
D Currier, William Eugene.
A Currier, William Hale.
D Curry, Edward Farnham.
D Curry, Joseph James.
E Curtis, Belle Dora.
A Curtis, Francis George.
A Curtis, Hall.
A Curtis, Henry Fuller.
A Curtis, Lucian Willis.
B Curtis, Thomas Mitchell.
D Curtis, William Goodwin.
A Cushing, Alvin Mathew.
A Cushing, Ernest Watson.
A Cushing, Eugene Bonapart.
A Cushing, Hayward Warren.
A Cushing, Henry Joseph.
A Cushing, Ira Barrows.
A Cushing, Oliver Fernald.
A Cushman, Andrew Bernard.
A Cushman, George Thomas.
D Cushman, Mary Floyd.
D Cusick, Thomas Francis.
A Cutler, Cecil Stevens.
A Cutler, Charles Lewis, Jr.
E Cutler, Charles Newton.
A Cutler, Edward Roland.
A Cutler, Elbridge Gerry.
B Cutler, George.
A Cutler, James Tucker.
A Cutler, William Bullard.
A Cutter, Charles Kimball.
A Cutter, Edward Jones.
A Cutter, Ephraim.
A Cutter, John Ashburton.
A Cutter, John Clarence.
A Cutts, Harry Madison.
A Daigneault, Joseph Arthur.
D Dailey, Richard Connell.
A Daily, John Wesley.
A Dake, Dumont Charles.
A Dakin, Edward Arthur.
A Dakin, Mary Anna Dorgan.
A Dale, John Lombard.
A Daley, Robert Nicholas.
D Dalrymple, Addie Blanche.
D Dalrymple, Alfred Tomblinson.
D Dalton, John Edward.
D Dalton, Martin James.
D Dalton, Michael Henry.
A Daly, Bernard Thomas.
A Daly, James.
A Daly, Richard Francis.
D Daly, Timothy Joseph.
C Daly, William Joseph.
A Dam, Alvah Morton.
D Dame, Fred Russell.
A Damon, Arthur Lewylenn.
A Damon, Newcomb Lincoln.
A Dane, John.
D Daniel, Vivian.
A Daniels, Edward William.
A Daniels, Edwin Alfred.
E Daniels, Roy Adelbert.
D Darby, Edward Arthur.
D Darby, Margaret Gurney.
D Darling, Cassius Harriot.
A Darling, Charles Balfour.
A Darling, Eugene Abraham.
A Darrah, Rufus Elmer.
D Daudelin, Siméon Alphonse.
A Davenport, Bennett Franklin.
A Davenport, Charles Albert.
A Davenport, Francis Henry.
D Davenport, Frank Douglass.
A Davidson, Kallman Meyer.
A Davie, Charles Herbert.

Official List of Practitioners of Medicine — Continued.

A	Davis, Andrew Jackson.
D	Davis, Anna Belle.
A	Davis, Bessie Delano.
D	Davis, Charles Henry.
A	Davis, Edward Parker.
A	Davis, Ella Maxfield.
D	Davis, Francis Alvorde.
E	Davis, Frank Albert.
D	Davis, Frank Albin.
A	Davis, Frank Stewart.
A	Davis, Franklin Jerome.
A	Davis, Frederick Augustus.
A	Davis, Frederick Augustus.
D	Davis, George Healy.
D	Davis, Lincoln.
D	Davis, Myron, Jr.
C	Davis, Myron Henry.
A	Davis, Nathan Johnson.
D	Davis, Percy Guy.
A	Davis, Roland Augustus.
A	Davis, Samuel Alonzo.
A	Davis, Samuel Thomas.
D	Davis, Stephen Rich.
A	Davis, Wesley.
B	Davis, William Everett.
E	Davis, William Horace.
B	Davis, William Philip.
D	Davis, Winnifred Puffer.
C	Davison, Archibald Thompson.
A	Dawes, William Greenleaf.
A	Day, Clarence Currier.
B	Day, Henry Bailey.
D	Day, James Arnold.
D	Day, Josiah Fisher.
A	Deal, Edward Edwin.
A	Deal, George Francis.
A	De Amezaga, Gualtiero.
D	Dean, Charles Henry.
D	Dean, Ralph Denniston.
A	Deane, Asahel Sumner.
A	Deane, Ebenezer Alexander.
A	Deane, Henry Augustus.
A	Deane, James Robinson.
A	Deane, Wallace Harlow.
A	Deans, Herbert Clair.
A	Dearborn, Alvah Burton.
A	Dearborn, John George.
A	Dearborn, John Henry.
A	Dearborn, Reuben Fletcher.
A	Dearing, Henry Lincoln.
A	Dearing, Howard Summer.
A	Dearing, Thomas Haven.
A	DeBeer, Johannes Benedic David.
A	De Blois, Thomas Amory.
E	Decker, William Nelson.
A	Dedrick, Albert Clinton.
A	Deehan, Peter Eugene.
A	Defriey, William Peabody.
A	De Grandpré, Louis Phillippe.
A	Dehn, Edward William.
A	De la Granja, Edward.
A	Delahanty, William Joseph.
A	Deland, Charles Airmet.
A	De Langle, Charles Petit.
A	Delano, Marcus F.
A	Delano, Samuel.
A	De Laval-Thyernay, Melville Endore Forbin.
A	De Liguori, Giovanbattista.
A	Delisle, Joseph Damase.
A	De Lue, Frederick Spaulding.
A	Dembo, Fanny.
D	De Merritt, Charles Law.
A	Denig, Blanche Alpine.
A	Denkinger, Joseph Anton.
D	Dennet, Charles Augustus.
D	Dennett, Alonzo Gustin.
D	Dennett, Daniel Clement.
A	Dennett, George William.
A	Dennett, John, Jr.
A	Dennis, James Henry.
C	Dennis, Jane Louise.
D	Dennison, Archibald Sayre.
C	Denny, Francis Parkman.
A	Denny, Harry Ernest.
A	De Normandie, Myra.
B	Derby, Emma Angeline.
A	Derby, Hasket.
A	Derby, William Parsons.
A	Deroin, Francis Xavier.
B	Desmarais, Joseph.
A	Desmario, Joseph Henry.
E	Desmond, Clarence Francis.
A	Desnoyers, Dontagne.
D	Desrochers, Alfred.
D	DesRosiers, Désiré.
A	Desrosiers, Louis Amedie.
A	Désy, Gustave.
D	Devenny, Joseph Henry.
A	Dever, Charles Edward.
D	Devere, Arthur Clarence.
D	Devere, Fred Hewitt.
A	Devereaux, Jane Smith.
A	Devine, William Henry.
A	Dewey, Charles Gipson.
E	Dewey, Melvin Morris.
A	Dewin, Peter John.
A	Dewis, John William.
A	Dewolf, Edward Gardner.
D	Dews, Frederic Gifford.
A	Dexter, Ella Louisa.
A	Dexter, Franklin.
D	Dezell, Frederick Burr.
A	Dickerman, Silas Barnet.
A	Dickins, Job Byron Marcus
A	Dickinson, Charles Henry.
A	Dickinson, Harvey Middleton.

Official List of Practitioners of Medicine — Continued.

D Dickson, Richard Ensign.
D Diemar, Lena Hess.
C Dike, John.
A Dillon, Thomas Joseph Bennett.
E Dillon, Richard Hastings.
A Dimock, Daniel Wright.
A Dinenson, Abraham Isaac.
A Dion, Thomas Joseph.
B Dionne, Louis.
B Dionne, Louis Edward.
D Disbrow, John Robert.
A Disbrow, Robert.
A Disney, Frank Arundel Elias.
A Dixon, Joseph Henry.
A Dixon, Lewis Seaver.
A Dixon, Robert Brewer.
A Dixwell, John.
A Doane, George Washington.
D Doane, Harriet M.
A Doble, Ernest Edgar.
D Dodd, Isaac Spencer Finney.
D Dodge, Arthur Malcolm.
A Dodge, Fred Wilder.
C Dodge, George Smith.
A Dodge, William Wooldredge.
A Doggett, Frederick Fobes.
A Doherty, Charles.
D Doherty, Helen Isabel.
A Dolan, William Andrew.
E Dole, Charles Frederick.
A Dole, Mary Phylinda.
A Dolloff, Albert Simeon.
A Doloff, Eugene Malcolm.
A Donahue, Hugh.
D Donahue, William Francis.
D Donlan, Charles Edwin.
D Donlan, John Malachi.
D Donnell, Rufus Edwin.
D Donnelly, James Harvey.
A Donnelly, John Bernard.
E Donner, John Albert.
D Donoghue, Daniel Francis.
A Donoghue, Francis Dennis.
D Donoghue, James Crowley.
E Donohue, George.
A Donovan, Benedict.
C Donovan, Michael Ricard.
D Donovan, Sylvester Edward.
A Dorcey, James Edmund.
D Dorgan, Joseph Aloysius.
D Dorion, Jean Baptiste Theophile.
A Dorion, Louis Philippe Adélard.
C Dorman, Albert Barnes.
A Dorman, Daniel Webster.
A Dorr, Charles Alonzo.
E Dort, Elizabeth.
A Dorval Tancrède Cesaire.
D Doten, Arthur Chapman.
A Douglas, Charles Joseph.
A Douglass, John Abbott.
D Dow, David Crooker.
A Dow, Edmund Scott.
D Dow, George Farwell.
A Dow, George William.
A Dow, James Arthur.
D Dowd, Edward Francis.
C Dowling, John Joseph.
A Downey, Charles John.
D Downey, Fred Clifton.
D Downey, Henry Arthur.
D Downey, William Henry.
E Downing, Bertha Carol.
D Downing, Franklin Chace.
F Downes, Nathaniel.
A Downs, Harry Ashton.
A Doy, Wilberforce Clarkson.
A Doyle, Daniel Patrick.
A Drake, Arathena Bianca.
E Drake, Arthur Knowlton.
A Drake, Norman Lucca.
D Drake, Olin Milton.
A Drake, William Abram.
D Dranga, Amelia Augenia.
D Draper, Alexis Lumb.
D Draper, Charles Ransom.
A Draper, Frank Eugene.
A Draper, Frank Winthrop.
A Draper, Joseph Rutter.
A Dresser, George.
D Drew, Charles Aaron.
B Drew, Frances Harriet.
A Drew, Frank Haynes.
A Drew, Frederick.
D Drew, Frederick Prescott.
A Drew, Maria Emma.
A Driscoll, Thomas Daniel.
A Driver, Stephen William.
E Drohan, James Henry.
A Drown, Edward Payson.
A Drummey, Nicholas Daniel.
E Drummond, Edward Augustine.
A Drummond, Juan Fernandez Bennett.
D Duckering, William West.
C Dudley, Augustus William.
E Dudley, Charles.
A Dudley, Henry Watson.
A Dudley-Clapp, Susan Ida.
A Duff, John.
A Duggan, John Joseph.
A Duggan, John Thomas.
D Duhalme, Gandlose Lemaitre.
A Duhamel, Oliva Gilbert.
B Du Mont, Henry.
A Dunbar, Frank Collins.
A Dunbar, Franklin Asaph.

Official List of Practitioners of Medicine — Continued.

B	Duncan, Florence Josephine.
D	Dunham, Frank Lee.
A	Dunham, George Perry.
A	Dunham, Henry Bristol.
D	Dunham, Whitefield Otis.
A	Dunlap, Charles Bates.
C	Dunn, Charles Stein.
A	Dunn, Jennie Sophia.
D	Dunn, Stephen Joseph.
C	Dunn, William Aloysius.
A	Dunn, William Ambrose.
A	Dunne, Alexander John.
A	Dunning, William Meddaugh.
B	Dunphy, John.
A	Dupont, Flavien.
B	Duquet, Philorome.
A	Durant, Charles Edwin.
A	Durell, Thomas Moulton.
A	Durgin, Samuel Holmes.
D	Durning, Charles Francis.
A	Dutton, Charles.
A	Dutton, George.
C	Dutton, Samuel Lane.
A	Dutra, Emmanuel Christian.
C	Dutra, Joseph.
D	Dutrizac, Joseph Ovid.
D	Duval, Josias Louis.
A	Duxbury, Joseph Edward.
A	Dwelly, Jerome.
A	Dwight, Edwin Weller.
D	Dwight, Henry Leonard.
A	Dwight, Thomas.
A	Dwinell, Byron Lee.
A	Dwyer, John Edward.
D	Dyer, Charles Lathrope.
D	Dyer, Ebenezer Alden.
D	Dyer, Florence May.
B	Dyer, Frank Pierce.
B	Dyer, Willard Knowlton.
D	Dyer, William Henry.
A	Eames, George Franklin.
A	Earl, George Henry.
A	Earle, William Alva.
D	Early, William Wallace.
A	Eastman, Charles Albert.
A	Eastman, Charles Albert.
A	Eastman-Schenck, Ellen.
B	Eastman, Mary Roena.
D	Easton, Elwood Tracy.
A	Eaton, John Marshall.
A	Eaton, Lilley.
D	Eaton, Richard Gardner.
A	Eaton, Samuel Lewis.
A	Eaton, William Winslow.
A	Eaton, Wyllis Gilbert.
A	Ebann, Charles Deletang.
B	Eckstein, Caroline Katherine.
A	Eddy, George Stetson.
A	Eddy, Hiram McCrery.
A	Eddy, Richard Henry.
C	Edes, Richard Edward.
A	Edes, Robert Thaxter.
A	Edgar, William Ladell.
A	Edgerly, Jonathan Frank.
D	Edmands, Idelle Lydia.
A	Edmonds, Louis.
A	Edson, Carroll Everett.
A	Edson, Ptolomy O'Meara.
D	Edwards, Arthur Frank.
D	Edwards, Franklin Wallace.
D	Edwards, Merton John.
A	Edwards, Thomas Alvin.
A	Edwards, William Lothrop.
D	Egan, Edward Winfield.
C	Egan, John Joseph.
B	Egan, Sebra Temple.
D	Egbert, Jay Hobart.
C	Egland, Christopher.
A	Ehrlich, Henry.
D	Eidam, Carl Hermann.
A	Ela, Paul Francis.
A	Ela, Walter.
D	Elcock, Harry Alfred.
B	Elderen, John Van.
B	Eldridge, Benjamin Davis.
A	Eldridge, David Gorham.
A	Eldridge, Jerrie Allen.
D	Eliot, Henry Whitney.
A	Elliot, John Wheelock.
D	Elliot, Sidney Barrington.
A	Elliott, James Prescott.
E	Elliott, James William.
D	Elliott, Richard Andrew.
A	Elliott, Russell Dunson.
A	Ellis, Charles Curtis.
A	Ellis, Dean Samuel.
A	Ellis, Edward Harvey.
A	Ellis, Frederick Warren.
A	Ellis, George Livingston.
E	Ellis, Sidney Allan.
D	Ellis, William Raymond.
A	Ellison, George Washington.
D	Ellsworth, Samuel Walker.
A	Ellsworth, Victor Albert.
D	Elmere, John Alfred.
D	Ely, Richard Skinner.
A	Emerson, Charles Sumner.
D	Emerson, Ernest Benjamin.
A	Emerson, Francis Patten.
A	Emerson, Frederick Lincoln.
D	Emerson, George Short.
A	Emerson, George Washington.
A	Emerson, Herbert Clark.
A	Emerson, Nathaniel Waldo.
D	Emery, George Edwin.
D	Emery, Harry Smith.
A	Emery, William Henry.
A	Emery, Winfred Newell.

Official List of Practitioners of Medicine—Continued.

D	Enebuske, Claës Julius.
D	Engelman, George Julius.
A	Ensworth, William Howard.
A	Entin, Gilel.
C	Erb, Theodore Charles.
E	Erickson, Anna Maria.
A	Ermentrout, Sallie Justinia.
A	Ernst, Harold Clarence.
D	Estabrook, Charles Taylor.
D	Estes, Florella.
D	Etienne, Arthur Octave, Jr.
B	Evans, David.
E	Evans, Rueben Osgood.
A	Eveleth, Edward Smith.
A	Eveleth, Philemon.
E	Everett, Eugene Ellsworth.
A	Everett, Horace Stanwood.
A	Everett, James Bradley.
A	Everett, Oliver Austin.
A	Everett, Oliver Hurd.
A	Everett, Willard Shepard.
C	Ewald, Carl Adolph.
D	Ewing, Edward Hilts.
D	Fagan, George Augustus
A	Fagnant, Benjamin.
A	Fahey, James Charles.
E	Fair, John Francis.
A	Fairbanks, Arthur Willard.
A	Fairchild, Courtland de Normandie.
D	Fairhurst, O'Connell.
D	Fales, Alonzo Cartland.
D	Falkenbury, Arthur Ezra.
A	Fallon, Michael Francis.
A	Farley, William Chase.
A	Farlow, John Woodford.
D	Farmer, Frank Emerson.
A	Farnham, Charles Chittenden.
A	Farnham, Edwin.
A	Farnham, Mary Eudora.
C	Farnham, John Marshall Willoughby.
B	Farnsworth, Sarah Elizabeth.
D	Farquhar, William Abercromby Gordon.
A	Farr, Edwin Lawson.
D	Farrell, George Louis.
C	Farrington, Annie Louise.
A	Farrington, Leander Morton.
A	Farwell, Charles Luther.
A	Farwell, George Davis.
A	Faulkner, Henry Clay.
A	Faunce, Robert Harris.
A	Faxon, Eudora Meade.
C	Faxon, William Lyman.
A	Faxon, William Otis.
D	Fay, Charlotte Hooker.
A	Fay, Frank Gleason.
A	Fay, James Monroe.
D	Fay, Joseph Henry.
A	Fay, William Eastman.
D	Fearl, Fred Henry.
D	Fecteau, Adelard.
D	Feindel, Joseph Creighton.
B	Fellows, George Robert.
A	Fenwick, Joseph Benson.
A	Ferguson, Arthur Bixby.
A	Ferguson, Charles John.
E	Ferguson, Edward Hugh.
A	Ferguson, Hugh.
D	Ferguson, Robert Henry.
A	Ferland, Joseph Severin Ernest.
A	Fernald, Alberto Francis.
A	Fernald, Charles Augustus.
C	Fernald, Herbert Elwood.
A	Fernald, Otis.
A	Fernald, Walter Elmore.
A	Ferrari, Francesco Edoardo.
A	Ferry, James Francis.
A	Fesler, Frank Joy.
A	Fessenden, Charles Hill.
A	Fessenden, George Russell.
A	Fessenden, Joseph Palmer.
A	Fewell, Samuel Jackson.
A	Fick, Hermann Andrew.
D	Fickett, Jerome Perley.
A	Field, Charles Elmer.
D	Field, Harvey Adams.
A	Field, James Brainerd.
A	Field, Phinehas Peck.
A	Field, Susan Hammond.
A	Fillebrown, Charles Dalton.
A	Fillebrown, Thomas.
D	Finch, Edward Bronson.
D	Finch, George Hardy.
A	Finn, Edward William.
A	Finn, James Anthony.
A	Finnigan, Patrick Joseph.
D	Fish, Ernest Clifford.
D	Fish, Louis.
A	Fish, Ralph Charles.
A	Fisher, Edgar Alexander.
D	Fisher, James Tucker.
A	Fisher, Theodore Willis.
A	Fisher, Preston.
A	Fisk, Charles Lee, Jr.
A	Fisk, William Willard.
A	Fiske, Eustace Lincoln.
D	Fiske, Harlo Adoniram.
A	Fitch, Edward Doolittle.
D	Fitts, Alston.
A	Fitz, George Wells.
A	Fitz, Reginald Heber.
D	Fitzgerald, Charles Francis.
D	Fitzgerald, Clara Pauline.
A	Fitzgerald, James Bernard.
D	Fitzgerald, Maurice Edward, Jr.
D	Fitzgerald, Thomas Patrick.

Official List of Practitioners of Medicine — Continued.

D	Fitzgerald, Vance Lee.
A	Fitz-Hugh, John Alexander.
A	Fitzsimmons, Philip Mansfield.
A	Flagg, Alpheus Dexter Smith.
D	Flagg, Cora Hosmer.
A	Flagg, Edwin Barber.
C	Flagg, Franklin Parkinson.
A	Flagg, Herbert Horatio.
B	Flagg, Jonathan.
A	Flagg, Payson Jonathan.
D	Flanagan, Peter Joseph.
D	Flanders, Alton Leroy.
A	Flanders, Frank Byron.
D	Flanders, Walter Hubert.
A	Fleet, William Earnest.
A	Fletcher, Robert Whitney.
A	Fletcher, Rosa.
A	Fletcher, Samuel Ernest.
A	Fletcher, Samuel William.
A	Fletcher, William Kelly.
D	Fleming, Margaret Amanda.
D	Flemming, Anthony.
A	Flewelling, Douglas Scovil
A	Flinn, Matthew Bonner.
A	Flint, Charles Cookeman.
A	Flint, Omar Alpha.
A	Flood, Everett.
A	Flower, Alfred Hollis.
A	Flower, Richard Charles.
E	Flynn, John Edward Leo.
A	Flynn, John Joseph.
D	Flynn, John Joseph.
A	Fogerty, Williams Clemmons.
A	Fogg, Irving Sylvester.
D	Fogg, Walter Augustus.
A	Foley, Timothy John.
A	Foley, Walter James Paul.
A	Follett, Ammi Ward.
A	Follet, John Atwood.
A	Folsom, Charles Follen.
A	Folsom, Norton.
A	Fontaine, Marc.
C	Fontaine, Henri Theophile.
A	Forbes, Charles Holt.
E	Forbes, Edwin Bannister.
A	Forbes, George Foster.
A	Forbes, Henry Gordon.
A	Forbush, Albert Waldo.
B	Ford, Daniel Frink.
A	Ford, John Francis.
D	Ford, Michael Angelo.
B	Forrest, Josephine Winifred.
D	Forrest, Robert Francis.
A	Fortin, Julian Elzéar.
D	Fosgate, Elmer Gilman.
D	Foskett, Eben.
A	Foskett, George Mason.
A	Foss, David.
A	Foss, John William.
E	Foss, Percy Harold.
A	Foss, Warren Sartwell.
A	Foster, Charles Chauncy.
D	Foster, Clarendon Atwood.
A	Foster, Edwin Scott.
A	Foster, Frank Albert.
E	Foster, Frank Brooks.
A	Foster, George Emory.
A	Foster, Horace Kendall.
A	Foster, James Milton.
A	Foster, James Richards.
D	Foster, Louis Everett.
D	Foster, Matthias Lanckton.
D	Foster, Winifred Smith.
A	Fountaine, Felix Dydime.
C	Fourtin, Edmund Randolph Peaslee.
A	Fox, William Yale.
A	Foye, Charles Frederick.
A	Frame, Joseph.
C	Francis, Adeline Eliza.
A	Francis, Carleton Shurtleff.
A	Francis, George Ebenezer.
A	Francis, George Hills.
A	Francis, Tappan Eustis.
A	Francois, Edward Albert Louis.
A	Franfaglia, Gabriéle.
D	Frankel, Charles Louis.
B	Franks, Baron.
A	Franz, Adolph.
A	Fraser, Donald Allan.
A	Fraser, John Chisholm.
D	Fraser, Roderick.
D	Fraser, William Leslie.
E	Frasier, Joseph Anthony.
B	Fréchette, Clément.
A	Freeman, Franklin Willard.
A	Freeman, Frederick Augustus.
D	Freeman, George Franklin.
A	Freeman, Russell Ballou.
A	Freeman, Simon Augustus.
A	French, Alfred Joseph.
A	French, Charles Austin.
A	French, Charles Ephraim.
A	French, Charles Henry.
A	French, Charles Lindol.
A	French, Charles Peaslee.
D	French, Edward Henry.
B	French, Elizabeth J.
A	French, George Henry.
A	French, George Morrill.
D	French, John Innes.
A	French, John Marshall.
E	French, Towneley Thorndike.
A	French, Winslow Burrell.
E	Frietas, José Carlos de.
B	Frink, Charles Tatman.
D	Frink, Lewis James.
A	Frisbie, Jesse Franklin.

Official List of Practitioners of Medicine — Continued.

A	Frissell, Edward Merle.
A	Frizzell, Seraph.
B	Frost, Charles Chauncy.
A	Frost, Edward Clayton.
D	Frost, Flora Eva.
D	Frost, Horace Bird.
D	Frost, Samuel Kapp.
A	Frost, Woodbury George.
D	Frothingham, Charles Benjamin.
A	Frothingham, James Edward.
D	Frumson, Lazarus.
A	Fry, Charles Wilson.
A	Frye, Charles Marshall.
A	Frye, Edmund Bailey.
A	Fryer, Winson Farnum.
B	Fuller, Amos Warren.
A	Fuller, Charles Metcalf.
A	Fuller, Daniel Hunt.
D	Fuller, Elmer Ellsworth.
D	Fuller, Ernest Page.
D	Fuller, Etheridge Ide.
D	Fuller, Frank Boutelle.
A	Fuller, Frederick Henry.
B	Fuller, George Albion.
A	Fuller, George Ephraim.
A	Fuller, James Robert.
D	Fuller, Solomon Carter.
B	Fuller, Walter Tracy.
D	Fullerton, Walter Wilson.
D	Furniss, Maud Granger.
A	Fyfe, Thomas Tass.
A	Gaertner, Alexander.
A	Gaffney, John Patrick.
A	Gaffney, Henry Joseph.
A	Gage, Edward Franklin.
A	Gage, Homer.
A	Gage, James Arthur.
A	Gage, Thomas Hovey.
A	Gaggioli, Girolamo.
A	Gagnon, Joseph Alfred.
A	Gahan, Edward William.
D	Gahan, Myles Joseph.
D	Gahan, Patrick Francis.
D	Gaidzakyan, Ohan.
B	Galbenewetz, Benjamin Goth.
D	Galboury, Henri Tancrede.
A	Gale, George Washington.
A	Gale-Warren, Mary Kendall.
B	Gallagher, James Thomas.
D	Gallagher, Thomas Morton.
D	Gallagher, William Howard.
A	Galligan, Edward Francis.
D	Galligan, Edward Joseph.
C	Galligan, Eugene Thomas.
A	Gallison, Ambrose John.
A	Gallison, Henry Hammond.
A	Gallison, Jefferson Cushing.
A	Gallivan, William Joseph.
A	Galloupe, Benjamin Franklin.
A	Galloupe, Charles William.
A	Galloupe, Isaac Francis.
E	Galloupe, Joseph Abbott.
A	Galvin, George William.
A	Galvin, William.
E	Gammell, Samuel.
A	Gannett, William Whitworth.
A	Gannon, Annie Margaret.
B	Gannon, Anna Maria.
D	Garabrant, Lillian.
A	Garceau, Edgar.
A	Gardiner, Perley Forest.
A	Gardner, Clarence Rhodolphus.
A	Gardner, Edward Everett.
A	Gardner, Frank Augustine.
A	Gardner, George Henry.
D	Gardner, Harry Milton.
A	Gardner, William Wallace.
A	Garey, Charles Wendell.
B	Garfield, John.
A	Gariepy, Joseph Camille.
A	Garland, Albert Stone.
D	Garland, George Franklin.
A	Garland, George Minot.
A	Garland, Guy W.
A	Garland, Joseph.
A	Garland, Joseph Everett.
A	Garmon, John Oscar.
A	Garneau, Joseph Pierre Alphonse.
D	Garrett, Frank Steele.
A	Garrigan, Thomas James.
A	Gary, Clara Emerette.
D	Gates, Ernest A.
A	Gates, George Wellesley.
D	Gates, James Moseley.
B	Gauthier, Franklin.
A	Gavin, George Freebern.
A	Gavin, John Harrison.
E	Gavin, Joseph Leo.
A	Gavin, Michael Freebern.
A	Gavin, Patrick Freebern.
A	Gay, Almon De Bois.
A	Gay, Arthur Park.
D	Gay, Clarence Bertram.
A	Gay, George Washington.
B	Gay, Mary Cochran.
A	Gay, Warren Fisher.
E	Gay, William Frederick.
A	Gaylord, John Flavel.
E	Gaylord, William Avery.
A	Geddes, Peter Spearce Walker.
A	Gelineau, Charles William.
A	Gelineau, Ovila Clément.
A	Gendron, Joseph Alexander.
A	Gendron, Joseph Etienne.
A	Genereux, Joseph Albérie.
A	Genereux, Joseph Oliver.

Official List of Practitioners of Medicine — Continued.

D George, Arthur Phillips.
A George, Oscar Fowler.
D Germain, Harry Homer.
A Gerould, Joseph Bowditch.
A Gerry, Edwin Peabody.
D Gerstein, Morris.
D Gerin-Lajoie, Mederic Thomas.
B Gertz, William Henry.
A Gervais, Emery.
A Getchell, Albert Colby.
C Getchell, Stillman Perry.
D Gibbons, Lister.
E Gibbons, Sherwin.
A Gibbs, Howard Augustine.
A Gibbs, Linnaeus Victor.
A Gibbs, Lucero Jackson.
A Gibbs, Samuel Whelpley.
D Gibbs, Susan Burley Harris.
A Gibby, Isabel Parker.
A Giblin, Frank Joseph.
A Gibson, Arthur Allen.
B Gibson, Elwyn Deloss.
D Giddings, Theodore.
A Gidman, Bramwell Carvosso.
A Gifford, Benjamin Dods.
A Gifford, Fred Hooker.
A Gifford, John Henry.
F Gifford, Silas Swift.
A Giguere, Joseph.
A Gilbert, Aurelia Eliza.
A Gilbert, Daniel Dudley.
D Gilbert, Frank Leslie.
A Gilbert, John.
D Gilbert, Louis Whitmore.
E Gilchrist, Charles Robert.
A Gildee, James Bennett.
A Gile, John Martin.
B Gilfether, Frank Emmet.
C Gilfillan, Thomas.
D Gillard, Arthur Ernest.
A Gillespie, John.
D Gillette, Claudius Wesley.
D Gillingham, Horace Porter.
A Gilman, Eugene Albert.
D Gilman, Frank Madison.
A Gilman, Warren Randall.
D Gilmartin, Albert Edward.
C Ginn, David Richards.
D Girdner, John H.
A Gironard, Simeon Joseph.
D Girouard, Joseph Arthur.
D Giroux, Charles.
A Giroux, Joseph Raymond.
A Glancy, Charles Augustine.
B Glancy, William Carte Minnette.
A Glazier, Frederick Prentiss.
A Gleason, Charles Sherman.
D Gleason, Edward Francis.
A Gleason, Edwin Putnam.
A Gleason, Mardis Edward.
D Gleason, Willis Webster.
A Glendenning, Robert Thompson.
A Glennon, Michael.
E Glidden, Howard Kenneth.
A Gobron, Louis Constant.
D Goddard, Abigail Elma.
D Goddard, Henry Edward.
A Goddard, Josiah Hamilton.
A Godfrey, Joseph Witter.
D Godfrey, Thomas Francis.
A Godin, Joseph.
E Golden, Lazarus.
A Golden, Michael Charles.
A Goldthwait, Joel Ernest.
A Goldthwaite, Seth Vale.
B Good, Jacob Adam.
A Goodale, George Lincoln.
A Goodale, Joseph Lincoln.
D Goodall, Ellis Leon.
D Goodall, Henry Skinner.
A Goodell, George Zina.
C Goodell, Jonathan Woodard.
D Goodenow, Daniel.
A Gooding Emma Jeanette.
A Goodman, Nathan Mark.
A Goodman, Samuel.
A Goodspeed, Helen Amanda.
A Goodwin, Charles Otis.
D Goodwin, Edward Everett.
D Goodwin, Elmer Ellsworth.
A Goodwin, George Erving.
A Goodwin, James Joseph.
A Goodwin, Richard James Plumer.
A Goodwin, Tirzah Eveline.
A Goodwin, Wilford Watson.
A Goray, James Philip.
A Gordon, John Alexander.
A Gordon, Miles Remond.
C Gordon, Stephen Masury.
A Gorham, Frederic Croswell.
A Gorshel, Richard.
A Goss, Arthur Vincent.
A Goss, Francis Webster.
A Gottschalk, William von.
D Groll, Maximilian Charles von.
A Gould, Charles Asahel.
A Gould, Clarke Storer.
D Gould, Chester Harlow.
B Gould, Forrest Burton.
A Gould, Frank Moriah.
F Gould, Joshua Bayley.
D Gould, Lawrence Merwin.
D Goulding, Timothy Francis.
D Grace, Ralph.
B Grady, John William.
A Grady, Joseph William.

Official List of Practitioners of Medicine — Continued.

D	Grady, Patrick Anthony Salmon.
A	Graham, Douglas.
D	Graham, Maria Louise.
A	Grainger, William Henry.
A	Granger, Frank Clark.
D	Granger, Karle Henry.
A	Grant, James Henry.
A	Grant, James Henry.
A	Grant, William Herbert.
D	Graves, Benjamin Augustus.
A	Graves, Frank Walker.
E	Graves, Frederick Clinton.
E	Graves, Walter John.
A	Gray, Charles Henry.
D	Gray, Elizabeth Taylor.
A	Gray, George Henry.
E	Gray, Hugh Barr.
A	Gray, Robert Williams.
E	Greaves, John George.
A	Greeley, William Henry.
A	Green, Charles Montraville.
A	Green, Jacob.
A	Green, John Orne.
A	Green, Milbrey.
A	Green, Thomas William.
D	Greenaugh, Robert Battey.
E	Greene, Daniel Crosby, Jr.
A	Greene, Edward Miller.
A	Greene, Frank Alonzo.
A	Greene, Frank Eugene.
A	Greene, Harrie William.
A	Greene, James Sumner.
A	Greene, Jered Alonzo.
A	Greene, Nathaniel.
A	Greene, Ray Woodville.
A	Greene, Reuben.
A	Greene, Robert Anderson.
A	Greene, Thomas Francis.
D	Greene, William Addison.
D	Greene, William Henry.
A	Greenleaf, George Walter.
A	Greenleaf, John Ruggles.
A	Greenleaf, Richard Cranch.
A	Greenleaf, Robert Willard.
D	Greenough, Clara Mary.
A	Greenwood, Allen.
A	Greenwood, Sewell Elliott.
A	Gregg, John Argelo.
B	Gregoire, Albert.
A	Grieumard, George Augustus.
B	Griffin, Alva James.
A	Griffin, Arthur George.
D	Griffin, Frederic Stanley.
A	Griffin, Louise Amanda.
A	Griffith, John Auckland.
D	Griffith, Thomas Richards.
E	Grimes, James Henry.
D	Grimes, Warren Parker.
A	Grinfield-Coxwell, John Edward.
B	Grise, Herman Pierre.
D	Griswold, Merton Lyman.
A	Groll, Edward Wright.
D	Gross, Hermann Williams.
A	Grouard, John Shackford.
D	Grovestein, William Pride.
A	Grow, Timothy Rose.
A	Gruver, Samuel James.
A	Guertin, Auguste.
A	Guild, Edgar Hunt.
A	Guild, Edward Frank.
D	Guild, Thomas Ezra.
D	Guller, Robert Workman.
D	Guimond, Omer.
D	Gulick, Luther Halsey.
A	Gunning, Thomas Francis.
A	Gunter, Adolphus Byrum.
A	Gunter, Fred Berkeley.
A	Guptill, Ira Clark.
A	Guptill, Lucian Hayden.
D	Gurley, Revere Randolph.
D	Guy, Walter Bryant.
D	Gwin, Robert Campbell.
D	Haché, Henry Clement.
A	Haddock, Charles Whitney.
A	Hagopian, Sarkis Morkir.
A	Hahn, Ammi Rahamah.
D	Haines, Ignatius.
A	Hale, Edward Preston.
A	Hale, Edwin Emery.
B	Hale, George Carleton.
A	Hale, Josiah Little.
D	Hale, William.
B	Hale, William Alonzo.
C	Hall, Charles Brackett.
D	Hall, Charles Francis Adams.
A	Hall, Charles Henry.
A	Hall, George Clifton.
D	Hall, Herbert James.
D	Hall, Harry Porter.
E	Hall, James Frank.
D	Hall, James Sanberg.
A	Hall, Mahlon Freeborn.
A	Hall, Milton Wilder.
A	Hall, Newbert Jackson.
D	Hall, Rufus Hacker.
D	Hall, Walter Davis.
A	Hall, Walter Langdon.
D	Hall, William.
A	Hall, William Dudley.
A	Hallett, Edward Bangs.
A	Hallett, Walter Lewis.
A	Halloran, Michael Joseph.
E	Halloran, Timothy Joseph.
A	Hallowell, Clement Howard.
A	Hallowell, Henry Carleton.
C	Halpin, Andrew James.

Official List of Practitioners of Medicine — Continued.

D	Halsted, Alfred Thompson.
A	Halsey, Frederick Wadsworth.
D	Hamblen, Edward Everett.
D	Hamilton, Annie Lee.
E	Hamilton, Edward Sylvester.
A	Hamilton, Erskine Erasmus.
A	Hamilton, Theodore Erskine.
E	Hamilton, Walter.
D	Hamlin, Charles Franklin.
D	Hamlin, William Edward.
A	Hammersley, Jonathan Beadmore.
A	Hammond, Allen Dexter.
A	Hammond, Lemuel Hodges.
A	Hammond, Philip.
A	Hammond, Roland.
D	Hammond, William John.
A	Hammond, William Penn.
A	Hands, Anna Carville.
A	Hands, Herbert Abraham.
A	Handy, Benjamin Jones.
A	Handy, Harrie Delmar.
D	Handy, Harry Tucker.
A	Hanley, Francis Joseph.
A	Hanley, John Joseph.
A	Hanlon, Daniel James.
A	Hanna, Edmund Steelman.
A	Hannum, James Wilson.
D	Hanscom, Walter Vose.
A	Hanscom, Sanford.
A	Hanson, Frederick Augustus Tafte.
A	Hanson, William Green.
D	Harding, Ambrose Hastings.
A	Harding, Edward Mitchell.
A	Harding, George Franklin.
D	Harding, Walter Allen.
A	Harding, Wilbur Fisk.
A	Hardy, Charles Silenus.
D	Hare, Andrew Jackson.
A	Hare, Charles Henry.
D	Hare, William Andrew.
B	Hargrove, Alfred.
B	Hargrove, Frances Flora.
B	Hargrove, Sidney Bulwer.
E	Harkins, Cornelius Patrick, Jr.
A	Harkins, Daniel Stanislaus.
A	Harlow, Corydon Webster.
A	Harlow, George Arthur.
A	Harlow, Granville Albert.
A	Harlow, Harriet Susan.
A	Harlow, John Martyn.
D	Harman, Austin Roy.
A	Harmon, Byron Richmond.
A	Harmon, Melville Alphonzo.
A	Harriman, Charles Henry.
A	Harriman, James Lang.
A	Harriman, Samuel Knight.
A	Harrington, Arthur Hudson.
A	Harrington, Charles.
D	Harrington, Charles Woodbury.
A	Harrington, Francis Bishop.
A	Harrington, Francis Michael.
A	Harrington, Harriet Louisa.
A	Harrington, Thomas Francis.
D	Harris, Arthur Eugene.
D	Harris, Charles Edward.
A	Harris, Emanuel.
A	Harris, Francis Augustine.
A	Harris, Georgianna Warren.
E	Harris, Samuel Jacob.
B	Harris, Sophia Roper.
D	Harris, William Landow.
A	Harrower, David, Jr.
B	Hart, Charles Oliver.
E	Hart, Francis Joseph.
A	Hart, George Fred.
D	Hart, Henry Brown.
E	Hart, Joseph Storer.
B	Hart, Mary Schoonmaker.
D	Hart, Michael Joseph.
A	Harte, Richard Hickman.
A	Hartley, Henry Alexander Saturnise.
D	Hartley, Rebecca Agnes.
D	Hartnett, Edward Daniel.
D	Hartshorn, Edward.
D	Hartung, Harry Hall.
B	Harvey, Alvah.
A	Harvey, Edwin Bayard.
B	Harvey, Elvira Adelaide.
E	Harvey, Frank.
A	Harvey, Frank T.
A	Harvey, Henry Sydney.
A	Harvey, John Franklin.
A	Harvey, Walter Emerson.
E	Harvey, William Wirt.
D	Hartwell, Arthur Spear.
A	Hartwell, Benjamin Hall.
A	Hartwell, Edward Mussey.
D	Hartwell, Harry Fairbanks.
A	Harwood, Charles Hamant.
D	Hasbrock, Ira Daniel.
A	Haskell, Henry Hill.
D	Haskell, Lyman George.
A	Haskell, Nelson Cary.
D	Haskins, Frank Henry.
A	Haskins, Solomon Foot.
A	Haslam, Frank Alden.
A	Hassett, John Joseph.
A	Hastings, Benjamin Franklin.
A	Hastings, Caroline Eliza.
B	Hastings, Frank Josiah.
D	Hastings, John Mason.
A	Hastings, Judson Worthington.
A	Hastings, Robert Worthington.
A	Hastings, William Henry Howe.
A	Hatch, Anselm Dimmic.

Official List of Practitioners of Medicine — Continued.

D	Hatch, Edward Sparhawk.
D	Hatch, George Stephen.
D	Hatch, Leonard Francis.
A	Hatchett, William Josephus.
E	Hatfield, Hugh Kerr.
A	Hathaway, Clarence Lockwood.
D	Hathaway, John Gael.
B	Hathaway, Marcus Morton.
A	Hathaway, Sarah Lewis.
A	Hathaway, William Fales.
A	Haub, Augustine Catherine.
A	Haven, George.
D	Haviland, Nathaniel Clark Bacon.
A	Hawes, Edward Everett.
A	Hawes, Joseph Quinnum.
B	Hawkins, Horatio Gates.
A	Hawks, Alfred Joseph.
A	Hawks, Esther Hill.
A	Hay, Gustavus.
D	Hayden, Lewis Brooks.
A	Hayden, William Richardson.
A	Hayes, Albert Hamilton.
D	Hayes, Frederick Legro.
A	Hayes, Irving Benjamin.
B	Hayes, John Joseph.
A	Hayes, Justin Gideon.
A	Hayes, Stephen William.
D	Hayford, Herbert Scott.
A	Haynes, Charles Frederick.
D	Hayward, Abner.
A	Hayward, Joseph Warren.
A	Hayward, Levi Thomas.
D	Hayward, Walter Barrows.
D	Hayward, William Frank.
C	Haywood, George Griswold.
A	Haywood, George William.
A	Haywood, Isabel Pridham.
A	Hazard, George Stevens.
A	Hazelton, Isaac Hills.
D	Heald, Charles Gerry.
A	Heald, Joseph Berthelet.
A	Heald, William Frederick.
D	Healy, Daniel Laurence.
A	Healy, James Joseph.
D	Healy, John Aloysius.
D	Healy, Thomas Raymond.
A	Heard, John Theodore.
B	Heath, Abbie Knowlton Marden.
A	Heath, Joseph Webster.
A	Hebbard, Ellery Cola.
A	Hebbert, Charles Alfred.
D	Hébert, Georges.
A	Hedenberg, James.
A	Heffern, Patrick William.
A	Heigham, Jabez William.
D	Hemeon, Frederick Chipman.
D	Hendee, Leslie Horatio.
A	Henderson, Charles Russell.
A	Henderson, Pinckney Marion.
A	Hendrickson, Charles Damarin.
D	Henin, Chaim Chaimor.
A	Henion, John Briggs.
B	Henotte, Constant.
A	Henry, John Goodrich.
A	Henshaw, George Bridges.
A	Herrick, Edward Barton.
A	Herrick, Joseph Thomas.
E	Herrick, Timothy George.
D	Herrick, Van Buren.
A	Hersey, Freeman Clark.
A	Hetherington, Gilbert Edwin.
C	Hewes, Henry Fox.
A	Hewins, Parke Woodbury.
D	Hewitt, Clarence Elbert.
D	Hews, India Cochel.
A	Hichborn, Herman Granville.
A	Hickey, Garrett Joseph.
D	Hickey, John Aloysius.
D	Hickey, Lawrence Joseph.
D	Hicks, Charles Andrew.
D	Hicks, Elias Peter.
A	Hicks, Joseph.
A	Hidden, Charles Walter.
A	Higbee, Edwin Wilbur.
A	Higgins, Frank Albert.
D	Higgins, Harry Eugene.
A	Higgins, Henry Rich.
A	Higgins, James Hayden.
B	Higgins, John Henry.
B	Higginson, Ella Aurilla.
A	Hildreth, John Lewis.
A	Hildreth, William Hartwell.
A	Hill, Almon Ward.
B	Hill, Calvin Augustus.
D	Hill, Edgar Dwight.
D	Hill, Eugene Woodbury.
C	Hill, George Hillard.
D	Hill, George Sumner.
D	Hill, Ira Clark.
A	Hill, Ira Joseph.
A	Hill, Lucy Chaloner.
B	Hill, Mary Jenerson.
A	Hill, Noble Hind.
A	Hills, Frederick Lyman.
A	Hills, William Barker.
A	Hills, William Henry.
A	Hilton, George Whitefield.
D	Hilton, John Daniel.
B	Hiltpold, Jacob.
D	Hinchcliffe, Harry Palmer.
D	Hinchey, Richard.
D	Hinckley, Daniel Rose.
D	Hinckley, James William.
A	Hincks, William Sylvanus.
A	Hines, Archelaus Don.
A	Hines, Francis Edward.

Official List of Practitioners of Medicine — Continued.

A	Hines, Isaac Bright.
A	Hipkiss, George.
D	Hinson, Jacob Miller.
A	Hitchcock, Alfred Owen.
A	Hitchcock, Edward Bigelow.
A	Hitchcock, George Goodwin.
A	Hitchcock, Henry Russell.
A	Hitchcock, John Sawyer.
A	Hitchcock, Walter Samuel Deane.
D	Hitchcock, William Alvan, Jr.
E	Hixon, Edwin Colfax.
A	Hoadley, Alfred Henry.
D	Hobart, Austin Walter.
A	Hobart, Mary Forrester.
D	Hobbie, John Remington.
A	Hobbs, Ezra Allen.
D	Hoch, Charles August.
A	Hodgdon, Andrew Hall.
D	Hodgdon, Frank Amasa.
D	Hodgdon, Luther Albion.
B	Hodge, Dwight Munson.
A	Hodges, Almon Danforth.
A	Hodgson, Mary Cobb.
A	Hodgson, Richard.
A	Hodgson, Thomas Smithson.
A	Hodskins, Edward Bryant.
A	Hoffman, Gustavus Adolphus.
D	Hoffses, Granville Ernest.
A	Hogan, Fremont Lincoln.
D	Hogan, Joseph Ambrose.
A	Hogner, Per Gustaf Richard.
A	Hoitt, Eugene Gorham.
D	Holbrook, Bradbury.
A	Holbrook, George.
A	Holbrook, Guy.
B	Holbrook, Joseph Edgar.
A	Holbrook, Levi Bradford.
A	Holbrook, Silas Pinckney.
B	Holbrook, Solomon Harding.
A	Holbrook, William.
A	Holbrook, William Edward.
A	Holcombe, Charles Clifford.
A	Holden, Austin.
A	Holden, Charles Sumner.
D	Holden, Clarence Parnell.
A	Holden, Eugene Martin.
D	Holden, George Walter.
A	Holden, Leonard Preston.
A	Holden, William Daniel.
B	Holland, Allen Joseph.
D	Holland, Hubert Thomas.
A	Holland, James William.
D	Holland, William Timothy.
A	Holmes, Alvin Dennett.
D	Holmes, Benjamin Henry.
D	Holmes, Daniel Henry.
E	Holmes, Edgar Miller.
A	Holmes, Harry Bigelow.
D	Holmes, Harry Clinton.
A	Holmes, Horace Marshall.
C	Holmes, John Parker.
B	Holmes, Lydia Maria.
D	Holmes, May Salona.
A	Holmes, William Dennison.
D	Holmes, William Franklin.
A	Holmquist, Gustavus.
D	Holohan, Patrick Athanasius.
A	Holt, Edward Brown.
D	Holton, Charles Edward.
A	Holyoke, Frank.
D	Holzman, Joseph.
E	Homan, John Milton.
A	Homans, John.
A	Homans, John, 2d.
A	Homer, John.
D	Hood, Mary Gould.
A	Hooker, Charles Parker.
A	Hooker, Edward Dwight.
A	Hooper, Everett Dennison.
A	Hooper, Frederick Hubbard.
A	Hooper, Harriett Pervier.
D	Hopkins, Bertrand Hiram.
D	Hopkins, Frederick Eugene.
A	Hopkins, Samuel Augustus.
A	Hopkins, Stephen Worcester.
A	Hopkins, William Thorpe.
A	Horgan, John Augustus.
F	Horne, James Metcalfe.
A	Hornly, Mary Stamper.
A	Horr, Albert Winslow.
D	Hoskins, Bertha Ladd.
A	Hosmer, Charles Edward.
A	Hough, Garry de Neuville.
A	Houghton, Henry Lincoln.
A	Houghton, Niedhord Hahnemann.
A	Houghton, Silas Arnold.
A	Houghton, Simon Willard.
A	Houle, Anselme Ephrem.
A	Houle, Joseph.
A	Houston, James.
A	Houston, John Alexander.
D	Hovey, Robert Ferry.
C	Howard, Alonzo Gale.
A	Howard, Amasa.
A	Howard, Arthur Chadwick.
D	Howard, Charles James.
D	Howard, Charles Tilden.
D	Howard, Eugene Henry.
A	Howard, George Canning.
A	Howard, Herbert Burr.
D	Howard, Joseph Francis.
D	Howard, William Francis.
A	Howe, Elsie Brewster.
A	Howe, Francis Augustine.
A	Howe, George Joseph.
D	Howe, Harry Newell.

Official List of Practitioners of Medicine — Continued.

A	Howe, James Sullivan.
D	Howe, Joseph Dimock.
A	Howe, Octavius Thorndike.
A	Howe, Oliver Hunt.
D	Howe, Walter Clarke.
E	Howe, Winfred Lewis.
B	Howell, Ella Virginia.
D	Howell, Harry Warfield.
D	Howell, Thomas.
A	Howes, Clarence Linden.
A	Howes, Pitts Edwin.
A	Howland, Barker Cushman.
D	Howland, Clarence Eugene.
D	Howland, Edgar Joseph.
D	Howland, Joseph Briggs.
D	Howlett, Thomas.
D	Hoyt, Dixie George.
A	Hoyt, Edward Malcom.
A	Hoyt, Walter Scott.
D	Huard, Joseph Edouard.
A	Hubbard, Charles Thacher.
A	Hubbard, Frank Allen.
A	Hubbard, George William.
D	Hubbard, Joshua Clapp.
A	Hubbard, Josiah Clark.
A	Hubbard, Osmon Huntley.
A	Hubbard, Rufus Peabody.
A	Hubbard, Simeon Pease.
A	Hubbard, William Allen.
A	Hubbell, Adelbert Merton.
A	Hudnut, Frank Parker.
D	Hudnut, Paul Albert.
E	Hudson, Arthur Stanton.
D	Huehne, Julius.
C	Hughes, Laura Ann Cleophas.
A	Hull, Ernest Liverus.
A	Hull, John Byron.
A	Hull, William Henry.
A	Hulme, Laura Payne.
B	Hulse, Lester Addison.
B	Humes, Albert Henry.
A	Humphrey, Daniel.
A	Hunking, Charles Dustin.
D	Hunt, Alice Elizabeth Palmer.
A	Hunt, Allston Frost.
A	Hunt, Charles Richard.
A	Hunt, Daniel Lawrence.
A	Hunt, David.
A	Hunt, George.
A	Hunt, George Eddy.
A	Hunt, Israel Thorndike.
A	Hunt, John Abram.
A	Hunt, Lemuel Judson.
C	Hunt, Otis Eugene.
F	Hunt, Simeon.
A	Hunt, William Eustis.
D	Hunt, William West.
A	Hunt, William Otis.
D	Hunter, Henry John.
A	Hunting, Nathaniel Stevens.
A	Huntoon, Hazen Prescott.
F	Huntoon, James W.
A	Huntress, Leonard.
D	Hurd, Albert Gordon.
A	Hurd, Alonzo L.
A	Hurd, George Platt.
D	Hurd, Randolph Campbell.
A	Hurd, William Weymouth.
C	Hurley, Daniel Bartholomew.
A	Hurley, Daniel Madison.
A	Hurtubise, Louis Francis Athagnase.
C	Huse, George Wood.
D	Hussey, Charles Bumps.
A	Husted, Louise Akerly.
B	Hutchings, Charles William.
A	Hutchings, Joseph Henry.
A	Hutchings, George Henry.
A	Hutchinson, Charles Martin.
A	Hutchinson, Chessman Palmer.
A	Hutchinson, Claribel Merrill.
A	Hutchinson, Edwin Darius.
A	Hutchinson, Ellen Angeline Kidder.
A	Hutchinson, Marcello.
B	Hutchinson, Nelson Vinal.
D	Hyatt, Harry William.
D	Hyde, Frederick Tanquary.
A	Hyde, George Smith.
A	Hyde, Seneca Tobias.
D	Ide, Henry Clay, 2d.
D	Ide, Philip Sheridan.
A	Ilsley, Frederick Roscoe.
A	Inches, Charles Edward.
A	Ingalls, George Hancock.
A	Ingalls, William.
D	Ingham, Lucius Thomas.
E	Ingoldsby, Joseph Emmanuel.
A	Ingraham, Lena Vaughn.
A	Ingram, Mary Petronella de Booij.
A	Irish, John Carroll.
A	Irvine, William Herbert.
D	Irwin, Vincent Joseph.
A	Jack, Edwin Everett.
A	Jack, Ernest Sanford.
A	Jack, Frederick Lafayette.
A	Jack, Robert.
D	Jackson, Alexander Washington.
C	Jackson, Alton Atwell.
A	Jackson, Amos Messer.
A	Jackson, Charles William.
A	Jackson, Cornelius Sampson.
A	Jackson, Fred William.
E	Jackson, Gertrude Pearson.
A	Jackson, Henry.
A	Jackson, James Marsh.

Official List of Practitioners of Medicine — Continued.

A	Jackson, John Henry.
D	Jackson, Oliver Howard.
D	Jackson, Osceola E.
A	Jackson, Ralph Wentworth.
A	Jackson, Samuel Hahnemann.
D	Jackson, William Andrew, Jr.
A	Jackson, William Benjamin.
A	Jackson, William Leavitt.
D	Jacques, Louis Désire Onesiphore.
A	Jacques, Napoleon.
A	Jaffe, James Arthur.
A	James, Frances Celicia.
D	James, Howard.
D	James, Joseph Francis.
D	James, Lucille Amanda.
B	James, Woodbury Dyer.
B	Jameson, Robert Edwin.
A	Janes, George Herbert.
A	Janson-La-Palme, Rodolphe Gaspard.
A	Jaques, Henry Percy.
A	Jarvis, William Furness.
D	Jeffers, Edward.
A	Jefferson, Herbert Perry.
D	Jefferson, Willis Grover.
A	Jeffries, Benjamin Joy.
D	Jelalian, Hairabed S.
B	Jelen, Henry.
A	Jelenkiewicz, Jacob.
A	Jelly, Arthur Carlton.
A	Jelly, George Frederick.
A	Jenckes, Joseph Franklin.
B	Jenkins, Charles Dunsford.
A	Jenkins, Charles Edwin.
A	Jenkins, George Oscar.
E	Jenkins, Gladstone Lawson.
A	Jenkins, Thomas Lincoln.
A	Jenks, Harrison Darling.
D	Jenness, Burt Franklin.
A	Jenness, Sarah Abbie.
A	Jenney, Arthur Barker.
D	Jennings, Robert.
A	Jernegan, Holmes Mayhew.
D	Jernegan, Walter Stewart.
A	Jewett, Fred Bryce.
A	Jewett, Frederick Augustus.
A	Jewett, Howard Clifton.
A	Jewett, Nathaniel.
C	Jewett, Walter Kendall.
A	Jillson, Franklin Campbell.
A	Johnson, Charles Frederic.
D	Johnson, Charles Kimball.
B	Johnson, Charles Lemuel.
D	Johnson, David Joseph.
A	Johnson, Edward Stearns.
C	Johnson, Elmore Reuben.
A	Johnson, Francis Emerson.
C	Johnson, Frank Mackie.
A	Johnson, Frederick William.
D	Johnson, George Anson.
D	Johnson, Grahame Dove.
E	Johnson, Granville Roswell.
D	Johnson, Harold Abbott.
D	Johnson, Herbert Shattuck.
A	Johnson, John Gore.
A	Johnson, John Waldo.
A	Johnson, Orville Edson.
A	Johnson, Otis Henry.
A	Johnson, Sara.
A	Johnson, Stephen Joseph.
A	Johnson, William Augustus.
A	Johnson, William Louis.
D	Johnston, William.
A	Johnstone, William Joseph.
D	Jones, Arthur Willis.
A	Jones, Charles David.
A	Jones, Claude Perry.
D	Jones, Daniel Fiske.
A	Jones, Daniel Wayland.
A	Jones, Elbert Archer.
A	Jones, Elgin Wilbur.
A	Jones, Ellis Preston.
D	Jones, Everett.
D	Jones, Frederick Ellis.
D	Jones, Frederick Elmer.
A	Jones, George Howard.
A	Jones, George Warren.
A	Jones, Gilbert Norris.
A	Jones, Henry Newell.
A	Jones, John Clark.
B	Jones, John Paul.
A	Jones, Joseph.
A	Jones, Lombard Carter.
A	Jones, Lyman Asa.
A	Jones, Mary Elizabeth.
D	Jones, Mary Scott.
A	Jones, Sophia Carlton.
A	Jones, William Marks.
A	Jordan, Charles.
A	Jordan, Charles Harold.
A	Jordan, George Albert.
A	Jordan, Henry Jacob.
C	Joslin, Elliott Proctor.
D	Joslin, Perry Edward.
A	Josselyn, Eli Edwards.
A	Joyce, Charles Pitt Fld.
A	Joyce, Thomas Francis.
A	Judah, Lucian Alexander.
A	Judd, David Hiram.
E	Judge, Albert Augustine.
B	Judge, James Daniel.
D	Judkins, Anna Gertrude.
A	Judkins, Frank Luvelle.
A	Kaan, George Warton.
A	Kahn, Alexander.
D	Kahn, Paul.
D	Kahn, Wulf.

Official List of Practitioners of Medicine — Continued.

D	Kaloustian, Nazareth Manoug.
A	Kane, John Henry.
A	Karner, Edwin Belden.
D	Kazanjiam, Hampar Baghoss.
A	Kean, Louise Janett Darnstaedt.
C	Keany, Francis Joseph.
E	Kearney, John Henry.
E	Keate, Walter.
A	Keating, James Edward.
D	Keay, Harry Chester.
D	Keck, Charles Erhard.
A	Keefe, Daniel Edward.
A	Keefe, Patrick Henry.
A	Keegan, Charles Andrew.
A	Keegan, Vincent Elijah.
A	Keenan, Herbert John.
A	Keep, Charles Manning.
A	Keife, Carolyn Ignasce.
A	Keith, Ellen Louisa.
A	Keith, Frederick Scott.
A	Keith, George Wallace.
D	Keith, Halbert Lynn.
A	Keith, Wallace Cushing.
A	Keleher, Francis Joseph.
A	Keleher, William Henry.
D	Kelleher, Patrick Francis.
A	Keller, Elizabeth Catherine.
A	Kelley, Horatio Sprague, Jr.
A	Kelley, Joseph Henry.
A	Kelley, Michael Joseph.
A	Kelley, Seth Wight.
D	Kelliher, Mayville Sumpter.
A	Kelliher, Michael William.
A	Kellogg, Edward Brinley.
A	Kellogg, Frederic Leroy.
D	Kelly, Jane Downes.
A	Kelly, Michael.
A	Kelly, Samuel James.
D	Kelly, Thomas Francis.
A	Kelly, William P.
B	Kelsay, Brookens Campbell.
A	Kelsey, Otis Hiland.
A	Kemp, Edwin Augustine.
C	Kennard, Harry Delano.
A	Kennealy, John Henry.
A	Kennedy, Alexander Edward.
D	Kennedy, Alexander G.
A	Kennedy, Alonzo Lewis.
A	Kennedy, Catherine Moloney.
A	Kennedy, Charles Francis Joseph.
D	Kennedy, Eugene Augustine.
A	Kennedy, Frederick William.
A	Kennedy, George Golding.
D	Kennedy, Harris.
A	Kennedy, James Simon.
D	Kennedy, Michael Colville.
B	Kennedy, Thomas Patrick.
A	Kenney, Franklin Woodbury.
D	Kenney, Hattie Eliza.
D	Kennon, Charles Edward de Ven.
B	Kent, Daniel Hurley.
A	Kenyon, Henry Jesse.
A	Keown, James Archibald.
D	Kepler, Charles Ober.
D	Kernan, William Everett.
A	Kielty, John Daniel.
A	Kier, Erskine Johnston.
A	Kilburn, Henry Whitman.
D	Kirby, Francis Joseph.
A	Kilby, Henry Sherman.
A	Kiley, Edward Stephen.
F	Kilgore, George Liberty.
A	Kilroy, Philip.
D	Kimball, James Henry.
A	Kimball, Joseph Edwin.
A	Kimball, Leonard Morong.
A	Kimball, Levi Houghton.
A	Kimball, Samuel Ayer.
A	Kimball, William George.
A	Kimpton, Edwin Sewell.
A	King, Calvin Bryant.
B	King, Charles Duncan.
C	King, Frederick Augustine.
D	King, George.
D	King, Howard Frost.
D	King, Jesse.
D	King, Myron Louis.
A	King, Nathaniel Clark.
C	King, William Rufus.
A	Kingman, James Henry.
A	Kingman, Rufus Anderson.
A	Kingsbury, Albert Dexter.
A	Kingsbury, Charles Franklin.
E	Kingsbury, Charles Henry.
A	Kingsbury, Joseph Byron.
A	Kingsbury, Charles Langdon.
A	Kingsley, Charles.
D	Kingsley, Patrick Joseph.
A	Kinne, George Lyman.
A	Kinney, Eunice Draper.
A	Kinney, John Edgar.
D	Kinney, William D'Arcy.
A	Kinnier, Denis Francis.
E	Kinsley, Cephas Daniel.
D	Kinsman, Henry Francis.
D	Kirby, Frank Alonzo.
D	Kirby, Nathaniel Harris.
A	Kirby, Thomas Edward.
A	Kirk, Lucy Anne.
D	Kite, Walter Chester.
A	Kittredge, Joseph.
A	Kittredge, Thomas.
A	Klein, August Andreas.
A	Klemmer, Denis Francis.
A	Klemmer, Wilhelm Nickolaus.

Official List of Practitioners of Medicine — Continued.

D Klopp, Henry Irwin.
A Kludjian, Assadour Hagot.
A Knapp, Philip Coombs, Jr.
A Knight, Augustus Smith.
D Knight, Charles Eugene.
D Knight, Charles Storer.
A Knight, Charles Sumner.
D Knight, Edwin Augustus.
A Knight, Frederick Irving.
A Knight, Granville.
A Knight, Henry Sargent.
D Knight, Howard Webster.
A Knight, Joseph Noble.
A Knight, Marcus Whitney.
B Knight, William Henry Anderson.
A Knowles, James Harris.
A Knowles, William Fletcher.
A Knowles, William Kelley.
A Knowlton, Charles Davison.
A Knowlton, Herbert Eugene.
A Knowlton, Wallace Mills.
D Knowlton, William Thomas.
D Koch, James Lafayette.
B Kohan, Alexander.
A Konikow, Moses Joseph.
A Krauss, James.
A Krebs, Franz Hugo.
B Kronberger, Israel Baruch.
D Krum, Frank Wilson.
D La Belle, Martin James.
D Labelle, Urgele.
E Ladd, Fred Eugene.
D Ladd, Maynard.
D Lafontaine, Gustave.
A Laforce, Edward Dontial.
B L'African, Eugéne.
A Laidley, John Baine.
D Laighton, Florence Marion.
A Lajoie, Louis Zotique.
A Lake, Hiram.
D Lake, John, Jr.
C Lakeman, Mary Ropes.
D Lamarche, George Tancrède.
A La Marche, Walter Joseph.
A Lamb, Colby.
A Lamb, Frances Gertrude.
D Lamb, William Dan.
D Lambert, John Henry.
D La Motte, Xavier Alexander.
A Lamoureaux, Joseph Elzéar.
D Lanphear, Charles Howard.
A Lamson, John Augustus.
A Lancaster, Sherman Russell.
A Lancaster, Walter Brackett.
B Lande, Abraham Joseph.
D Landers, Garrett John.
D Landers, Maurice Joseph.
B Landis, Lillian Etta.
A Landis, Simon Mohler.
A Landry, Napoleon.
A Lane, Albert Clarence.
A Lane, Charles Franklin.
A Lane, Edward Binney.
A Lane, Francis Augustus.
D Lane, Frank Ellsworth.
B Lane, Ida Ella Hale.
A Lane, John Goodwin.
A Lane, Orville Wilbur.
A Lane, Robert Low.
B Lane, William Colton.
D Langan, John Thomas.
A Langevin, Joseph Alphonse.
A Langlois, Joseph Augustin.
D Langlois, William Edward.
A Langmaid, Samuel Wood.
B Lanman, Charles Henry.
A Lanoie, Joseph Eusibe Eugene.
A Large, Alfred.
B Larkeque, Garret Bancroft Breckinbridge.
A Larose, Paul Herbert.
D Larrabee, Ralph Clinton.
A Lartie, Joseph Charles Hormisdas.
E Latham, Benoni Mowry.
A Latham, Caroline Augusta.
A Lathe, Leonora Fletcher.
A Lathrop, William Henry.
A Latter, Leonard.
D Latterner, Frederick Henry.
B Laurence, David.
D Laurin, Theophilus.
D Laurion, Adelard.
D Lavellee, George Omer.
D La Vigne, Alfred Willis.
D Lavoie, Joseph Paradis.
A Lawler, Thomas Joseph.
A Lawler, William Patrick.
D Lawlor, John Joseph.
D Lawlor, Richard Henry.
E Lawrence, Arthur Abbott.
D Lawrence, James Chrisby Hurd.
D Lawrence, James Wilmot.
A Lawrence, Joseph Henry.
D Lawrence, Nellie Louise.
A Lawrence, Rhoda Ashley.
D Lawrence, William Ethan.
A Lawson, Frederick Bartlett.
D Lazarus, Benjamin.
A Leach, Albert Clinton.
A Leach, Clara Celestia Austin.
A Leach, Edward Morton.
A Leach, Horace Morton.
A Leach, William.
A Leahey, George Henry Aloysius.
A Leahy, Thomas Joseph.

Official List of Practitioners of Medicine — Continued.

A	Leard, John Samuel Hick.
B	Learned, Noyes Newton.
A	Learned, John Barr.
A	Learned, William Turell.
A	Learoyd, Charles Berry.
A	Leary, James Edward.
A	Leary, John Henry.
A	Leary, Patrick Frank.
C	Leary, Timothy.
D	Leary, William Charles.
D	Leary, William Cornelius.
A	Leavitt, Dudley.
D	Leavitt, Edwin Alden.
D	Leavitt, Frank Clyde.
A	Leavitt, William Whipple.
D	Le Bel, Timothée.
A	Leblanc, Aimé Noël.
D	Le Blanc, Clement Oliver.
A	Le Boeuf, Joseph Sylva.
D	Lecompte, Walter Augustus.
A	Lee, Frank Herbert.
A	Lee, Luther Milo.
D	Lee, Wesley Terence.
A	Leeds, Charles.
A	Lehmann, Anthony.
A	Leib, Thomas Nuttall.
B	Leighton, Harry Burbank.
A	Leitch, John Alvin.
A	Le Lacheur, Ellis Sweetlove.
A	Leland, Clarence Henry.
A	Leland, George Adams.
A	Le Maitre, Joseph Michel.
D	Lemieux, Théodule Alfred.
D	Leonard, Edwin, Jr.
D	Leonard, Henry Fiske.
A	Leonard, Henry Patrick.
E	Leonard, Isaac Edward.
A	Leonard, Milton Hall.
D	Leonard, William Joseph.
A	Lescadre, Henry.
A	Leslie, Freeland David.
E	Leslie, Herbert Granville.
A	Leslie, Horace Granville.
D	Levasseur, Augustus Joseph Hugo.
B	Levenson, Sophia.
A	Levey, George.
B	Lewis, Andrew Valentine.
A	Lewis, Arthur Cuthbert.
C	Lewis, George Fred.
A	Lewis, John Taylor.
C	Lewis, Marion Hall.
B	Lewis, Millard Edrie.
B	Lewis, William Edmund.
D	Libbey, Charles Emerson.
B	Libbey, Hosea Waite.
A	Libby, Charles Adelbert.
D	Libby, Edward Norton.
A	Libby, Jesse Herbert.
D	Libby, Mary Gordon.
D	Libby, Mildred Augusta.
A	Liebmann, Gustavus.
A	Lighthill, August Ponham.
B	Lilley, William.
E	Lilly, Thomas Eugene.
A	Lincoln, Guy Alvan Thorndike.
A	Lincoln, Jacob Read.
C	Lincoln, John Clifford.
D	Lindsay, Joseph Ira.
D	Lindsey, John Hathaway.
A	Lindsey, Joseph Ferdinand, Jr.
A	Lindstrom, Alfred Herman.
A	Linfield, Edwin Porter.
A	Litch, John Goodrich.
C	Litchfield, William Harvey.
A	Littell, Alice.
D	Little, Abby Noyes.
D	Little, Charles Sherman.
A	Little, Harry James.
A	Little, William Brimblecom.
D	Littlefield, Anna Maria.
D	Littlefield, George Curtis.
D	Littlefield, George Henry.
A	Littlefield, Samuel Horace.
B	Liverpool, Joshua Henry.
D	Livingston, Ernest George.
A	Livingston, Joseph Alexander.
A	Lloyd, Charles.
B	Lloyd, Seth Louis.
D	Lockary, Joseph Logue.
A	Locke, Horace Mann.
A	Lockhart, Joseph Smith.
D	Lockwood, Charles Edwin.
D	Lockwood, George Bertrand.
D	Logan, Frank Parker Tays.
A	Lombard, John Patrick.
C	Lombard, Julia Mary.
A	Lonergan, Thomas Daniel.
B	Longfellow, Melvina Frances.
A	Longley, Mary Theresa.
A	Loomis, Charles Otis.
D	Loomis, Julius Sterling.
A	Loomis, William Wellington.
D	Lord, Herbert.
A	Lord, Sidney Archer.
D	Loring, Benjamin Tappan.
A	Loring, Harriet Augusta.
D	Loring, Robert Gardiner.
A	Loring, Robert Pearmain.
A	Lothrop, Charles Arthur.
A	Lothrop, George Edgar.
A	Lothrop, Harriet Eleanor.
A	Lothrop, Howard Augustus.
B	Loucks, John Stearns.
D	Lougee, Arthur Jewett.
A	Lougee, Frank Taylor.
A	Lougee, May Williamina.
D	Lougee, William Wheeler.

Official List of Practitioners of Medicine — Continued.

B	Lougest, Charles Albert.
D	Loughran, James Francis.
A	Louis, Isaac.
D	Love, James.
D	Love, William Lathrop.
A	Lovejoy, Charles Averill.
D	Lovejoy, Fred Wendell.
A	Loveland, Charles Harrison.
A	Lovell, Charles Dixon Smith.
A	Lovell, Charles Edward.
A	Lovell, David Bigelow.
B	Lovell, Gideon.
D	Lovell, Martha Eleanor.
A	Lovering, Anna Temple.
A	Lovett, Robert Williamson.
C	Lowe, Fred Messenger.
D	Lowell, Alverne Percy.
D	Lowenstein, Frederick Philip.
A	Lubin, Leon Thèophile Jules.
A	Luchsinger, Harry Warner.
D	Luck, Emil Paul Max.
A	Ludden, Emerson Augustus.
B	Lull, Henry Cushman.
A	Lund, Fred Bates.
A	Luscomb, Job Everett.
A	Lussier, Charles Arthur.
A	Lussier, Cyrille Francois.
D	Lynch, Charles Francis.
A	Lynch, Michael Henry.
F	Lynn, Charles William.
A	Lyon, Annie Isabelle.
A	Lyon, Arthur Vinal.
D	Lyon, Frederick Dow.
A	Lyons, Christopher Philip.
A	Lyons, Herbert Henry.
A	Lyons, Joseph Benedict.
A	MacArthur, George Elden.
D	MacCabe, Arthur.
D	Macdonald, Alexander Ambrose.
A	Macdonald, Angus.
A	MacDonald, Archibald Elexcis.
A	Macdonald, Colin William.
A	Macdonald, Donald Francis.
D	Macdonald, Donald William.
D	MacDonald, Elmar Joseph.
A	Macdonald, James.
D	Macdonald, James Stevens.
A	MacDonald, Rufus Cyrene.
D	MacDonald, William Campbell.
D	Macdonald, William Clifford.
A	Macdonald, William Gregory.
A	Macdonald, William Lewis.
A	MacDonnell, John.
A	Macdougall, Duncan.
A	Mace, Herbert Eugene.
D	Macgowan, Joseph Johnston.
C	Mack, Charles David Gibson.
C	Mack, Helen Georginia Flagler.
D	MacKay, George Finlay.
A	Mackeen, Alfred Atwater.
A	MacKenzie, Freeman Alexander.
A	Mackie, George.
A	Mackie, Laura Viola Gustin.
A	Mackie, William Basilio.
D	Mackie, William Charles.
C	Mackin, Charles.
D	Mackintosh, Ernest Robert.
D	Macleod, Harry Found.
D	McMahon, John Joseph.
D	MacMillan, Andrew Louis.
D	Macomber, Nathaniel Gifford.
C	Macpherson, George Sturtevant.
A	Macpherson, Frederick William.
B	MacRae, Duncan.
D	MacSweeny, Edmund George.
D	MacWhinnie, Arthur Morgan.
D	Macy, Fred Stevens.
E	Madden, John Joseph.
C	Madden, William Daniel.
A	Magee, Edward Joseph.
A	Magee, John Augustine.
D	Magrath, George Burgess.
D	Maguire, Charles Francis.
C	Maguire, John Edward.
C	Magurn, Francis Thomas Louis.
D	Mahady, Joseph John.
D	Mahon, James Arthur.
D	Mahoney, Edward Joseph.
D	Mahoney, George Clifton.
A	Mahoney, John Bernard.
A	Mahoney, John Francis.
E	Mahoney, John Lewis.
A	Mahoney, John Stephen.
A	Mahoney, Stephen Andrew.
A	Maine, Frank Duane.
D	Mains, Charles Frederick.
A	Makechine, Horace Perkins.
C	Mallory, Frank Burr.
A	Manahan, Herbert Wellington.
A	Manchester, Delos Burd.
A	Mangan, John Joseph.
D	Manix, Edward Tuck.
D	Mann, Arthur Teall.
F	Mann, Augustine Alvan.
A	Mann, Martha Elizabeth.
A	Mann, Mary Ella.
A	Mann, Mary Frances.
A	Mann, William Orris.
B	Manseur, Mary Merrill.
A	Mansfield, Charles.
A	Mansfield, Henry Tucker.
D	Mansfield, James Albert.
A	Mansfield, John Robbins.
A	Mansfield, Robert Joseph.

Official List of Practitioners of Medicine — Continued.

D	Mansur, Leon Wallace.
A	Mansur, Richard Harrison.
A	Mara, Frank Timothy.
A	Marble, John Oliver.
D	Marcley, Walter John.
D	Marcon, Louis Benjiman.
A	Marcy, Henry Orlando.
D	Marcy, Henry Orlando, Jr.
D	Marden, Milmot Leighton.
A	Marin, Joseph Paul Aster.
A	Marion, Horace Eugene.
A	Marion, Otis Humphrey.
D	Markham, Erwin Walter.
D	Marr, Myron Lawrence.
A	Marsh, Albert.
C	Marsh, Arthur White.
A	Marsh, Charles David.
D	Marsh, Frank Filmore.
A	Marsh, James Elmer.
A	Marshall, Carey Fenton.
A	Marshall, Foster Leroy.
A	Marshall, Julia Ann.
D	Marshall, Perry.
D	Marstin, Chauncey Macaulley.
D	Marston, Albert Jeremiah.
D	Marston, Daniel William.
A	Marston, Edward Brooks.
B	Marston, George Dexter.
E	Marston, Joseph Norris.
A	Marston, Luther Moulton.
D	Martel, Stanislas.
D	Martin, Archibald Herbert.
A	Martin, Francis Coffin.
A	Martin, George Albert.
A	Martin, George Forrest.
A	Martin, Gregory Arvide.
D	Martin, Harry Charles.
E	Martin, John Brayton.
D	Martin, John Joseph.
D	Martin, John Macleod.
A	Martin, Luther Orin.
A	Martin, Miles.
A	Martin, Pearl.
D	Martin, William John.
A	Marvin, Grace.
B	Marvin, Ora Elisha.
D	Marvin, Sydney Robertson.
A	Maryott, Erastus Edgar.
D	Maskell, Leonard Joseph.
B	Mason, Almond Waldo.
A	Mason, Amos Lawrence.
A	Mason, Atherton Perry.
D	Mason, Gilbert McClellan.
E	Massa, Gaetano.
D	Masten, Charles Howard.
D	Matheson, James Renwick.
A	Mather, Edward Elias.
D	Mathews, George William.
A	Matte, Joseph Hubert Ambrose.
D	Maxwell, George Bannerman.
A	Maxwell, Warren Brown.
E	May, Charles Emerson.
A	May, George Elisha.
D	May, John Shepard.
D	May, William Ropes.
C	Mayberry, Charles Bradford.
A	Mayberry, Edwin Nelson.
D	Mayberry, Frank Eugene.
A	Maynard, Louis Aime.
D	McAdams, James Philip.
D	McAdams, Peter Stevens.
D	McAllister, Frederick Danforth.
D	McAllister, John Gilman.
D	McArdle, John Joseph.
E	McAuslan, James Lewis.
A	McAvinnue, Frank.
D	McAvoy, John Joseph.
D	McCabe, Denis John.
A	McCabe, John Joseph.
A	McCann, Alfred Ernest Arthur.
D	McCarthy, Charles Ambrose.
A	McCarthy, Charles Daniel.
A	McCarthy, Charles Florence.
A	McCarthy, Eugene Allen.
E	McCarthy, Frederick.
A	McCarthy, John Coakley.
D	McCarthy, Timothy Francis.
D	McCarthy, Thomas Francis.
A	McCarthy, Thomas Horatio.
A	McCarthy, William Henry.
A	McCarty, James Joseph.
E	McCauley, Albert Anthony.
A	McClean, Alexander Spear.
A	McClean, George Chesley.
A	McClearn, Charles William.
D	McCluskey, Henry Lincoln.
A	McCollester, John Quincy Adams.
A	McCollom, John Hildreth.
A	McConnell, Hugh Beemer.
A	McCormack, Alexander Leslie.
A	McCormack, Reynold James.
D	McCormick, Alfred Hugh.
A	McCormick, Cornelius Joseph.
E	McCormick, John.
D	McCormick, Thomas Henry.
E	McCoy, Hugh Alexander.
D	McCoy, John Cresap.
D	McCurdy, James Huff.
A	McCrea, Albert James.
D	McDermott, Bernard Francis.
D	McDermott, Joseph Edward.
D	McDermott, William Vincent.
A	McDevitt, James John.
A	McDonald, James Athanasius.
A	McDonald, John Henry.
A	McDonald, William Alexander.
D	McDonald, William Joseph.

Official List of Practitioners of Medicine — Continued.

A	McDougall, Samuel Jay.
A	McDonough, Lawrence John.
B	McDonough, Thomas Patrick.
E	McEvoy, George Albert.
D	McEvoy, Thomas Edward.
D	McFee, William David.
D	McGann, John Henry
A	McGannon, Thomas Gerald.
D	McGauran, George Daniel.
B	McGauran, George Francis.
A	McGauran, Michael Sheridan.
D	McGee, Fannie Maria.
D	McGillicuddy, Cornelius Joseph.
A	McGillicuddy, John Timothy.
D	McGirr, Felix Francis.
D	McGourty, James Eugene.
D	McGovern, Catherine Elizabeth.
D	McGrath, Bernard Francis.
A	McGrath, John Edward.
D	McGrath, William Fennelly.
A	McGuigan, John Joseph.
A	McIntire, David.
A	McIntosh, Donald M.
D	McIntosh, Elizabeth Ellard.
A	McIntosh, Frederic Lemont.
D	McIntosh, Herbert.
D	McIntosh, John David.
A	McIntosh, William Page.
A	McIntyre, Herbert Bruce.
D	McKeen, Byron Wesley.
D	McKeen, Sylvester Forshay.
A	McKenna, Frank A.
A	McKenna, Francis Patrick.
E	McKenna, James Charles.
A	McKenty, Jonathan Thomas Edmund.
A	McKenzie, John Robert.
B	McKinstry, John Alexander.
D	McKnight, Adam Stephenson.
A	McKoan, John William.
D	McLaren, Alexander Lorne.
A	McLaughlin, James Stephen.
A	McLaughlin, Henry Valentine.
A	McLaughlin, Joseph Ignatius.
A	McLaughry, Elizabeth.
A	McLean, Charles.
D	McLean, James Clifford.
D	McLellan, Archibald Colin.
A	McLellan, Edward Augustus.
A	McLennan, Roderick.
A	McLeod, Percy DeMille.
D	McLeod, William McKenzie.
A	McMichael, Willis Brooks.
A	McMillan, Isaac Murray.
D	McMillan, Kate.
D	McMurray, Francis Michael.
D	McNair, Robert Hamilton.
A	McNally, William Joseph.
D	McNamara, Eugene Thomas.
D	McNeil, Archibald.
E	McNeish, Alexander.
D	McNiff, William Joseph.
A	McOwen, Timothy Edward.
A	McOwen, William Henry.
A	McPherson, William Ellsworth.
D	McQuaid, Thomas Bernard.
A	McQueeney, Francis Joseph.
D	McWilliams, John Leslie.
D	Mead, Frederick Ammi.
A	Mead, George Nathaniel Plumer.
A	Mead, Julian Augustus.
A	Mead, William Frederick.
A	Meader, Charles Eugene.
A	Meagher, Michael John.
A	Means, Andrew Fuller.
E	Means, Philip Corydon.
D	Meara, Frank Sherman.
A	Mecuen, George Edward.
D	Meek, Edith Ruth Eliza.
A	Meeker, George.
A	Mehegan, Daniel Joseph.
A	Mehrenlender, Albert Nochim.
A	Meigs, Joe Vincent, Jr.
C	Meigs, Jonathan Harding.
A	Meigs, Return Jonathan.
D	Meikle, Robert Howard.
D	Melifant, George Francis.
A	Mellen, William Michael Edward.
D	Mello, Antonio Amor de.
E	Mellus, Edward.
A	Mellus, Edward Lindon.
A	Menard, Anthyme Sylvestre.
D	Meramble, Clarence Eugene.
D	Mercier, Joseph Euclide.
A	Mercer, William James.
A	Mercer, William Marcelline.
D	Merchant, Harry Alvin.
A	Merriam, Frances Adelaide.
E	Merriam, Franklin Henry.
A	Merrick, Robert Michael.
D	Merrick, Sara Newcomb.
A	Merrill, Arthur Ellsworth.
D	Merrill, Quincy Heald.
D	Merrill, Theodore Clarkson.
D	Merrill, Tristram Hurd.
A	Merrill, William Howe.
A	Merritt, Louis Arthur.
A	Merritt, Salome.
A	Merritt, Silas Virgil.
D	Merritt, Victor Sulviro.
A	Merry, William Henry.
A	Messer, Charles Carson.
A	Metcalf, Ben Hicks.
B	Metcalfe, Stephen Michael Ryves.

Official List of Practitioners of Medicine — Continued.

D	Metzger, Butler.
D	Meyer, Adolf.
D	Meyer, Edward James.
D	Meylan, George Louis Julien.
A	Mignault, Armand.
A	Mignault, Arthur.
D	Mignault, Louis Joseph Adolphe.
A	Mignault, Rodrique.
A	Mignault, Victor.
A	Milan, Michael Bernard.
A	Miles, Charles Edwin.
A	Miles, George Albert.
A	Millard, Henry James.
A	Miller, Albert Eber.
A	Miller, Albert Monroe.
A	Miller, Charles Hermann.
D	Miller, Edward Alexander.
A	Miller, Edward Roscoe.
D	Miller, Elmer Manton.
A	Miller, Ernest Parker.
B	Miller, Frances Jane.
D	Miller, James, Jr.
E	Miller, Lester Colwell.
A	Miller, Lizbeth Dora.
A	Miller, Norman Rogers.
D	Miller, Samuel Osgood.
A	Miller, Vesta Delphine.
A	Miller, Webster.
A	Millerick, Daniel Edward.
A	Millet, Wilfred Antonio.
A	Millett, Charles Sumner.
D	Milliken, Charles Warren.
D	Milliken, Roscoe Green.
A	Milliken, William Hardy.
E	Mills, Augustus Webster.
A	Mills, George Westgate.
A	Milot, Alphonse Francois.
D	Minard, Ralph Waldo.
D	Miner, Jennie Theodate.
A	Miner, Worthington Warner.
A	Minot, James Jackson.
A	Minot, John Francis.
D	Minshall, Arthur Gladstone.
A	Mintz, Fishel Tonchel Zelmarowich.
A	Mitchell, Arthur.
A	Mitchell, Charles Henry.
D	Mitchell, Harry Walter.
B	Mitchell, John Singleton.
D	Mitchell, William.
A	Mitchie, James Carey.
A	Mixter, Orlando.
A	Mixter, Samuel Jason.
A	Moffatt, George Tufton.
A	Moffitt, Carl Walmer.
A	Moffitt, Herbert Charles.
D	Moir, Archibald Campbell Milton.
A	Molin, Isaac.
A	Moll, Louis Arthur.
A	Molleur, Louis Francois.
D	Moomjian, Sarkis K.
A	Mongan, Charles Edward.
A	Monks, George Howard.
D	Monroe, John Eugene.
B	Monroe, Thomas Wilson.
D	Montague, Charles Elbert.
D	Montgomery, Mary Louise.
A	Monteiro, Manuel Garcia.
A	Mooers, Charles Albert.
A	Mooers, Emma Wilson.
A	Mooney, Philip.
D	Moore, Elmer Ellsworth.
D	Moore, Frederick Fiske.
D	Moore, Harry.
A	Moore, James Herbert.
D	Moore, James Spencer.
D	Moore, John Henry.
A	Moore, John Patrick.
E	Moore, Philip Patrick.
A	Moran, Horace Sheridan.
D	Moran, James Joseph.
A	Moran, John Brennan.
A	Moran, Martin William.
D	Morey, Mary.
A	Morgan, John.
A	Morgan, Lewis Edwin.
D	Morgan, William Edward.
D	Moriarty, James Lignori.
D	Morin, Jacob Mauritz.
A	Moroney, William Joseph.
A	Morong, Arthur Bennett.
A	Morrill, Charles Plummer.
A	Morrill, Ferdinand Gordon.
A	Morrill, Frank Armington.
B	Morrill, Frederick.
B	Morrill, George Albert, Jr.
A	Morrill, Henry Brown.
A	Morris, Frances Morris.
A	Morris, George Patrick.
A	Morris, James Stewart.
A	Morris, John Galvin.
A	Morris, Michael Augustine.
D	Morris, Richard Holt.
D	Morris, Robert.
D	Morrison, Charles Carr.
A	Morrison, James.
A	Morrison, Robert Edgar.
A	Morrison, William Alexander.
A	Morrow, Charles Harvey.
D	Morrow, William Robert.
A	Morse, Abby Swan.
A	Morse, Almon Gardner.
A	Morse, Charles Ellsworth.
A	Morse, Charles Francis.
D	Morse, Charles Frederick.
A	Morse, Charles Wheeler.

Official List of Practitioners of Medicine — Continued.

A	Morse, Edward Gilead.
A	Morse, Frank Adelbert.
A	Morse, Frank Leander.
A	Morse, Fred Harris.
A	Morse, George.
B	Morse, George Franklin.
A	Morse, George Mason.
C	Morse, Henry Lee.
A	Morse, John Aiine William.
A	Morse, John Lovett.
A	Morse, Martin Van Buren.
A	Morse, Nathan Ranson.
A	Morse, Robie Sidney.
D	Morse, Seth Bradford.
A	Morton, Helen.
D	Mosher, Frank Orson.
D	Mosher, Harris Peyton.
A	Mosher, Marshall James.
A	Mosher, Mary Edna.
D	Mossman, Alvaro E.
A	Mott, Albert.
A	Mott, Joseph Varnum.
A	Mott, Walter.
A	Moulton, Albert Roscoe.
A	Moulton, Benjamin Francis.
A	Moulton, Charles Fred.
A	Mowe, Frank Henry.
D	Mowry, Classen.
A	Mudge, Kate Gertrude.
A	Mulcahy, Joseph Francis.
A	Mulligan, James.
D	Mulliner, Mary Rees.
A	Mullins, Eugene Norton.
A	Mumford, James Gregory.
A	Munhall, Katharine Stanislaus.
C	Munro, John Cummings.
E	Murphy, Edward Vincent.
C	Munsell, George Nelson.
A	Munson, Virgil Hitchcock.
A	Murdock, Edward Arthur.
D	Murdock, Frederick William.
A	Murphy, Daniel David.
C	Murphy, Daniel Francis.
A	Murphy, Emily Frances.
A	Murphy, Francis Charles.
D	Murphy, Jeremiah Edward.
A	Murphy, John Henry.
A	Murphy, John McKonkey.
A	Murphy, Joseph Briggs.
C	Murphy, Joseph Patrick.
E	Murphy, Stephen Nicholas.
A	Murphy, Timothy Joseph.
D	Murray, Charles Albert.
A	Murray, Edward Francis.
D	Musgrave, Percy.
D	Musso, George Henry.
A	Muttart, George Morley.
D	Nalchajian, Dikran Davis.
D	Narey, William Joseph.
C	Nash, George William.
A	Nash, Horace Milton.
A	Nason, Arthur Clark.
A	Nason, Laurentius Melancthon.
A	Nason, Osmon Cleander Baker.
A	Neal, Charles Arthur.
D	Neale, Lillian Belle.
A	Neefus, Robert Henry.
C	Neilson, William.
D	Nelson, John William.
A	Nelson, Lois Leverett.
D	Nesbitt, Thomas.
B	Neuville, Josephine Mitivier de la.
A	Newcomb, Elizabeth.
B	Newcomb, George Lewis.
A	Newcomb, Luther.
D	Newcomb, Marietta Eaton.
D	Newcomb, Scott Campbell.
B	Newell, Charles Martin.
A	Newell, Frank Samuel.
D	Newell, Franklin Spilman.
D	Newell, Fred Amasa.
D	Newell, Henry Edward.
A	Newell, Otis Kimball.
A	Newhall, Edward.
A	Newhall, Herbert William.
A	Newhall, Lawrence Thompson.
D	Newman, Elizabeth Benham.
E	Newsome, Edgar Thomas.
D	Newton, Aaron Lewis.
A	Newton, Abiel Wood Kennedy.
B	Newton, Adin Hubbard.
D	Newton, Carrie E.
A	Newton, Edward Cazneau.
D	Newton, Edward Roswell.
A	Newton, Eleanor Frost.
A	Newton, Frank Loomis Sabin.
D	Newton, Leroy Allan.
A	Newton, Sarah Fenno.
D	Newton, William Curtis.
A	Nichols, Arthur Howard.
B	Nichols, Charles Edward.
A	Nichols, Charles Fessenden.
A	Nichols, Charles Lemuel.
A	Nichols, Edward Hall.
D	Nichols, George Hayward.
B	Nichols, Helen Lucinda Clift.
A	Nichols, John Holyoke.
A	Nichols, John Taylor Gilman.
A	Nickerson, Asa Harden.
A	Nickerson, Franklin.
A	Nickerson, George Wheaton.
A	Nickerson, William Jabez.
D	Nicola, Charles Chesterfield.
D	Nicola, Mary Byington.
D	Nielson, Edwin Björne.
E	Nightingale, James.
A	Niles, Edward Harry.

Official List of Practitioners of Medicine — Continued.

D	Nilsson, Peter.	D	O'Connor, John Henry.
A	Nims, Edward Beecher.	A	O'Connor, John James.
A	Niquette, Louis Bartholomew.	A	O'Connor, Thomas Hugh.
D	Niver, Emmett.	A	O'Connor, Watkins Roberts.
A	Nixon, Alfred John.	A	Odlin, Charles Cushing.
A	Nobile, Angelo.	D	O'Doherty, John Dominaca.
A	Noble, Alfred Ira.	D	O'Donnell, Edmund Emmet.
D	Noble, Anngenette Fowler.	A	O'Donnell, Francis Michael.
B	Noka, Benjamin Gardner.	E	O'Donnell, George Thomas.
D	Nolan, Frank Wesley.	D	O'Donnell, James Coughlin.
E	Nolan, William Francis.	A	O'Donnell, Louis Patrick.
A	Noonan, Michael Charles.	B	O'Donnell, William.
A	Norcross, Ernest Freeman.	D	Ogden, Charles Ludlow.
A	Nordstrom, Cynthia Maria.	A	Ogden, Jay Bergen.
D	Normand, Jean Napoléon.	D	Ogilvie, James.
D	Normandin, Alphonse.	A	O'Hearn, William Henry.
A	Normandin, Louis Zephirin.	D	Ohnesorg, Karl.
A	Norris, Albert Lane.	A	O'Keefe, Michael Wallace.
A	Norris, Sarah Frances.	A	O'Keeffe, Daniel Thomas.
D	Northrop, Clarence Clark.	A	O'Kie, Howard.
A	Norton, Eben Carver.	A	Olds, Frank Williams.
A	Norton, Eliza Bogart Lawrence.	A	O'Leary, Helen Bartlett.
D	Norton, George Edward.	A	O'Leary, Joseph Augustus.
D	Norton, George Paul.	A	Olin, Francis Henry.
D	Norton, Herbert Rozelle.	B	Olive, Eben.
A	Norton, James Safford.	A	Oliver, Charles Augustus.
A	Norwood, Ephriam Wood.	A	Oliver, James.
A	Nott, Albert.	A	Oliver, Joseph Pearson.
A	Nottage, Herbert Percy.	A	Olmstead, Charles Edward.
D	Nowland, George Dunn.	A	Olmstead, William Adams.
A	Noyes, Ernest Henry.	A	O'Meara, Michael John.
D	Noyes, Henry Allen.	E	O'Neil, Richard Frothingham.
A	Noyes, Nathaniel Kingsbury.	A	Oppe, Samuel.
A	Noyes, Rufus King.	D	Ordway, Charles Anthony.
A	Noyes, William.	A	Ordway, George Albert.
D	Nute, Marion.	B	O'Regan, John.
D	Nutt, Walter Elwyn.	A	O'Reilly, William Joseph.
A	Nutter, William Dennett.	D	Orr, Samuel Sanford.
D	Nutting, Frederick Harrison.	A	Osborne, Aaron Sylvanus.
A	Nutting, William Walace.	D	Osborne, Caroline Amelia.
A	Nutting, Will Wallace.	A	Osborne, George Sterne.
D	Oakes, Fitz Albert.	B	Osceonneo, Charles Edwin.
A	O'Brien, Denis Aloysius.	A	Osgood, George Cowles.
D	O'Brien, John Charles.	C	Osgood, George Edward.
A	O'Brien, John Francis.	A	Osgood, Gilman.
B	O'Brien, Michael John.	A	Osgood, Hamilton.
A	O'Brien, Owen St. Clare.	A	Osgood, James Henry.
A	O'Brien, Philip Thomas.	E	O'Shea, Daniel Joseph.
D	O'Brien, Thomas James.	C	O'Shea, Edward Flavin.
D	O'Brien, Walter John Leo.	D	O'Shea, Joseph Francis.
A	O'Callaghan, Denis Francis.	A	Osman, Charles Frank.
A	O'Callaghan, Mary Vincent.	A	O'Sullivan, Daniel Joseph.
A	O'Callaghan, Thomas Albert.	D	O'Sullivan, John Joseph.
D	O'Connell, Delia Maria.	A	Otis, Edward Osgood.
A	O'Connell, John David.	A	Otis, Walter Joseph.
A	O'Connor, James Bernard.	A	O'Toole, James Henry.
D	O'Connor, Charles.	D	O'Toole, Thomas Henry.
D	O'Connor, John Edward.	A	Ott, George John.
D	O'Connor, John Francis.	A	Otterson, William David.

Official List of Practitioners of Medicine — Continued.

D	Outhouse, John Stanley.
D	Overlock, Melvin George.
A	Oviatt, George Alexander.
B	Owen, James Williamson.
D	Owen, Mary Angell.
A	Owen, Varillas Linus.
A	Packard, Edward Albert.
D	Packard, George Henry.
A	Packard, Horace.
A	Packer, Edmund Hilliard.
D	Packer, Henry Ernest.
A	Paddock, Franklin Kittridge.
A	Paddock, William Leroy.
A	Padula, Thomas Francis.
A	Page, Albert Kidder.
C	Page, Calvin Gates.
B	Page, Charles Edward.
A	Page, Charles Whitney.
A	Page, Charlotte Evans.
A	Page, Edward.
A	Page, Frank Wilfred.
D	Page, Frederick Carroll.
D	Page, George Thornton.
A	Page, Harstein Wendell.
D	Page, Joseph Gregory Elias.
B	Page, Margaret Beulah.
D	Page, Peirson Sterling.
A	Pagelsen-Howard, Margaret Emily.
A	Paige, Nomus.
A	Paine, Amasa Elliot.
F	Paine, Ara Marshall.
A	Paine, Nathaniel Emmons.
D	Paine, Sumner.
D	Painter, Charles Fairbank.
A	Palardy, Joseph Hector.
D	Palecek, Albina Marie.
A	Palmer, Charles.
A	Palmer, Ezra.
A	Palmer, George Monroe.
D	Palmer, Harris Orlendo.
A	Palmer, Lewis Merritt.
A	Palmer, Sarah Ellen.
B	Papineau, Louis Joseph.
D	Paquin, Elzear.
A	Parcher, George Clarence.
A	Park, Francis Edwin, Jr.
A	Park, Isaac Park.
A	Park, James Timothy.
A	Park, John Gray.
E	Park, Osmond Franklin.
E	Parker, Arthur Holmes.
A	Parker, Charles Edwin.
A	Parker, Charles Frederick
D	Parker, Edward Grahame.
D	Parker, Edward Oliver.
A	Parker, Edwin Monroe.
B	Parker, Ernest Kent.
A	Parker, Francis Fullam.
A	Parker, Frank Howard.
A	Parker, Harriet Eliza.
C	Parker, Henry Ward.
D	Parker, John Howard.
A	Parker, Moses Greeley.
D	Parker, Ralph Walter.
A	Parker, Rufus Stanly.
A	Parker, Rupert William.
D	Parker, Walter Henry.
A	Parker, Wallace Asahel.
A	Parker, William Edward.
A	Parker, William Thornton.
A	Parkhurst, Luman Boyden.
A	Parks, Edward Luther.
A	Parks, John Wilson.
A	Parks, Silas Henry.
A	Parmalee, William Josiah.
D	Parmenter, Kenneth Raymond.
D	Parodi, Teofilo.
B	Parris, John Bowers.
D	Parry, Eleanor.
D	Parsons, Clarice Johnston.
D	Parsons, Frank Sears.
A	Parsons, Harry Snow.
A	Parsons, John Eleazer.
B	Parsons, Vienna Amelia.
D	Partree, Homer Tomlinson.
A	Partridge, Charles Catlin.
A	Partridge, Frank Joseph.
A	Partridge, Thomas Jefferson.
D	Pascoe, James Botterell.
A	Pascoe, William Whelan.
A	Passoff, Edward Jacob.
D	Patch, Ann Sophia Kenney.
A	Patch, Frank Wallace.
A	Patch, William Thurston.
A	Patenaude, Samuel.
B	Patrick, Joseph Edward.
A	Patrick, Thomas William.
D	Pattee, Asa Lee.
A	Patten, Anthony Dimock.
A	Patten, Frank Williams.
A	Patten, Julia Maria.
D	Patten, Stephen Kerr.
A	Patterson, Alice Maria.
D	Patterson, Alice Zelia.
E	Patterson, Belle French.
D	Patterson, Charles Frederick.
A	Patterson, David Nelson.
C	Patterson, William Francis.
D	Patton, Lawrence Finney.
A	Patoël, Francis.
A	Paul, Walter Everard.
D	Paul, Willard Augustus.
A	Paulhus, Ovide Maxime.
A	Paulig, Frederick August.
D	Paulsell, Mary.
A	Paun, Amos Bosworth.
D	Pavlides, Demosthenes.

Official List of Practitioners of Medicine — Continued.

A	Payne, Frederick William.
A	Payne, George Harkness.
A	Payne, James Henry.
A	Payne, James Henry, Jr.
A	Payne, John Howard.
A	Peabody, Charles Augustus.
D	Peabody, Sophia Reed.
D	Pearce, Mary Alice.
A	Pearce, Richard Mills.
D	Pearl, Frederick Warren.
D	Pearson, Charles Lusby.
A	Pearson, John William.
A	Pearson, Mary Morey.
A	Pearson, Maurice Wellesley.
D	Pease, Charles Wood.
A	Pease, Edward Allen.
D	Pease, Ella Gertrude.
A	Pease, Herbert Orrin.
A	Pease, James Milton.
A	Peasley, Emma Janet.
A	Peck, Albert Fred.
D	Peck, Eugene Chase.
D	Peck, Luke Baker.
A	Peckham, Anson Churchill.
A	Peckham, Katherine Fenner.
D	Peckham, William David.
C	Pedrick, Stephen Augustus.
D	Peebles, Thomas Chalmers.
A	Peirce, Amos Hagar.
A	Peirce, Charles John.
A	Peirce, Edward.
A	Peirce, Elihu Proctor.
E	Peirce, Frederic Joseph.
D	Peirce, George Alphonso.
A	Peirce, James.
A	Peirson, Edward Lawrence.
D	Pender, George Edward.
D	Penny, Herbert Thomas.
D	Percy, David Thomas.
A	Percy, Frederick Bosworth.
A	Percy, George Emery.
D	Perkins, Anne Elizabeth.
A	Perkins, Archie Elmer.
A	Perkins, Charles Edwin.
D	Perkins, Eben Meade
A	Perkins, Edward Augustus.
A	Perkins, Henry Phelps, Jr.
E	Perkins, Herbert Crawford.
A	Perkins, Nathaniel Royal.
A	Perkins, Stella Manning.
A	Perkins, Thomas Lyman.
D	Perkins, Thomas Tounge.
A	Perkins, Wesley Bennor.
A	Pero, Joseph Thomas.
A	Perrins, John.
A	Perrins, William Arthur.
D	Perley, Roscoe Damon.
A	Perry, Arthur Pedro.
D	Perry, Arthur Reed.
D	Perry, Charles Freeman.
A	Perry, Charles Homer.
A	Perry, Eben Greeley.
D	Perry, Edgar.
D	Perry, Edward Franklin.
A	Perry, Edward William.
A	Perry, Frederic Davis.
A	Perry, George Lewis.
D	Perry, Henry Joseph.
A	Perry, Herbert Brainerd.
C	Perry, Joseph Frank.
A	Perry, Martha.
D	Petersen, Alfred Charles Nicholas.
A	Petersen, Henrik Georg.
A	Peterson, Charles Augustus Burton.
A	Petit, Alphonse Hubert.
D	Pettee, John Harris.
A	Pfaff, Franz Ludwig Friedrich Ernst.
D	Pfarre, Edward Robert.
B	Pfefferkorn, Charles Hermann.
A	Pfefferkorn, Ferdinand Carl Ludwig.
B	Pfeiffer, Jens Paulus Immanuel.
B	Phelps, James Richardson.
A	Phelps, John Samuel.
A	Phelps, Olney Windsor.
B	Phillimore, Frederick George.
A	Phillips, Charles Hiram.
A	Phillips, Eugenie Marion.
B	Phillips, Freeman Allen.
A	Phillips, Leslie Almond
D	Phillips, Wilson Frank.
A	Phippen, Hardy.
A	Phipps, Walter Andros.
A	Pick, Albert.
D	Pickard, Isaiah Lovell.
A	Pidgin, Lucy Sturtevant.
A	Pierce, Andrew Martin.
C	Pierce, Appleton Howe.
E	Pierce, Charles Willard.
A	Pierce, Frank Benneville.
A	Pierce, Gardner Carpenter.
D	Pierce, George Burgess.
B	Pierce, George Jacob.
A	Pierce, Helen Frances.
A	Pierce, Matthew Vassar.
A	Pierce, Willard Henry.
A	Pierson, Henry Walter.
A	Pigeon, James Cogswell Dumaresque.
D	Pike, Forrest Fay.
A	Pike, Forrest Wiley.
A	Pike, Lucy Johnson.
D	Pilgrim, Maurice Fischer.
D	Pilling, Simeon Orison.
E	Pillsbury, Boyden Harlin.

Official List of Practitioners of Medicine — Continued.

D Pillsbury, Ernest Dean.
E Pillsbury, Frederick Ainsworth.
A Pillsbury, George Harlin.
D Pillsbury, Warren Wilbur.
D Pinault, Joseph Josué.
B Pinkham, Arthur Clarance.
A Pinkham, George Edwin.
A Pinkham, Joseph Gurney.
A Piper, Frank.
D Piper, Fred Smith.
A Pirlot, Julius Adrien.
A Pitcher, Herbert Frank.
A Pitcher, Samuel.
A Pitkin, Leonard Fox.
A Pitman, Benjamin Fosdick.
A Pitt, Thomas Smith.
D Pitta, João Carlos da Silva.
A Pixley, Elbridge Simpson.
A Platt, Belle Joanna.
A Plimpton, Lewis Henry.
A Plummer, Edward Marwick.
C Plummer, Frank Wentworth.
D Plummer, Frederic Howard.
D Plummer, Francis Joseph.
C Plummer, Henry Lincoln.
A Plummer, Julia Morton.
D Plummer, Paul.
A Plunkett, Francis Charles.
A Plunkett, John Lawrence.
D Poirier, Alfred.
A Poirier, Emile.
E Poitras, Joseph Francois Xavier.
A Pollock, Lewis Lawrence.
A Pomerat, Charles Marius.
A Pomeroy, Hiram Sterling.
A Pomeroy, Stephen Franklin.
A Pomeroy, William Henry.
D Pond, Eleanor Dorcas.
A Pool, Charles Bret.
A Poole, George Fred.
A Pope, Frank Fletcher.
A Pope, Irvine Clarendon.
A Porter, Charles Allen.
A Porter, Charles Burnham.
C Porter, Charles Ilsley.
A Porter, Francena Elizabeth.
A Porter, Francis Edward.
D Porter, Fred Knight.
D Porter, Herbert Kent.
D Porter, Margaret Cochran Dewar.
A Porter, Omer Pillsbury.
D Porter, William James.
A Post, Abner.
E Pote, Leonard Holden.
A Pothier, Joseph Charles.
D Potter, Frances Wason.
A Potter, La Forrest.
D Potter, Lester Forest.
A Potter, William Gage.
A Potts, Joseph Henry.
A Poulin, Damase Mark.
D Pound, John C.
D Powell, Jonathan Rider, Jr.
D Powell, Lefferts Morrell.
A Powers, Abner Howard.
A Powers, Edward Joseph.
A Pratt, Calvin.
A Pratt, Charles Albert.
A Pratt, Charles Augustus.
A Pratt, Charles Sumner.
B Pratt, Edwin Alton.
D Pratt, John Edward.
A Pratt, John Frank.
A Pratt, John Washburn.
A Pratt, Joseph Chester.
D Pratt, Joseph Hersey.
B Pratt, Samuel Barker.
B Pratt, Thomas Choate.
A Preble, Wallace.
D Préfontaine, Louis Aurèle.
A Prentiss, Harold Townsend.
A Prentiss, Henry Conant.
A Presbrey, Silas Dean.
A Prescott, Charles Dudley.
D Prescott, Royal Blood.
A Prescott, William Herbert.
D Preston, James Louis.
D Prevaux, John Jacob.
D Price, Walter Herbert.
A Primeau, Narcisse Arthur.
D Prince, Calvin Oliver.
A Prince, Morton Henry.
A Prindle, Charles Henry.
A Prior, Charles Edwin.
D Prior, James Edward.
D Prisco, Nicola.
E Pritchard, William Percival.
A Procter, Percy Clement.
A Procter, Thomas Walter.
A Proctor, Francis Ingersoll.
B Proctor, Hannah Maria.
D Proctor, John Donald.
E Proctor, Joseph Whipple.
A Proulx, Jean Thomas Philias.
A Prouty, Albert Henry.
C Provan, Robert.
D Provandie, Paul Hector.
D Pulsifer, Thomas Benton.
A Purcell, Thomas Aquinas.
D Purdy, Frank Le Roy.
D Purvis, Alice Hatheway.
A Putnam, Charles Pickering.
D Putnam, Charles Russell Lowell.
C Putnam, Charles Willis.
A Putnam, James Jackson.
A Putnam, Joseph Morrill.
D Putnam, Marion Zachariah.

Official List of Practitioners of Medicine — Continued.

A	Putnam, Mary Parks.	D	Reid, Eustace Palmer.
A	Putnam, Thomas Joy.	E	Reid, Francis Walsh.
A	Putnam, Willard Abram.	A	Reid, Robert Alexander.
A	Qua, Lester Robert.	D	Reilly, James Aloysius.
A	Quackenboss, Alexander.	D	Remillard, Joseph Laury.
A	Quimby, Samuel Foster.	A	Remington, John Alfred.
A	Quimby, Sumner Ferdinand.	E	Rencurrel, Manuel Emile.
A	Quinby, Hosea Mason.	A	Reynolds, Edward.
D	Quinlan, Henry Francis.	A	Reynolds, Henry Vose.
A	Quint, Norman Perkins.	B	Reynolds, Hiram Creamer.
A	Rabethge, Charles Armand.	C	Reynolds, John Phillips.
A	Rabinovich, Helen.	D	Rhodes, Frank Edson.
A	Race, Gorton Herbert.	A	Rhoads, George.
D	Racine, Ernest Eusèbe.	A	Rice, Albert James.
A	Raddin, Frank Stocker.	A	Rice, Albert Raymond.
D	Radcliff, Sue.	D	Rice, Alger William.
A	Rand, John Prentice.	B	Rice, Austin Bradford.
A	Rand, John William.	A	Rice, Charles Henry.
A	Rand, Nehemiah Wheeler.	A	Rice, Frederick Winslow.
A	Rand, Richard Baxter.	A	Rice, George.
D	Randall, Arthur Theodore.	A	Rice, George Brackett.
B	Randall, Charles H.	A	Rice, George Le Roy.
A	Randall, Charles Lawrence.	A	Rice, Harry Edwin.
D	Randall, Clifford Walcott.	A	Rice, Joseph Marcus.
A	Randall, Francis Drew.	D	Rice, Thomas.
D	Randall, George Merrill.	D	Rice, Walter Henry.
A	Randell, Leo.	A	Rich, Frank Urbanus.
B	Randell, Otis Gray.	D	Rich, Herbert Lowell.
A	Rankin, Thomas David.	D	Richard, Alfred Edouard.
D	Ranks, Walter Hildreth.	A	Richard, Marcel.
A	Ranney, Archibald.	A	Richards, Caroline Maria.
C	Ransom, Nathaniel Morton.	A	Richards, George Edwards.
B	Rappoport, Abraham.	A	Richards, George Lyman.
A	Rawson, Charles.	D	Richards, James Forsaith.
A	Rawson, George Wallace.	A	Richards, William.
C	Ray, John Edward.	A	Richardson, Anna Gove.
D	Raymond, Charles Nevier.	A	Richardson, Benjamin Franklin.
A	Raymond, Richard Michael.	D	Richardson, Dana Putnam.
D	Raynes, Myrton Berry.	A	Richardson, Edward Blake.
A	Read, Robert McLellan.	A	Richardson, Emily Metcalf.
D	Read, Willard Fulton.	E	Richardson, Francis Allen.
D	Reagh, Arthur Lincoln.	A	Richardson, Frank Chase.
D	Rearden, Thomas Francis.	A	Richardson, Mark Wyman.
D	Reardon, Timothy Joseph.	A	Richardson, Maurice Howe.
D	Record, Wellington.	A	Richardson, William Lambert.
D	Reddy, Joseph Warren.	A	Richardson, William Shedd.
A	Redfearn, Joseph.	A	Richmond, Ernest Dalton.
A	Redmond, James William.	D	Richmond, Lauriston Amaziah.
D	Redmond, Thomas Henry.	B	Richmond, Mary Lovejoy.
A	Reed, Albert Church.	D	Richmond, Simon.
A	Reed, Andrew Fairfield.	A	Ricketson, Arthur.
C	Reed, Asa Pingree.	D	Rideout, Herman Leslie.
A	Reed, Clara Deborah Whitman.	D	Riley, Elizabeth Angela.
A	Reed, Thomas Greenhalgh.	A	Riley, John Henry.
A	Reed, Robert Gates.	A	Riley, Thomas.
D	Reed, Victor Augustus.	E	Riley, William Norton.
A	Reed, William Gilman.	A	Ring, Allen Mott.
B	Reeder, Albert.	D	Ring, Arthur Hallam.
A	Reeves, Harriet Elmira.	D	Ring, Barbara Taylor.

Official List of Practitioners of Medicine — Continued.

B	Riopelle, Alexander Joseph.
A	Ripley, Frederick Jerome.
A	Ripley, William King.
D	Ritter, Henry.
C	Rix, Frank Reader.
D	Roach, George Ernest.
D	Robb, William Matthews.
A	Robbins, Elliott Daniel.
D	Robbins, Elmer Elsworth.
A	Robbins, Fred Gibson.
D	Robbins, Fred McAuslan.
D	Robbins, Frederick Carver.
A	Robbins, James Henry.
E	Robert, Albert Napoleon.
E	Robert, George Clovis.
A	Roberts, Dolphin Pernanders.
D	Roberts, Frederick Alpha.
A	Roberts, George Kerr.
A	Roberts, Henry Ambrose.
A	Roberts, Isaac Lincoln.
A	Roberts, Linneus Alton.
D	Roberts, Oscar Brown.
A	Roberts, Oscar Samuel.
A	Roberts, Oscar Waldo.
A	Roberts, Osmon Osmore.
D	Roberts, Stephen Martindale.
A	Robertson, James Douglas.
C	Robey, William Henry, Jr.
A	Robie, Walter Franklin.
A	Robinson, Albert Brown.
A	Robinson, Alexander Lincoln.
D	Robinson, Arthur Thayer.
D	Robinson, Ernest Franklin.
A	Robinson, Ernest Frederick.
A	Robinson, Florence Nightingale.
D	Robinson, Francis Arnold.
D	Robinson, Fred Hilyard.
D	Robinson, Fred Israel.
A	Robinson, Gilman Parker.
A	Robinson, Jonathan Henry.
D	Robinson, Joseph.
A	Robinson, Joseph Henry.
A	Robinson, Lucy Morton.
D	Robinson, Mary Emma Bliss.
B	Robinson, Millard Lyman.
A	Robinson, Thomas Johns.
A	Robinson, Wilhelmus Bogart.
A	Robinson, William Henry.
D	Robinson, William Perry.
A	Roche, Thomas Francis.
D	Roche, Thomas Francis.
A	Rochette, Louis Victor.
D	Rockafellow, John Chester.
E	Rockwell, Alfred Elijah Perkins
D	Rockwell, Herbert George.
A	Rockwell, John Arnold.
D	Rockwell, John Arnold, Jr.
B	Roff, Moses.
A	Rogers, Albert Edward.
A	Rogers, Charles Rufus.
A	Rogers, Frank Alvin.
D	Rogers, Gorham Davis.
A	Rogers, Orville Forrest.
B	Rogers, Triton Raphel.
A	Rohrer, Sofier Rudolf.
A	Rolfe, William Alfred.
A	Rollins, Charlotte Abbie.
A	Rollins, William Herbert.
D	Romei, Troiano.
D	Rood, Luther Colby.
B	Root, Alice Lucinda.
B	Root, John Reynolds.
A	Root, Richmond Barbour.
D	Rosa, Henry Antonio.
B	Roscoe, Tom.
E	Rose, Alwyn.
A	Rose, Daniel Campbell.
A	Roseman, Milton Joseph.
D	Rosenstein, Isidore Eugene.
D	Ross, Ellsworth Frank.
D	Ross, Frank Augustus.
A	Ross, George Ivison.
D	Ross, Lydia.
D	Ross, Robert Oswald.
D	Ross, Walter Howard.
B	Rosson, Emma.
A	Rotch, Thomas Morgan.
A	Roth, Edward.
D	Rotheram, Marie Cecelia.
D	Rothfuchs, Charles Christian.
D	Rothwell, Charles Robert.
A	Roulier, Jacobum Phillippe.
A	Round, Arthur Morey.
D	Rounds, Daniel Willis.
D	Rounds, George Herbert.
A	Rourke, Joseph Edward.
A	Routhier, Michael Omer.
A	Rovinsky, Alexander.
A	Rowe, Alice Eliza.
A	Rowe, George Howard Malcolm.
C	Rowen, Henry Stanislaus.
A	Rowley, William.
A	Roy, James McDonald.
D	Roy, Joseph Ferdinand Elzear.
A	Roy, Joseph Hormidas.
D	Roy, Joseph Napoleon.
A	Roy, Louis Joseph.
A	Roy, Pramath Nath.
A	Royal, Herbert Benjamin.
A	Ruddick, William Henderson.
A	Ruggles, Willard Osman.
A	Runnells, Andrew Jackson.
A	Ruppel, Emil Carl Fraser.
A	Ruppel, Myra Daniel Allen.
C	Russegue, Henry Elmore.
D	Russell, Edward Ervin.
A	Russell, Flora Smith.

Official List of Practitioners of Medicine — Continued.

D	Russell, Frederick James.
A	Russell, Frederick William.
A	Russell, John Henry.
B	Russell, John Perkins.
C	Russell, Julia Ann Bray.
C	Russell, Simon James.
A	Russell, Trueman Everett.
D	Russell, Walter Aloysius.
A	Russell, William Henry.
D	Russell, Willis Adams.
B	Rust, Charles Manning.
D	Rust, Frank Lee Drummond.
D	Rutter, Clara Hannah Rogers.
D	Ryan, Dennis Matthew.
D	Ryan, John Francis.
A	Ryan, John Lawrence.
A	Ryan, Philip Marcellus.
A	Ryan, William John.
D	Ryder, Charles Edward.
D	Ryder, George Hale.
A	Ryder, Godfrey.
D	Ryder, James William.
A	Sabine, George Krans.
A	Sackett, Harry Robert.
A	Safford, Moses Victor.
D	Safford, Wilber Pray.
A	Saltmarsh, Seth.
A	Sampson, Lottie Emma.
B	Sampson, Nellie.
A	Sanborn, Edwin Aaron.
A	Sanborn, Emma Mary Eastman.
E	Sanborn, Fletcher Greene.
A	Sanborn, Frederick James.
C	Sanborn, John Eastman.
D	Sanborn, John Wesley.
A	Sanborn, Joseph Lander.
A	Sanborn, Kate.
A	Sanborn, Nathan Willard.
A	Sanborn, Perley Lewis.
D	Sanders, Charles Barton.
B	Sanders, Edwin Melvin.
E	Sanders, James Samuel.
A	Sanders, Orren Burnham.
A	Sanders, William Bernhard.
A	Sanderson, James Henry.
D	Sanderson, Mary.
A	Sanford, Edward.
D	Sanford, Frank Burton.
D	Sanford, Margaret McPhee.
D	Sanford, Walter Howard.
A	Sanft, Frank.
D	Santosuosso, Joseph.
D	Sargent, Albert Alonzo.
A	Sargent, Ara Nathaniel.
A	Sargent, Charles Samuel.
C	Sargent, George Amory.
A	Sargent, George Bancroft.
A	Sargent, Lorenzo Dow.
A	Sargent, Orin Shaw.
A	Saunders, Ambroze Courtis.
D	Saunders, Edward Louis.
F	Saunders, Levi.
D	Savage, Ross Eliot.
A	Savard, Alfred Henry.
A	Savignac, Arthur.
C	Saville, Sumner Carruth.
A	Sawin, Charles Dexter.
A	Sawin, Robert Valentine.
A	Sawtelle, Benjamin Albert.
A	Sawtelle, George Bassett.
A	Sawtelle, Henry Winchester.
D	Sawyer, Alfred Stanford.
A	Sawyer, Alzaman.
A	Sawyer, Benjamin Addison.
D	Sawyer, Carleton.
A	Sawyer, Charles Milton.
D	Sawyer, Edward Allen.
E	Sawyer, Edward Keyes.
A	Sawyer, Elihu LeRoy.
B	Sawyer, Emily Harriet.
A	Sawyer, Frank Wade.
A	Sawyer, Herbert Houston.
B	Sawyer, Katie Sarah.
A	Sawyer, Walter Fairbanks.
A	Sawyer, Wesley.
A	Sawyer, Willis Herbert.
D	Sayles, Joseph Borland.
D	Sayward, William Henry, Jr.
A	Scales, Edward Payson.
D	Scales, Robert Bass.
A	Scannell, Michael Edward.
A	Schiller, Louis Edouard.
E	Schmidt, Frederick Sextus.
A	Schneider, Jacob Philip.
D	Schofield, Benjamin Franklin.
D	Schofield, Otho Lester
D	Schoonmaker, Arthur Twing.
D	Schorer, Cornelia Bernhardine Johanna.
D	Schubmehl, Frank Edward.
D	Schultz, Simon Robert.
C	Scoboria, Arthur Gilmore.
A	Scofield, Walter.
B	Scott, Charles Winfield.
A	Scott, Chester Walter.
A	Scott, Cyrus Wallace.
A	Scott, Gavin Steel.
B	Scotti, Federico.
A	Scribner, Ernest Varian.
A	Scudder, Charles Locke.
A	Seaman, William.
A	Searle, George James.
A	Sears, Eloise Augusta.
A	Sears, George Gray.
D	Sears, Harry Edward.
C	Sears, Henry Francis.
A	Sears, Henry Thatcher.
D	Sears, Stephen Hull.

Official List of Practitioners of Medicine — Continued.

A	Seelye, Hiram Henry.
A	Seelye, Ralph Holland.
E	Seelye, Walter Clark.
B	Segool, Hyman.
A	Segur, Willard Blossom.
A	Seip, Charles Lewis.
A	Selee, Annie Maud.
A	Sellew, Philip Hamilton.
A	Selling, Leo Milton.
A	Selva, Julius.
C	Senay, Joseph.
B	Senter, George Eldredge.
A	Serijanian, Tatios Kasbar.
A	Severance, William Lyman.
A	Severance, William Sidney.
A	Sewall, John Jasper.
D	Sewny, Karékeen Hekimian.
D	Sexton, Frank Joseph.
D	Sexton, James Henry, Jr.
A	Seymour, Christopher.
A	Seymour, James Dwight.
A	Seymour, Susan Pheland.
A	Shackford, Charles Harrison.
D	Shanahan, Edward Joseph.
A	Shanahan, John.
D	Shanahan, Thomas Joseph.
A	Shannon, Nat Vaughn.
A	Shapira, Israel Jarius Elihaf.
A	Shapleigh, Alfred Lindsay.
D	Sharp, Leedom.
A	Sharp, Walter Nevin.
D	Shatswell, James Arthur.
D	Shattuck, Albert Milo.
A	Shattuck, Charles Harvey.
D	Shattuck, Edwin Chase.
A	Shattuck, Frederick Cheever.
A	Shattuck, George Brune.
A	Shaw, Albert Joel.
A	Shaw, Arthur John.
B	Shaw, Charles Albert.
D	Shaw, Francis.
A	Shaw, Henry Lyman.
A	Shaw, James Stott.
A	Shaw, John Cook.
A	Shaw, John Holbrook.
A	Shaw, John Joseph.
D	Shaw, John Port.
A	Shaw, Sarah Jane Hutchinson.
D	Shaw, Thomas Bond.
A	Shaw, Thomas Pierpont.
D	Shaw, William Hubbard.
A	Shay, Thomas McGuire.
D	Shea, John Francis.
D	Shea, John Joseph.
A	Shea, Thomas Bernard.
D	Shea, Peter Owen.
E	Sheahan, Joseph Maurice.
D	Sheedy, John Francis.
E	Sheehan, Martin David.
A	Sheehan, William Joseph.
A	Sheehy, William Clinton.
A	Sheldon, Chauncey Cooley.
B	Shepardson, Oscar Jerome.
C	Shepherd, Hovey Learned.
A	Shepherd, Susan Symonds.
E	Sherburne, Frederick William.
A	Sheridan, Oliver Michael.
A	Sherman, Charles Francis.
A	Sherman, Frank Morton.
B	Sherman, James Henry.
A	Sherman, James Turner.
A	Sherman, John.
A	Sherman, John Howard.
A	Sherman, Mary Hastings.
A	Sherman, Sarah Eva.
A	Sherman, William Sprague.
D	Sherskefsky, Cecilié Lande.
A	Sherwin, Aurelius Calvin.
E	Sherwood, Walter.
D	Sherwood-Dunn, Berkeley.
A	Shirley, Allen Lincoln.
D	Shisler, William Henry.
A	Shores, Harvey Towle.
A	Shreve, Octavius Barrell.
D	Shultis, Frederick Charles.
C	Shurtleff, Augustine.
A	Shurtleff, Eugene.
A	Shurtleff, Frank Atwood.
A	Shurtleff, Fred Cazeaux.
A	Shurtleff, George Frederick.
A	Shurtleff, Henry Austin.
D	Shurtleff, James Frederick.
D	Shurtleff, Walter Davis.
A	Sibley, Hartwell Augustus.
A	Sidney, Austin Wilbur.
A	Siggins, John Jacob.
D	Silbert, Joseph Jacob.
B	Sill, John Wellesley.
A	Silva, Francis Pierce.
A	Simmons, Clara Congdon.
A	Simmons, William Edmund.
A	Simonds (née Nutter), Marilla Reed.
A	Simpson, Charles Edward.
A	Simpson, Edmund S.
A	Simpson, George Foster.
A	Simpson, James Edwin.
B	Simpson, John Thomas Lionel.
A	Simpson, William Langdon.
B	Sims, Charles Hawkins.
A	Sinclair, Alexander Doull.
A	Sinclair, William Albert.
A	Siskind, Alexander Louis.
A	Sisson, Edward Rotch.
D	Skelton, Grace Evelyn.
A	Skinner, Edward Manning.
A	Skinner, John.
D	Skolfield, Ezra Byington.

Official List of Practitioners of Medicine — Continued.

D	Slack, Francis Hervey.
D	Slagle, Sarah Elizabeth.
E	Slate, Ames Wilsworth.
A	Slattery, John Richard.
A	Slayter, John Theodore Harding.
A	Slayton, William Taft.
A	Sleeper, Walter Julian.
D	Slettengren, Oscar.
C	Slocomb, George Albert.
E	Small, Guy Darwin.
A	Small, Herbert Elwyn.
A	Small, John Wesley.
D	Small, Richard Dresser.
A	Small, Whitmell Pugh.
D	Smalley, Fred Lyman.
D	Smart, Frank Everard.
E	Smith, Alfred Charles.
A	Smith, Arthur Vincent.
A	Smith, Asa Dennis.
A	Smith, Charles John James.
A	Smith, Charles Morton.
A	Smith, Charles Sherman.
D	Smith, Chiron Waterville.
D	Smith, Conrad.
A	Smith, Daniel Patrick.
B	Smith, David Wiley.
D	Smith, Edward Shepard.
A	Smith, Ella Gertrude.
A	Smith, Ezra Algernon.
D	Smith, Frank Herbert.
D	Smith, Frank Llewellyn.
A	Smith, Frank Simpson.
A	Smith, Franklin Benjamin.
C	Smith, Fred Stevens.
A	Smith, Frederick Glazier.
A	Smith, George Herbert.
A	Smith, George La Breche.
D	Smith, Harry Atherton.
A	Smith, Henry Marcellus.
A	Smith, Herbert Llewellyn.
A	Smith, Hermon Joseph.
A	Smith, Hiram Fred Markley.
A	Smith, Homer Alvan.
D	Smith, James Gardner.
D	Smith, James Jay.
D	Smith, Jeremiah Ranlet.
D	Smith, John Hall.
A	Smith, Jonathan Jason.
D	Smith, Joseph Arthur.
A	Smith, Joseph Heber.
B	Smith, Julia Ann Crafts.
A	Smith, Lawrence Sumner.
B	Smith, Levi Jasper.
D	Smith, Lewis Albert.
D	Smith, Marshall Evans.
A	Smith, Mary Almira.
A	Smith, Murdock Campbell.
D	Smith, Ota Mafry.
D	Smith, Peter Matthew.
D	Smith, Samuel Breese.
D	Smith, Samuel Finlay.
A	Smith, Sumner Phinney.
A	Smith, Thomas Burke.
A	Smith, Walter Anson.
D	Smith, William Henry.
C	Smith, William Lord.
A	Smith, Winfield Scott.
A	Smithwick, John.
C	Smithwick, Marsena Parker.
A	Smyth, Herbert Edmund.
D	Smyser, Charles James.
A	Snow, Asa Vernon.
E	Snow, Frederick Stedman.
D	Snow, Henry Curtis Butler.
A	Snyder, Charles Wight.
D	Solomon, Florence Augusta.
B	Solomon, James Madison.
B	Solomon, Sarah Augusta.
B	Solomon, William Burr.
A	Somers, John Edward.
A	Soper, Lyman White.
A	Sopher, Curtis Levi.
C	Sosnoski, Philip.
D	Soule, Horace John.
B	Soule, John Albion.
A	Soules, Silas George.
D	Sousa, Jayme Ernesto Salazar D'Eça e.
A	Souther, William Towle.
B	Southgate, George Alonzo.
A	Southgate, Robert William.
A	Southwick, George Rinaldo.
D	Southworth, Thomas Shepard.
D	Soutter, Robert.
D	Spaid, Charles Jacob.
A	Spalding, Charles Franklin.
D	Spalding, Fred Maurice.
D	Spalding, Harry Osgood.
A	Spalding, Henry Edwin.
B	Spalding, Jacob Franklin.
A	Spalding, Samuel Hopkins.
E	Spalter, Charles Marsh.
A	Sparhawk, Clement Willis.
D	Sparks, Clarence Irving.
D	Sparling, John Henry.
D	Spaulding, Charles Lester.
F	Spaulding, Ebenezer Farrington.
A	Spear, Edmund Doe.
C	Spears, George William.
B	Spencer, Emily Jone.
A	Spencer, Esek Edwin.
C	Spencer, George Albert.
A	Spencer, George Frederick Allen.
A	Spencer, William Warren Conant.

Official List of Practitioners of Medicine—Continued.

A	Spooner, George Robert.
E	Spooner, Henry Garrettson.
A	Spooner, John Winthrop.
A	Sprague, George Percy.
A	Sprague, Phebe Ann.
A	Sprague, Rufus William.
D	Spratling, Edgar Johnson.
A	Spring, Clarence Walter.
A	Springer, Nathan Ayer.
A	Squier, Angelo Orin.
E	Stack, Charles Francis.
A	St. Clair, Austin Emery.
A	St. Dennis, Joseph Nelson.
D	St. George, Archibald.
A	St. George, Norman.
A	St. Georges, Wilfred Mark.
A	St. Germain, Joseph Pierre.
A	St. Germain, Valmore.
A	St. Jacques, Joseph Robert.
D	St. Marie, Philippe.
A	Stackpole, George Edmund.
A	Stacy, Charles Franklin.
A	Stafford, Frank Dalmon.
B	Stahl, Alfred Franz.
A	Standish, Myles.
A	Stanley, Charles Sullivan.
A	Stanley, George Henry.
A	Stanley, Josiah Marsh.
D	Stanley, Leonard Gove.
D	Stanley, Mark Page.
A	Stanton, Jere Edmund.
C	Stanton, Thomas Leo.
A	Stapleton, Richard Henry.
A	Starbird, Edward Perley.
A	Starbird, Isaac Warren.
D	Starbuck, Joseph Clinton.
D	Stark, Maurice Albert.
D	Starkweather, Charles Robert.
B	Starr, Christopher Hamlin.
A	Steadman, John Abraham.
A	Stearns, Charles A.
A	Stearns, Charles Goddard.
C	Stearns, Daniel Waldo.
A	Stearns, George Washington.
A	Stearns, Isaac Holden.
A	Stebbins, George Stanford.
B	Stebbins, Marion Rowena Hayward.
A	Stedman, Charles Ellery.
A	Stedman, George.
A	Stedman, Henry Rust.
A	Stedman, James Parker.
A	Stedman, Joseph Cyrus.
E	Steele, Harry Leon.
A	Steele, John McClary.
A	Steere, David Roscoe.
B	Steinberg, Joseph.
A	Stephens, Edward Buckminster.
A	Stephenson, Benjamin Swift.
B	Stephenson, Milton Elmer.
A	Stephenson, Nellis Witter.
E	Stepp, Jacob, Jr.
A	Stetson, Clarence Augustus.
D	Stetson, Frank Eliot.
D	Stetson, Frederick Winslow.
D	Stetson, Halbert Greenleaf.
A	Stevens, Andrew Jackson.
B	Stevens, Charles Albert.
A	Stevens, Charles Benjamin.
A	Stevens, Charles Wistar.
A	Stevens, Edmund Horace.
A	Stevens, George Beckwith.
A	Stevens, Harry Laurence.
A	Stevens, Henry Burt.
A	Stevens, James Herbert.
D	Stevens, Oscar Howard.
D	Stevens, Ralph Emerson.
D	Stevens, Ruey Bartlett.
D	Stevens, Sara Elmina.
A	Stevens, Seriah.
A	Stevens, William Caldwell.
A	Stevens, William Stanford.
D	Stevenson, Arthur William.
D	Stewart, Abraham Lincoln.
A	Stewart, Anne Clark.
A	Stewart, James.
A	Stewart, James Hope.
C	Stewart, Lincoln A.
A	Stickney, Alonzo Lawrence.
A	Stickney, Clifford Webster.
A	Stickney, Edwin Pangman.
A	Stickney, George Augustus.
A	Stiles, Charles Wallace.
A	Stiles, Fred Merritt.
C	Stiles, Herbert Kendall.
A	Still, James Thomas.
D	Stilwell, Benjamin Watson.
A	Stilson, Willard Charles.
A	Stinson, John Woodbury.
F	Stocker, Alfred Augustus.
D	Stockwell, Edgar Washburn.
D	Stockwell, George Norman.
D	Stockwell, Herbert Emmons.
A	Stoddard, Henry Bradish.
D	Stoddard, Mortimer Joseph.
D	Stodder, Charles William.
A	Stokes, William Royal.
A	Stone, Arthur Kingsbury.
D	Stone, Arthur Lile.
A	Stone, Byron.
A	Stone, Charles Sinclair.
A	Stone, Ella Gertrude.
A	Stone, Frank Ellsworth.
C	Stone, George Arthur.
A	Stone, James Savage.
A	Stone, Lincoln Ripley.
D	Stone, Moses Cornelius.
A	Stone, Waldo Hodges.

Official List of Practitioners of Medicine — Continued

D Stone, Warren Buxton.
B Stone, Wolf.
A Storer, John.
A Storer, Malcolm.
C Story, Alvin Francis.
D Story, Helen Louise.
E Stowe, Irving Elmer.
A Stowe, Willard Hanley.
A Stowell, Edmund Channing.
A Stowell, Joab, Jr.
C Stowell, Maud Evelyn.
A Stowell, Sarah Russell.
D Straw, O'Neil Watson Robinson.
D Strayer, Edgar.
A Street, Charles Carroll.
A Street, Jerome Charles.
D Street, Lionel Alexander Burnet.
D Streeter, Howard Alvertus.
D Strickland, Samuel Perley.
D Strong, Charles Howard.
E Strong, Frederick Finch.
D Strong, James Henry.
D Strong, Lawrence Watson.
A Strong, Thomas Morris.
A Stuart, Frederick William.
A Stuart, James Henry.
D Stubbs, Frank Raymond.
D Sturgis, Benjamin Franklin, Jr.
D Sturgis, Walter Horatio Wakeman.
A Sturtevant, Charles.
A Stutson, William Peckham.
D Styles, Myron Francis.
A Suffa, George Alson.
D Sughrue, Dennis Francis.
E Sullivan, Daniel Aloysius.
A Sullivan, Daniel Henry.
D Sullivan, Daniel Thomas.
D Sullivan, Francis Augustus.
A Sullivan, James Francis.
A Sullivan, James Francis.
A Sullivan, James Stephen.
A Sullivan, James Stephen.
B Sullivan, John Francis.
A Sullivan, John Henry.
A Sullivan, John Langdon.
A Sullivan, John Thomas.
D Sullivan, John Thomas, Jr.
E Sullivan, Joseph Lawrence.
A Sullivan, Michael Francis.
A Sullivan, William Joseph.
A Sumner, Allen Melancthon.
A Suter, William Norwood.
A Sutherland, John Preston.
D Swain, Howard Townsend.
A Swain, Mary Lizzie.
D Swain, Oliver Alden Tinkham.
A Swan, Charles Louis.
A Swan, Charles Walter.
A Swan, Henry Storer.
A Swan, Jesse Johnson.
A Swan, Roscoe Wesley.
A Swan, Will Howard.
A Swan, William Donnison.
A Swan, William Ellery Channing.
A Swasey, Edward.
A Swasey, Oscar Fitzallan.
A Sweeney, Hilary Tucker.
A Sweet, Charles Frederick.
A Sweet, Clara Maria.
B Sweet, Elisha Wilbur.
D Sweet, Frederick Benoni.
B Sweet, Job.
E Sweet, John Henry, Jr.
B Sweet, Orrin Preston.
D Sweet, Willard Hamilton.
A Sweetser, Frederic Ellsworth.
A Sweetsir, Charles Leslie.
A Swett, George William.
A Swett, Percy Walter.
D Swift, Frederic Norman.
A Swift, John Baker
A Swift, Lawrence Chew.
A Swift, Robert
A Swift, William Nye.
D Swope, Dalva Hamit.
D Sylvester, Charles Porter.
A Sylvester, Stephen Alden.
A Sylvester, William Hillman.
A Sylvia, Manuel Victorino.
E Symonds, Alice Gertrude.
A Symonds, Benjamin Ropes.
A Synan, William Edward.
D Syrett, Edgar Charles.
D Taft, Albert Atherton.
A Taft, Mary Florence.
A Talbot, George Henry.
A Talbot, Winthrop Tisdale.
A Tallman, Augustus Littlefield.
B Tallman, William Cyprian.
D Taminosian, Timotheus.
A Tanner, John Alexander.
A Tarbell, George Grosvenor.
A Tasker, Frank Edwin.
A Tassé, Joseph Chrysanthe Edward.
A Tatum, Rives.
A Taylor-Cole, Anna Bessie.
A Taylor, Charles Warren.
A Taylor, Edward Wyllys.
A Taylor, Esther Woodman.
A Taylor, Frederic Weston.
A Taylor, George Lyman.
B Taylor, Henry.
E Taylor, John Danforth.
A Taylor, Jubal George.
D Taylor, Stella Mary.

Official List of Practitioners of Medicine — Continued.

A	Temple, Franklin Stuart.
A	Temple, Hiram.
A	Temple, William Franklin.
A	Ten Broeck, Stanton Jacob.
A	Tenney, Benjamin.
D	Tenney, Elmer Seth.
A	Tenney, John Arthur.
C	Tenney, William Northend.
D	Tessier, Charles.
D	Tétreau, Thomas.
D	Thatcher, Haines C.
B	Thayer, Charles Nathaniel.
A	Thayer, Charles Paine.
A	Thayer, Daniel Ellsworth.
A	Thayer, Eugene.
A	Thayer, Fred Lyman.
A	Thayer, George Dickinson.
A	Thayer, Henri Riedelle.
A	Thayer, Samuel Chase.
A	Thayer, Samuel Ezra.
B	Thayer, Washington Irving.
D	Thayer, William Hewins.
A	Thayer, William Sydney.
A	Therrien, Edward Joseph.
E	Therrien, John.
A	Thissell, Joseph Abbott.
B	Thomas, Adelida Annabel.
A	Thomas, Caroline Louise.
A	Thomas, Charles Holt.
A	Thomas, Flavel Shurtleff.
A	Thomas, George Francis.
C	Thomas, George Henry.
A	Thomas, John Jenks.
E	Thomas, John Willard.
D	Thomasson, Aaron Hood, Jr.
D	Thomes, John Blanchard.
D	Thompson, Arthur Percival.
D	Thompson, Charles Arthur.
A	Thompson, Charles Marsh.
A	Thompson, Charles Oscar.
A	Thompson, Eben.
A	Thompson, Edward Charles.
D	Thompson, Edward Henry.
A	Thompson, Frederick Henry.
A	Thompson, George Eben.
C	Thompson, Harry John.
A	Thompson, James Gillespie.
D	Thompson, John Budd.
B	Thompson, John Buxton.
A	Thompson, John Henry.
A	Thompson, John Joseph.
A	Thompson, John McQuaid.
D	Thompson, John Stephen.
B	Thompson, Marshall Elery.
D	Thompson, Peter Hunter.
D	Thompson, Richard Henry.
A	Thompson, Richard Joseph.
A	Thomson, George Francis.
D	Thorn, Edwin Cyrus.
A	Thorndike, Augustus.
A	Thorndike, Paul.
D	Thorning, William Burton.
A	Thornton, James Brown.
B	Thornton, William.
B	Thorpe, Benjamin Franklin.
A	Thorpe, Edward Elephalet.
B	Thumin, Samuel.
A	Thuot, John Vincent.
A	Thurber, Madison Templeton.
B	Thurlow, Edgar Theodore.
A	Thurlow, John Howard.
A	Thurston, Rufus Leander.
A	Tibbetts, James Thomas.
A	Tierney, Edward Howran.
A	Tierney, Martin Henry.
A	Tigh, Frederick.
A	Tilden, Frank Elmer.
E	Tilden, Irving Niles.
D	Tileston, Wilder.
A	Tilton, Edward James.
A	Tilton, Frank Herbert.
A	Tilton, Josiah Odin.
A	Tilton, Letitia Marie.
A	Timmins, Patrick Joseph.
F	Tingley, Benjamin Wilson.
A	Tinker, Martin Buel.
A	Tinkham, Granville Wilson.
A	Tirrell, Vinson Meader.
A	Titcomb, George Eugene.
D	Tobey, Carter McVine.
A	Tobey, George Loring.
A	Tobey, Walter Henry.
A	Tobin, James Henry.
E	Tobin, John Henry.
A	Tolman, Julia.
A	Tompkins, Albert Henry.
A	Toomey, John Peter.
A	Toomey, Thomas Patrick.
D	Toothaker, Horace Edward.
D	Torrey, John Paine.
A	Torrey, Noah.
A	Torrey, Samuel William.
A	Tower, Charles Bates.
A	Tower, Frederick Russell.
A	Tower, George Augustus.
D	Towle, Benjamin Newell.
D	Towle, Charles Edward.
A	Towle, Fred Scates.
A	Towle, Harvey Parker.
A	Towle, Henry Charles.
B	Towne, Charles Jefferson.
B	Towne, William Alexander.
A	Townsend, Charles Wendell.
C	Townsend, Willis Merrick.
B	Tracy, Christopher Columbus.
A	Tracy, Edward Aloysius.
A	Tracy, Thomas Henry.
D	Tracey, John Matthew.

Official List of Practitioners of Medicine — Continued.

A	Trafton, Alonzo Gardiner.
D	Trainor, John Brett.
D	Traver, Alvah Harry.
A	Traver, Edward Clarence.
C	Treanor, John Peter.
A	Trecartin, David Munson.
D	Tresilian, Florence Harvey.
D	Tripp, George Alston.
A	Trow, Cornelius Gilman.
A	Trow, William Marshall.
A	Trowbridge, Edward Henry.
D	Trudeau, Marc Aurele.
A	Trudeau, Wilfrid.
A	Trudel, Jacques Joseph.
A	True, Herbert Osgood.
D	True, Richard Smith.
A	Trueman, Harmon Silas.
A	Trueworthy, Edwin Weston.
D	Truslow, Walter.
B	Tuck, Lucy Wadsworth.
A	Tucker, Edward Tobey.
A	Tucker, Samuel Chase.
A	Tucker, William Emerson.
A	Tucker, Willis Leroy.
A	Tully, Edward Joseph.
E	Tupper, Arthur Gordon.
A	Tupper, Augustus Maclanchlan.
C	Tupper, John Darrow.
A	Turner, Augustus Walter.
D	Turner, Charles Haverly.
D	Turner, Charles Humphrey.
A	Turner, Maurice Worcester.
D	Tustin, Ruth.
A	Tuttle, Albert Henry.
A	Tuttle, Frances Caroline.
A	Tuttle, George Herman.
A	Tuttle, George Thomas.
A	Tuttle, Karl Rand.
A	Twitchell, Edward Thayer.
A	Twitchell, George Pierce.
A	Twombley, Edward Lambert.
A	Tygesson, Alfred.
A	Tyler, Albert Mason.
A	Tyler, John Bennett.
A	Tyler, Waldo Henry.
A	Underhill, Charles Dudley.
E	Underhill, George Herbert.
A	Underwood, David Gleason.
D	Underwood, Francis Andrew.
A	Underwood, George Baker.
A	Underwood, George Latham.
D	Upham, Emily Clark.
D	Upton, Charles Louis.
A	Urich, John Henry.
C	Urie, John Francis.
A	Urquhart, John Edwin.
A	Utley, Edward Roswell.
A	Utley, James.
A	Utley, Maurice Howell.
A	Valentine, Henry Charles.
D	Valentine, John Forrest.
A	Van Allen, Harvey Ward.
B	Van Alstyne, Seymour March.
D	Van Deursen, George Livesey.
B	Van Magness, Benjamin.
D	Van Marter, Le Roy John.
A	Van Pelt, Gertrude Wyckoff.
D	Van Rensselaer, Henry Rensselaer.
D	Van Winkle, Peter.
D	Vance, Michael E.
A	Vander Burgh, David Williams.
A	Varney, Edith Charles.
A	Varney, Fred Elbridge.
A	Vaughan, Charles Everett.
A	Vaughan, Jonas Hobart.
A	Vermilye, Oscar Eugene.
A	Verner, Ismael.
A	Vickery, Herman Frank.
A	Vickery, Lucia Florence.
A	Vietor, Agnes Caecilia.
D	Vigeant, Joseph Edward.
D	Viger, Joseph Edmund Avila.
A	Viles, Clarence Albertus.
A	Vinal, Frank Thomas
E	Vinal, Harry Gardner.
D	Vinal, Walter Henry.
A	Vincent, Philip.
B	Viney, William Henry.
A	Virgin, Franklin Pierce.
A	Vose, Albert Churchill.
D	Vose, Robert Henry.
D	Voss, John William.
B	Wade, George Washington.
A	Wadsworth, Oliver Fairfield.
A	Wadsworth, Peleg.
B	Wagner, David.
D	Wait, Sheridan Paul.
A	Waite, Clarence Howard.
A	Waite, Edwin Everett.
A	Waite, Lorenzo.
A	Wakefield, Albert Tolman.
B	Wakefield, Josiah Judson.
D	Walcott, Henry Joel, Jr.
A	Walcott, Henry Pickering.
B	Wales, Edward Clarence.
E	Wales, Ernest de Wolfe.
A	Walker, Alexander Taylor.
A	Walker, Augustus Chapman.
A	Walker, Frank Clifford.
B	Walker, Gustavus Freedom.
A	Walker, James Taylor.
A	Walker, James William.
D	Walker, Lewis Marshall.
A	Walker, Thomas Jackson.
A	Walker, William.
D	Walker, William Pomp.
C	Walkley, William Samuel.

Official List of Practitioners of Medicine — Continued.

A	Wallace, Frank Huron.
D	Wallace, George Loney.
A	Waller, Thomas Gilmore.
D	Walsh, Charles Francis Adams.
A	Walsh, Charles Joseph.
A	Walsh, Frank Winfield.
D	Walsh, John Edward.
A	Walsh, Peter Duggan.
A	Walton, George Lincoln.
D	Walton, William Joseph.
D	Ward, Frederick Spalding.
A	Ward, George Otis.
D	Ward, Parker Myles.
A	Ward, Rollin Clayton.
E	Ward, William Greenleaf.
E	Warden, Ralph Alexander.
A	Wardwell, Percival Goodwin.
A	Wares, Abel.
A	Warner, Carmillus Turten.
D	Warner, Charles Norton.
A	Warner, Emerson.
A	Warner, Frederick Augustus.
A	Warner, Henry.
B	Warner, Thomas Jefferson.
D	Warren, Arthur Fay.
B	Warren, Edwin Smith.
A	Warren, Ernest Leighton.
A	Warren, Frank Randall.
D	Warren, Franklin Lafayette.
A	Warren, Herbert.
A	Warren, Hobart Endicott.
A	Warren, John Collins.
A	Warren, John Kelso.
A	Warren, Orin.
D	Warren, William Barnard.
B	Warren, William Marvin.
A	Warren, William Thomas.
A	Warwick, James.
A	Washburn, Elliott.
E	Washburn, Frank Hall.
D	Washburn, Frederic Augustus.
A	Washburn, George Hamlin.
D	Waterman, George Arthur.
A	Waterman, Thomas.
B	Waters, Samuel William.
D	Watkeys, Frederick William.
B	Watkins, Charles Edward.
A	Watkins, Robert Lincoln.
D	Watkins, Royal Philip.
C	Watson, Francis Sedgewick.
D	Watson, Frank Gilman.
B	Watson, Fred William.
A	Watson, George Henry.
A	Watson, James Maurice.
D	Watson, Walter Linwood.
A	Watson, William Purkis.
A	Watters, William.
A	Wattles-Faunce, Mary Ann.
D	Watts, Harry Adelbert.
A	Watts, Henry Fowler Ransford.
D	Weaver, George Albert.
A	Webb, Mary Elizabeth.
A	Webb, Melville Emerson.
D	Webb, Walter James.
A	Webber, Alonzo Carter.
A	Webber, Amos Paterson.
A	Webber, Frank Orland.
C	Webber, Frederick Ward.
A	Webber, George Franklin.
D	Webber, Henry Allen.
A	Webber, Horace Green.
A	Webber, Samuel Gilbert.
A	Webster, George Arthur.
A	Webster, Helen Baker Worthing.
A	Webster, Jonathan Edwards.
A	Webster, Joseph Rowe.
D	Weed, George Franklin.
A	Weeks, Charles Tupper.
A	Weeks, Joshua Franklin.
D	Weeks, William Joshua.
D	Weidner, Calvin.
A	Weinerovitch, Nochine.
A	Weinstein, Isaac.
A	Weir, Frank Le Sieur.
D	Weis, Joseph Deutsch.
A	Weiser, Walter Rupert.
A	Welch, Edward John.
A	Welch, John Frederick.
A	Weller, Francis Joseph.
F	Wellington, James Lloyd.
D	Welles, Delbert Arthur.
D	Wells, Abner Toothaker.
D	Wells, David Washburn.
B	Wells, Edward Frederic.
A	Wells, Frank.
A	Wells, James Lee.
D	Wells, John Milton.
E	Wennerberg, Francis Joseph.
A	Wentworth, Arthur Howard.
C	Wentworth, Caroline Young.
D	Wentworth, Harry Wilder.
B	Wentworth, Horace.
A	Wentworth, Jacob Brackett.
D	Wentworth, Lowell Franklin.
A	Wentworth, Walter Henry.
D	Wentworth, William Ezekiel.
D	Wentworth, William Parish.
A	Wentworth, William Warren.
A	Werner, Anders Christen.
A	Werner, Julius Dominick.
D	Wescott, William Henry.
B	Wesley, Charles Main.
A	Wesley, John Lyman.
A	Wesley, Sarah Jane.
A	Wesselhoeft, Conrad.
A	Wesselhoeft, Walter.
C	Wesselhoeft, William Fessenden.

Official List of Practitioners of Medicine — Continued.

C	Wesselhoeft, William Palmer.
A	West, Benjamin Hussey.
D	West, Bertha Helen.
A	West, Edward Graeff.
A	West, George Leon.
B	West, Pliny Hume.
D	Westall, John.
A	Westergren, Frances Clarke.
A	Weston, George Dake.
A	Weston, Isabel Gray.
D	Westwood, Mabel Inez.
A	Wetherbee, Angeline Giles.
A	Wetherbee, Roswell.
A	Wetherbee, Sarah Lucretia.
A	Wetherell, Arthur Bryant.
A	Whalley, Thompson.
A	Wheatley, Frank George.
D	Wheaton, James Lucas, Jr.
A	Wheeler, Alfred Augustus.
A	Wheeler, Charles Augustus.
A	Wheeler, Charles Douglas.
A	Wheeler, Edward Reed.
D	Wheeler, Emma Hammond.
E	Wheeler, George Day.
E	Wheeler, Gilman Avery.
A	Wheeler, Harry Deveraux.
D	Wheeler, James Hudson.
E	Wheeler, Jenness Day.
A	Wheeler, Leonard.
D	Wheeler, Lucia Anna.
A	Wheeler, Morris Plumer.
D	Wheelock, Albert Andrews.
C	Whipple, Albert Lawrence.
A	Whipple, Farrington Hasham.
C	Whipple, Frank Lewis.
A	Whiston, Edward Andem.
A	Whitaker, Clarence Wilder.
A	Whitcombe, Charles Reed.
C	White, Charles James.
A	White, Charles Warren.
A	White, Edward Forest.
C	White, Emory Lincoln.
D	White, Everett.
D	White, Franklin Warren.
A	White, George Edwin.
D	White, Henry George.
A	White, Herbert Warren.
A	White, Horace Carr.
A	White, James Clarke.
D	White, Jonathan Hutchings.
A	White, Leon Edward.
A	White, Leonard Darling.
A	White, Levi.
D	White, Michael William.
A	White, Robert.
A	White, Walter Henry.
A	White, William Allen.
D	Whitehead, Eugenia.
D	Whitehead, Mary Charlotte.
D	Whitehead, Willett William.
A	Whitehill, George Edward.
D	Whiteside, George Shuttuck.
A	Whitford, Andrew Foster.
A	Whiting, George Washington Whitney.
A	Whiting, Lewis.
A	Whiting, Walter Booth.
B	Whitman, Edson Fobes.
C	Whitmarsh, Willard Francis.
A	Whitmore, Albion Stinson.
A	Whitney, Charles Alvano.
A	Whitney, Charles Melville.
D	Whitney, Chester Field Smith.
A	Whitney, Edward Melville.
A	Whitney, William Fiske.
A	Whitney, William Herbert.
B	Whittaker, William Austin.
A	Whittemore, Dwight Stanley.
A	Whitten, George Edwin.
D	Whittier, Cordelia Melvina.
A	Whittier, Daniel Brainard.
A	Whittier, Edward Newton.
A	Whittier, Francis Fremont.
B	Whittier, Helen Adelaide.
D	Whoriskey, John Joseph.
A	Wight, Daniel Webster.
A	Wight, George Dewitt.
C	Wilbur, Alliston Chester.
B	Wilbur, Ezra Richmond.
A	Wilbur, Hubert Granville.
A	Wilbur, Sarah Mann.
A	Wilcox, Dorvil Miller.
A	Wild, George Warren.
A	Wilder, Raymond Sargent.
A	Wilder, Sarah Elizabeth.
A	Wildes, Adeline Wilkins.
D	Wiley, Alfred Soule.
B	Wilinsky, Adolph.
A	Wilkin, Anna Maria.
D	Wilkins, George Clarence.
A	Wilkins, George Henry.
B	Willard, Mary Antoinette.
D	Williams, Abram Case.
A	Williams, Augustus Gilbert.
B	Williams, Benjamin Barney.
A	Williams, Charles Crosby.
C	Williams, Charles Herbert.
A	Williams, Christopher Earle.
B	Williams, Clara Augusta.
C	Williams, Edward Denison.
A	Williams, Edward Russell.
A	Williams, Edward Tufts.
A	Williams, Frances Elizabeth.
A	Williams, Francis Henry.
C	Williams, Frank Percival.
D	Williams, Frederic Allen.
A	Williams, Harold.
A	Williams, Harry Augustus.