

SEVENTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

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OF

MASSACHUSETTS.



JANUARY, 1876.

BOSTON:

WRIGHT & POTTER, STATE PRINTERS,
79 MILK STREET (CORNER OF FEDERAL).

1876.

expressly to leak, and thus save the expense, labor and nuisance of frequent emptying. And it is obvious that as soon as any town obtains an abundant water-supply by aqueduct, its sewage is immensely increased (from six to ten or more times), so as to make the old method of drainage altogether inadequate to the new order of things. Yet, how many of the towns which have recently introduced water or have begun water-works, are providing any adequate system of drainage? The "water committees," or "commissioners," do not dare to tell the truth to the town, because of the great additional expense involved. They know that the necessity will become apparent in a few years after their water-supply goes into operation, and must then be met at an outlay much greater than would suffice if sewerage-works went side by side with laying of water-pipes.

In addition to the expense, there must arise the usually embarrassing question, Where shall be the outlet of the sewerage system, if it is undertaken? In the answering of this question, neighboring towns, as well as individuals, must be consulted, and vexatious and costly litigation may follow. This problem of the disposal of sewage, in which health and comfort are balanced against cost, is before many of our towns and cities to-day, and in the solution of it the smaller towns may be greatly helped by these odorless emptying machines. As was said under the head of excrement-removal, let it be obligatory on every householder to make his cesspool as tight* as possible, and to empty it by the new method alone, and the sanitary requirements may be met without incurring a great town debt and without wasting the sewage. Meanwhile, and also by the adoption, on suitable lots of land, of the plan of private irrigation by drain-tile, elsewhere suggested, valuable experience may be acquired to assist in solving the important question of irrigation on a large scale.

WATER-SUPPLY.

There are three forms of water-supply: wells, cisterns, aqueducts. Of these, the first has, of course, been that in

* The action of frost, the jarring of the earth from various causes, and imperfections in workmanship render it impossible, practically speaking, to keep cesspools *perfectly* tight.

général use in Massachusetts, as it must long continue to be in most towns not closely built up. To what forms of pollution it is exposed from privies, "sinks," cesspools, stables, etc., has been shown under a previous head. Whenever dwellings are within one hundred feet of each other, even on a level surface, there is danger that one may pollute the other's well through some one of the above-named agencies. It may quicken the reader's sense of this danger to construct a diagram of four houses, each within one hundred feet of the other three, to locate the privy, cesspool, stable, hen-house and well of each as these are ordinarily placed, and then, making another diagram, showing a vertical section of one of these wells, thirty feet deep, to study its possible action as a drain of the neighboring surface, especially in the case of dwellings so circumstanced for many years. Such a neighborhood, however, would never be considered a close one. How is it with the wells of houses whose walls touch each other? How with those of houses situated below numbers of others on a slope?

However free a well may be from danger of drainage-pollution, it should be examined yearly in the dry season, and cleared of all droppings and settlings. Wood from curbing or pump, dirt from the sides, burrowing animals, earthworms, slugs, etc., etc., are often found rotting in the bottoms of wells. Of course the cleaning is not thorough unless a man descends, examines and remedies all defects.

Cisterns are liable to the same dangers with wells, and usually have carried into them much more fine dirt in suspension, washed away from the roofs which form their "watershed." Even when made with an effective filter-chamber, they should be examined and cleaned every summer—oftener, if their water grows distasteful. Who is not familiar with the strong smell of water from cisterns, which has been furnished him for bathing? Cisterns are also liable to be cracked or burst by pressure from within or without, in consequence of the soil around them not affording support enough; or by pressure from beneath, as the subsoil water rises. Being thus rendered leaky under pressure from without, they are occasionally entered by polluted water at times when their contents cannot leak against the external pressure. From

just such a cause there occurred in the autumn of 1874 an epidemic of typhoid fever in a boarding school in Burlington, New Jersey, a full report of which may be found in the "Philadelphia Medical Times" for May 29, 1875. It is interesting to note that the infecting agent in this case was the leakage into the subsoil from a privy-vault which had been strongly and carefully built only three years before.

The "overflow" of cisterns furnishes another channel of possible contagion, which should be borne in mind, as capable of admitting gases as well as fluids. It being probable that cisterns will be more and more used as substitutes for wells, where soil-contamination is on the increase, and before an aqueduct supply is secured, it is important that they should be built and maintained with intelligent care, and that their owners should not rest secure in the idea that because they no longer use well-water they are in no danger of drinking fouled water. Whatever be the source of supply, "eternal vigilance is the price," the only price, of safety.

The aqueduct, the third source of supply, is the method which all large towns must of necessity resort to, and which, apart from the question of cost, commends itself to all communities by its convenience, its abundance, and its comparative purity. In our Commonwealth it has already been adopted with more or less completeness by forty-six cities and towns, comprising 963,721 persons, or a little over one-half of the entire population.

WATER-SUPPLY AND SEWERAGE.

In the following five tables are gathered certain statistics in regard to the towns thus supplied. It is probable that it is not complete as regards all the smaller towns of the State, which, having partial aqueduct supplies, have not replied to the circular of the Board. Another year will undoubtedly remedy this incompleteness, and meanwhile it is certain that we have some facts in regard to all the larger towns. It would be interesting to know how many towns are now discussing the question of a public water-supply, since it is evident that there is a general awakening to the importance as well as the convenience of it.

These tables furnish, with as much completeness as has

Twelve Cities supplied by Aqueduct, having a population of 20,000 and more.

CITY OR TOWN.	Effect on health.	Dwellings.	Dwellings taking water.	Population.	WATER.		SEWERS.	
					Source of Supply and Date of Introduction.	Daily capacity in gallons.	Total length, in miles.	Where discharged.
Boston, ¹ . .	Some improvement,	-	-	341,919	Lake Cochituate, 1848; Jamaica Pond, 1840; Mystic Lake, 1870; Sudbury River, 1873.	64,000,000	166	The outlets encircle the city proper.
Cambridge, ² .	Probable benefit, but no proof.	7,700	-	47,538	Fresh Pond, 1857; Spy and Little ponds, 1875.	8,000,000	40	Charles River, Alewife Brk.
(Charlestown, ³)	Not proved to be affected.	-	-	†	Mystic Pond, . . .	-	-	Charles, Mystic and Miller's rivers.
Chelsea, ⁴ . .	Thought to be favorable.	3,831	-	20,095	Mystic Pond, . . .	Mystic supply, 12,000,000	17	Chelsea Creek, Mystic River.
Fall River, ⁵ .	Improved, where used.	4,610	-	45,340	Watuppa Lake, . . .	-	-	Mt. Hope Bay, partly by way of "Fall River."
Lawrence, ⁶ .	Too recent, . . .	4,279	-	34,907	Merrimac River, . . .	-	-	Merrimac, Spicket and Shawshine Rivers.
Lowell, . . .	Good; typhoid believed to be lessened.	7,800	-	49,677	Merrimac River, through filter-chamber, 1872-3.	2,500,000	13.4	Concord River, Merrimac River.
Lynn, ⁷ . . .	Statistics show decrease of typhoid.	5,667	3,585	32,600	Two ponds, made by damming brooks on the edge of city, 1870.	1,500,000	7	Lynn Harbor.
New Bedford, ⁸ .	Less typhoid, . . .	3,998	15,000 persons supplied.	25,876	Acushnet River, dammed,	Enough for four-fifths of population.	14	New Bedford Harbor, twelve outfalls into deep water.

Salem, ⁹	Partial supply for years. No change since full supply.	3,888	-	25,968	Wenham Lake, . . .	-	-	Harbor, North River, Mill Pond.
Somerville, ¹⁰	Very good; less typhoid and kindred diseases.	3,968	-	21,968	Mystic Pond, . . .	-	14	Charles River, Mystic River.
Springfield, ¹¹	Too recent, . . .	4,977	-	31,063	Reservoir in Ludlow, .	-	-	Connecticut River.
Worcester, ¹²	Good; less typhoid,	6,096	-	49,265	Reservoir, fed by Lynde Brook.	-	-	Blackstone River, by Mill Brook.
				726,993				

Nine Cities and Towns supplied by Aqueduct. Population from 10,000 to 20,000.

Adams, ^{†13}	Can hardly be ascertained, but advantageous.	2,002	Eight hundred families.	15,760	Mountain stream, 1865, .	Varies from 2½ to 6 millions.	-	No sewers.
Brockton, ¹⁴	Unpalatable; not used for drinking or cooking.	1,769	One-fourth of all, perhaps less.	10,578	Pumped from large brook to small reservoir in centre, 1870.	Small, . . .	-	No sewers.
Chicopee, ¹⁵	Diarrhœa when the season of low and impure supply occurs.	1,214	Nearly all, .	10,331	Private Co. Springs in high plateau, 1830.	Scanty and intermittent.	-	No sewers.

* Average daily use 1,329,290 gallons.

† Used lavishly.

‡ Included in Boston.

¹ Sewerage very unsatisfactory.

² Sewerage very unsatisfactory.

³ "Fall River" portion, sewerage unsatisfactory.

⁴ Sewerage bad.

⁵ Harbor portion, sewerage unsatisfactory; North River portion vile; easily remedied.

⁶ Sewerage very unsatisfactory.

⁷ Fouls the river visibly for seven miles; discussing a system of irrigation, and rapidly improving sewerage within city.

⁸ Has rapid surface-drainage into Hoosac River.

⁹ Sewerage very unsatisfactory.

¹⁰ Sewerage calls for improvement.

¹¹ Merrimac portion, sewerage satisfactory; Spicket portion unsatisfactory.

¹² Sewerage very satisfactory.

¹³ Good plan of sewerage begun upon.

¹⁴ Two-thirds sewerage runs on surface.

¹⁵ Drains finally into Connecticut River.

Nine Cities and Towns supplied by Aqueduct. Population 10,000 to 20,000—Concluded.

CITY OR TOWN.	Effect on health.	Dwellings.	Dwellings taking water.	Population.	WATER.		SEWERS.	
					Source of Supply and Date of Introduction.	Daily capacity, in gallons.	Total length, in miles.	Where discharged.
Fitchburg, ¹	Too recent; still, thought to be less sickness.	1,974	-	12,289	Reservoir fed by small stream, 1871-72.	One million, can be trebled.	-	Nashua River.
Haverhill, ²²	Salutary, . . .	2,643	10,000 persons.	14,623	Three ponds, 1801; and Merrimac River, 1848. Private Co.	Capable of indefinite increase.	-	Merrimac River, Little River.
Holyoke, ³	None observable, .	1,479	-	16,260	Deep, natural ponds, 1872; abundant and pure.	3,000,000	-	Connecticut River.
Malden, . .	Decidedly good, .	1,923	-	10,843	Spot Pond, 1870, . .	-	-	Cesspools.
Northampton, ⁴	Too recent, . . .	1,823	-	11,108	Mountain stream, 1871, .	-	-	No system.
Pittsfield, . .	Generally thought to be improved.	2,052	-	12,267	Ashley Lake, 1855; Sacket Brook, 1875.	-	2	West Branch of Housatonic River.
				114,064				

Ten Towns supplied by Aqueduct. Population from 5,000 to 10,000.

Attleborough, ⁵	No appreciable effect as yet.	1,520	-	9,224	Ten Mile Brook and large well, 1874.	Maximum, 809,280	-	None.
Beverly, ⁶ . .	Good; much less fever, especially typhoid.	1,399	-	7,263	Wenham Lake, . . .	-	-	None.
(Brighton, ⁷)	Too recent, . . .	997	-		Lake Cochituate, 1875-6, .	-	-	Natural outlet, Charles River.

Brookline, [†]	Too recent, . . .	1,000	870	6,675	Charles River, by filtering-chamber, 1875-6.	1,500,000	8	Charles River, through Muddy Brook, with tide-gate.
Medford, [‡]	Considered good, . .	1,374	1,100 takers.	6,627	Spot Pond, 1870, . . .	-	-	No system. Drains into Mystic River.
Natick, ^{††}	No perceptible effect as yet.	1,195	-	4,419	Dug Pond,	-	-	No system.
Peabody, ^{†††}	Partial supply; no typhoid among water takers.	1,350	-	8,066	- - - - -	-	-	Tanneries, etc., and some dwellings, into Procter's Brook and Goldthwaite's Brook, thence into North River in Salem.
Plymouth, ^{‡‡}	Typhoid the rarest disease.	1,268	-	6,370	Large natural pond, 1856,	-	A few sewers, .	Plymouth Harbor, bare at low tide.
Waltham, ^{††††}	Too recent,	1,317	-	9,945	Charles River, by filtering-chamber, 1874.	1,250,000	-	No system. Natural outlet into Charles River.
Westfield, ^{†††††}	Too recent,	1,468	-	8,429	Two reservoirs, by damming brook five miles distant.	-	-	No sewers.
Woburn, ^{§§§}	More sickness in two years since water than in preceding two.	1,625	-	9,568	Wells at Horn Pond, 1873,	1,200,000	-	Natural outlet into head waters of Mystic Pond, where most of the tanneries now discharge, also some dwellings.
				76,586				

* Average daily use, 75,000 gallons.

‡ Average daily use, 170,000 gallons.

† Average daily use, in summer, 320,000 gallons.

‡ Average daily use, 600,000 gallons.

|| Included in Boston.

1 Beginning to execute a plan for sewerage. River already fouled to sight, but not to smell.

2 Has a plan of sewerage, and is executing it.

3 Much needed.

4 A good system begun upon systematically. Outlet objectionable to Boston.

5 Most of the sewage runs into Pegan Brook, thence into Lake Cochituate.

6 Existing sewers have no traps, and their gases are blown back by east wind at outlets.

7 Three-fourths sewage into cesspools, one-fourth into streams and ponds.

8 Little River Valley in a bad condition. See Haverhill in Report.

9 Much needed. Sewerage under discussion.

10 Sewerage system begun upon, together with introduction of water.

11 Cesspools generally in use.

12 See Report on Peabody and Salem. Open stream through centre, the main sewer.

13 Cesspools mainly used.

14 Discussing a plan of sewers. See Report on Woburn, Winchester, Mystic Pond.

Nine Towns supplied by Aqueduct. Population 3,000 to 5,000.

TOWNS.	Effect on health.	Dwellings.	Dwellings taking water.	Population.	WATER.		SEWERS.	
					Source of Supply and Date of Introduction.	Daily capacity, in gallons.	Total length, in miles.	Where discharged.
Arlington, ¹	None perceptible, .	615	-	3,906	Reservoir on East Lexington meadows. Brook dammed; mainly rainfall, 1874.	-	None, . .	- -
Easthampton, ²	None noted, . .	586	-	3,964	Reservoir for fire department.	-	Imperfect system.	Into brook below pond.
Everett, . .	Salutary, . . .	770	-	3,651	Mystic Pond, . . .	-	None for dwellings.	Upon marsh.
Gt. Barrington, ³	Very decidedly good,	839	Every one, .	4,385	Mountain stream, 1871, .	-	None, . .	One-third into Housatonic River.
Hopkinton, .	No definite report, .	768	-	4,503	Private supply for 100 families and two factories, from spring in centre.	-	None, . .	Sewage mainly on surface.
Leominster, ⁴	Too recent, . .	924	-	5,200	Reservoir at foot of Monostock Mt., 1873.	-	Two street sewers.	Planned to discharge into brook below mills, thence into Nashua River.
South Hadley, .	Recent. No perceptible effect.	502	-	3,370	From brook for South Hadley Falls.	-	None, . .	- -
Winchester, ⁵	Too recent. Health always very good.	554	356*	3,099	Rainfall. Reservoir in elevated valley dammed, 1874.	Actual, 800,000; possible, 1,600,000.	None, . .	Natural drainage into Abajonna River, thence into Mystic Pond.
W. Springfield, ⁶	Not fairly in use yet,	680	12†	3,739	Reservoir on brook, 1875-76.	-	Beginning, .	- -
				85,817				

Six Towns supplied by Aqueduct. Population less than 3,000.

Ashfield, . . .	- . .	257	Nearly all, .	1,190	Springs. Private pipe to each house. Many yrs.	-	None, . .	Surface and cesspools.
Concord, ¹ . . .	Too recent, . .	470	125	2,676	Flint's Pond, in Lincoln, 1874.	500,000	None, . .	Surface and cesspools.
Kingston, . . .	- . .	354	40	1,569	Forced from springs by Private Co.	-	None, . .	Surface and cesspools.
Lincoln, . . .	Not used, . . .	147	Very few, .	834	Flint's Pond, 1875, . .	-	None, . .	Surface and cesspools.
Stockbridge, .	Typhoid once common; now very rare.	451	17	2,080	Private Co. From springs in East Mountain.	-	None, . .	Three-fourths on surface.
W. Brookfield, .	- . .	345	Nearly all, .	1,903	Three private companies, 1865. Reservoirs dug in hills, 1870. Two by lead pipe; one by block tin.	-	None, . .	Surface and cesspools.
				10,261				

* Also fifty-five stables, factories, etc.

† Also the public buildings.

¹ Sewage mainly into cesspools. Gas factory into Mill Brook, thence into Mystic Pond.
² One-third on surface, one-third into cesspools.
³ See Woburn, Winchester, Mystic Pond.

⁴ Sewerage under consideration.
⁵ Sewerage under discussion.

‡ Considering sewerage and introducing water.

† Sewerage much needed.

Cities supplied by Aqueduct. Population.

Class I.,	726,983
II.,	114,064
III.,	76,586
IV.,	35,817
V.,	10,261
	963,721

been practicable, certain statistics with regard to each of these towns; viz., the effect of its aqueduct-supply on the general health of its population, the whole number of dwellings, the number of dwellings (sometimes of families) using the water, the population of the town, the source of water-supply and date of introduction, the daily capacity (in United States gallons) of this supply, and, as most closely connected with the free use of water, a few important facts concerning the sewerage of the town; viz., the length (in miles) of its sewers, the place of their final discharge or outfall, and finally brief memoranda indicating the present state of the sewerage question in the town.

For the purpose of facilitating comparison between these towns, they have been arranged in five groups, according to population, giving of those with a population of 20,000 and upwards, 12; from 10,000 to 20,000, 9; from 5,000 to 10,000, 10; from 3,000 to 5,000, 9; less than 3,000, 6.

In proportion as the advantages of aqueducts are appreciated, the importance of preserving our streams and ponds from pollution will be more strongly felt, inasmuch as, with a single exception, to be hereafter mentioned, they afford the only sources for aqueduct-supply. It is to be hoped that the people will be aroused to a jealous care for their preservation before it is too late.

Twenty cities and towns now depend on streams, 16 on great ponds, 7 on springs, 2 towns on "gathering-grounds," and 1 town on ponds and springs.

It is of course understood that all these sources resolve themselves at last into the rainfall, being so many different forms of its reappearance on (or very near) the surface of the ground. Rivers are the open drains; ponds the storage reservoirs; springs smaller forms of the same, fed by a miniature water-shed, sometimes hard by, sometimes farther away, and carried awhile by an underground channel, to reappear as "a spring," or perhaps to be tapped by a well. River or rill, lake or spring, on the surface or subterranean, they are all modifications of this same rainfall, subject to filtration or to pollution from the strata over or through which it finds its way to its natural drains or reservoirs. No person of ordinary intelligence now hopes to secure a water-supply from