REPORT

ON

TYPHOID FEVER IN THE DISTRICT OF COLUMBIA

SUBMITTED BY THE

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA

TO THE

COMMITTEE ON THE DISTRICT OF COLUMBIA

OF THE

U. S. HOUSE OF REPRESENTATIVES,

JUNE 14, 1894.

COMMITTEE:

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WILLIAM W. JOHNSTON. G. WYTHE COOK.
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TYPHOID FEVER IN THE DISTRICT OF COLUMBIA.

[Report submitted to the Medical Society, June 6, 1894.]

The committee appointed by the Medical Society to report upon the subject of typhoid fever in the District of Columbia begs leave to make the following report:

The consideration of this subject by the Society is justified and demanded by the very great prevalence of typhoid fever and by the large number of deaths, which gives Washington a most unenviable position among American cities.

It is right that a disease which is known to be preventable, which has been almost abolished in some of the capitals of Europe, should receive here, in the capital of this country, the closest study and attention. If the causes of its persistence are known—if, above all, these causes can be removed—it is our part and duty to make the facts public and to arouse public attention to the necessity and urgency for action. Who is better fitted to speak authoritatively on this subject than the Medical Society of the District, whose members are in daily contact with the disease, and who have every opportunity to study the modes of its diffusion among our population?

The committe has endeavored to present, as briefly as possible, the data upon which an intelligent judgment can be formed. The magnitude of the task of making a complete study of typhoid fever in all of its aspects must be apparent to all, and the committee must ask indulgence for the imperfection of the report in many of its details. Much could only be touched upon, much had to be omitted. The importance of the subject demands continued observation and study, and it is suggested that the work be continued from year to year in whatever way which may seem best to the society.

The committee is indebted for much valuable assistance to the District Commissioners and their assistants, who have all shown great interest in the work of the Society in this investigation.

The accompanying report will consider—

1. The prevalence and mortality of typhoid fever in the District.

2. The relations of the dissemination of the disease to the—

(*a*) Public water supply;

(*b*) To the pollution of the soil with the leakage from privies, from defective sewers, and from the backing up of sewage from tidal movements;

(*c*) To the drinking of well or pump water;

(*d*) To contaminated milk and to other causes.

3. The difference in mortality in different areas of the city, with a view to discover the causes of the disease.

4. Conclusions based upon the foregoing data, as to what measures should be taken to diminish the spread of the disease.

PREVALENCE AND MORTALITY OF TYPHOID FEVER IN THE DISTRICT OF COLUMBIA.

The following table gives the statistics of typhoid fever in the District of Columbia from 1881 to 1893, the ratio of deaths from all causes, and the total deaths, based upon the records of the health office of the District:

TABLE I.—*Typhoid fever in the District of Columbia, 1881 to 1893, inclusive.*

Years.	Population.	Deaths from typhoid fever.	Ratio of deaths from typhoid fever to 1,000 deaths from all causes.	Ratio of deaths from typhoid fever to each 10,000 population.	Total deaths.
1881	183,000	67	16.2	3.6	4,136
1882	188,653	120	26.2	6.3	4,571
1883	191,980	92	21.4	4.8	4,286
1884	200,000	76	16.0	3.8	4,814
1885	200,000	124	25.0	6.2	4,998
1886	205,000	125	27.2	6.2	4,674
1887	210,000	116	25.0	5.5	4,685
1888	225,000	168	33.6	7.4	5,040
1889	250,000	170	33.3	6.8	5,152
1890	250,000	208	37.7	8.3	5,564
1891	250,000	208	36.6	8.3	5,720
1892	260,000	183	30.4	7.0	6,098
1893	285,000	186	28.6	6.5	6,452

From 1881 there has been an almost uninterrupted yearly increase of the death rate, the highest point being reached in 1890, with a ratio of 8.3 to 10,000 inhabitants. In 1891 the rate was 8.3; in 1892 it had dropped to 7, and in 1893 to 6.5. The lowest mortality, 3.6 and 3.8, was in 1881 and 1884. The past nine years show a greater number of deaths, representing a larger number of cases, than at any previous time. In the past two years the ratio has been less than in the previous seven years. An exception should be made to the percentage of 1893, as given in Table I. It is based upon an assumed increase of 25,000 population in one year. This is not thought to be justified by the actual increase of previous years, and the percentage of 6.5 as the ratio of deaths in this year should be much higher, as high, certainly, as 1892, which is 7 to 10,000 population.

The actual number of annual deaths has increased from 67 in 1881, to 208 in 1890 and 1891, both years reaching the same number. In 1892 there were 183 and in 1893 186 deaths.

Chart I.—Deaths from typhoid fever in Washington from 1883 to 1892, inclusive.

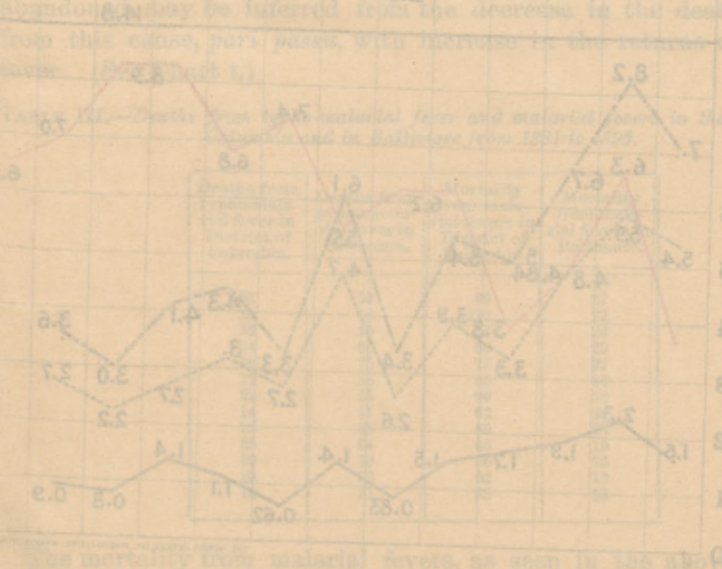
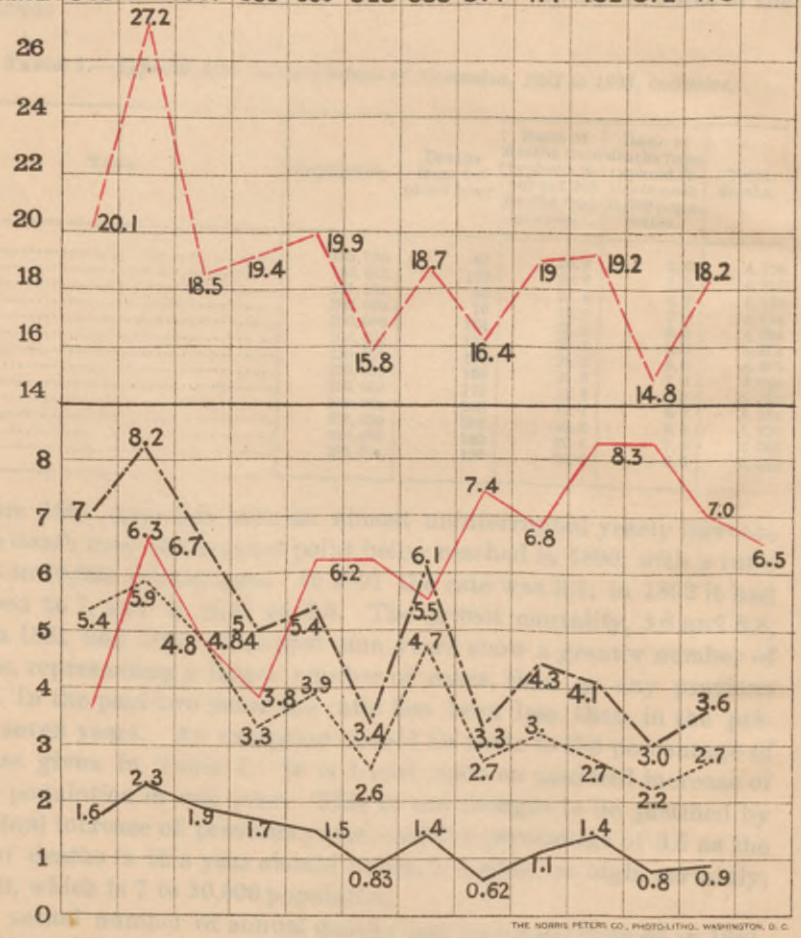


Chart I.

ACTUAL NUMBER OF DEATHS AND COMPARATIVE DEATH-RATE FROM TYPHOID FEVER, MALARIAL DISEASES, TYPHO-MALARIAL FEVER, AND DIARRHŒAL DISEASES, FROM 1881 TO 1893.

	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893
POPULATION	183060	188653	191980	200000	200000	205000	210000	225000	250000	250000	250000	260000	285000
DEATHS.TYPHOID	67	120	92	76	124	125	116	168	170	208	208	183	186
" TYPHO-MALARIA	31	44	38	34	30	17	22	14	28	35	20	23	
" MALARIA	99	112	93	66	78	54	99	62	80	68	56	72	
" DIARRHOEA	368	514	357	388	399	325	393	371	477	482	372	476	



Typho-Malarial Fever, ——————

Malarial Diseases, - - - - - - -

Typho-Malarial Fever and Malarial Diseases Combined, —·—·—·—

Typhoid Fever, ——————

Diarrhœal Diseases, — — — — —

TABLE II.—*Deaths from typhoid fever in Washington from 1883 to 1892, inclusive.*

Years.	White.		Colored.	
	Total number of deaths.	Number of deaths to 10,000 population.	Total number of deaths.	Number of deaths to 10,000 population.
1883	49	3.8	43	6.5
1884	53	4.05	23	3.3
1885	83	6.3	41	5.9
1886	81	5.9	47	7.05
1887	72	5.1	44	6.2
1888	95	6.3	73	9.7
1889	96	5.6	74	9.2
1890	118	6.9	90	11.2
1891	129	7.7	79	9.9
1892	107	6.1	76	8.9
Average for 10 years	----	5.8	----	7.8

In Table II the ratio of deaths in the white and colored population is given, in the ten years from 1883 to 1893, inclusive. The whites had an average mortality of 5.8 and the blacks of 7.8 to 10,000 population. Here, as in the general mortality statistics, the high death rate is due largely to the greater fatality of typhoid fever among the colored race.

Typho-malarial fever is not included in these tables. If deaths from this cause were added to those from typhoid fever, as they should be done, the percentage of fatal typhoid cases would be much higher than here given. The present drift of opinion is to abandon this term altogether, as it leads to continued confusion and error. That it is being abandoned may be inferred from the decrease in the death returns from this cause, *pari passu*, with increase in the returns of typhoid fever. (See Chart I.)

TABLE III.—*Deaths from typho-malarial fever and malarial fevers in the District of Columbia and in Baltimore from 1881 to 1893.*

Deaths from typho-malarial fever in District of Columbia.	Deaths from typho-malarial fever in Baltimore.	Mortality from malarial fevers in District of Columbia.	Mortality from malarial fevers in Baltimore.
31	50	99	27
44	44	112	22
38	48	93	24
34	66	66	29
30	75	78	27
17	58	55	30
22	55	99	28
14	41	62	24
28	33	80	23
35	54	68	19
20	39	56	26
23	33	62	19
18	31	85	25

The mortality from malarial fevers, as seen in the above table, is still greater than seems possible; the progressive falling off in the number of fatal cases, as seen in Chart I, shows either that malarial diseases are on the decrease or that there is a change of opinion as to the nature of many cases of fever.

In order to represent more clearly the extent and fatality of typhoid fever in this city, maps have been prepared, which accompany this report.

Map I is compiled from the maps of the health office, and is made up of an aggregation of the fatal cases of typhoid fever occurring in residences in five years from 1888 to 1892, inclusive, and shows the number of deaths (in red dots) during that period.

There were in the whole city 626 deaths in residences from this cause.

The same map shows (in blue dots) the number of deaths from the malarial fevers, including the deaths from typho-malarial fever. The actual number of deaths from typho-malarial fever in the five years was 120, an annual average of 24. There were 243 deaths from malarial fevers in the same period in residences, an annual rate of 48. No one can believe that malarial fevers have any such mortality in the District, and we are forced to the conclusion that many of the fatal cases of malarial fever were cases of typhoid fever. In public institutions and in the county the fatal cases of malarial fever numbered 130 in the five years, making a total of 493 deaths from this cause.

The map shows that there is a coincidence in locality of the deaths from typhoid fever, typho-malarial fever, and malarial fevers.

Deaths in the public institutions, hospitals, and in the county are not represented on this map; there were 201 in the hospitals and 90 in the county.

Map III shows the locality of deaths from diarrheal diseases. Here, too, the area of greatest mortality is the same as that of typhoid and the malarial fevers.

Table IV gives a comparative statement of the mortality from typhoid fever here and in a few of the chief cities of this country and Europe. The average annual mortality in the District to 10,000 population was 6.2; in Philadelphia, 6.3; Chicago, 7.8; Boston, 4.1; Baltimore, 4.1; New York, 3.1; Paris, 6.1; Berlin, 2.

TABLE IV.—*Comparative statement of the number of deaths per 10,000 inhabitants from typhoid fever in the cities named, during the years 1881 to 1893, inclusive, and the general average therein.*

Years.	District of Columbia.	Boston.	New York.	Philadelphia.	Chicago.	Baltimore.	Berlin, Germany.	Paris, France.
1881	3.6	5.2	4.8	7.4	.....	5.7	4.7	8.7
1882	6.3	5.1	4	7.7	.....	4.6	3	14.3
1883	4.8	4.6	4.7	6.3	.....	3.4	3	8.4
1884	3.8	5	3.5	6.1	.....	4	1.8	7
1885	6.2	3.8	2.9	6.4	7.4	4	1.9	6
1886	6.2	3.4	3	6.3	6.8	3.8	1.6	4.2
1887	5.5	4.6	2.9	6.2	5	3.4	1.3	6.1
1888	7.4	4.1	2.3	7.7	4.5	3.8	1.4	3.3
1889	6.8	4.1	2.5	7	4.1	4.5	1.3	4.4
1890	8.3	3.4	2.2	6.3	8.4	5.6	1.9	2.9
1891	8.3	3.3	2.3	6.4	16	3.3	0.9	2.2
1892	7	2.9	2.2	4.9	10.3	4.2	.....	.....
1893	6.5	.....	.....	.....	.....	.....	.....	.....
Average	6.2	4.1	3.1	6.31	7.81	4.19	2.08	6.14

Chart II.

Chart II, adapted from the valuable report of Erwin F. Smith, now of the Agricultural Department, on The Influence of Sewerage and Water Supply on the Death Rate in Cities, shows the comparative mortality in different cities of this country and Europe. We will have occasion to refer to this chart later.

CAUSES OF THE PREVALENCE OF TYPHOID FEVER.

What interests us most is to trace the cause of the disease as it exists here, and in so doing it is assumed in this report that the question of its etiology is definitely settled, and that the conditions underlying its prevalence are (1) an impure water supply, (2) the imperfect drainage of a polluted soil, (3) infected milk, (4) and other causes.

1. The water supply of our city and the District comes chiefly from two sources, the Potomac River and the wells which are scattered about the city and county.

Washington, out of fifty of the largest cities, stands second in the list, with a per capita and per diem public supply of 177 gallons of water. Only Buffalo, with 196 gallons, is better supplied, while Philadelphia has 111 gallons; Baltimore, 92; Boston, 89; and New York, 74.

Much of our public water supply is used in Government buildings and in public fountains, and the per capita estimate is not a fair one.

It is not possible to compare the extent of typhoid fever in cities with abundant water supply with those which have an imperfect supply, or none at all, for cities well supplied with water are at the same time furnished with a good sewerage system, and it is not possible in most cities to separate these conditions so as to discover the influence of water supply alone.

The example of Dantzic, however, shows that an abundant water supply alone does not diminish the death rate. This city was supplied with water in 1869 and sewered in 1872. No marked diminution in the death rate of typhoid fever occurred until after the introduction of the sewers. Washington, with a daily individual supply of 177 gallons, has an average annual mortality of 6.2, while New York, with 74 gallons per capita, has 3.1 deaths yearly to 10,000 population. Abundance of water alone, as might well be supposed, does not limit the spread of typhoid fever.

There is evidence enough to show that the public water supply may be contaminated with typhoid bacilli, and thus propagate the disease. The epidemic at Providence, R. I., in November, 1888, which was traced to the pollution of the water of the river with fecal matter from typhoid cases, 3¼ miles above the pumping station, is a case in point. The bacilli were found by Prudden and Ernst in the filters of the Providence houses. It is an admitted fact that the disease has often been originated in this way, but it is a question as to what value this mode of infection has as compared with others. Does the typhoid fever, which is the chief endemic fever of Washington, owe its continued existence to recur-

ring or continued infection from this source? Would we eliminate the disease by purifying the Potomac supply and destroying all its organic life?

The Potomac water has been subject to very careful analyses, and, "in general, the water may be said to be in excellent condition and to compare extremely favorably * * * with that of other cities. Its chief defect" is "the presence of suspended clay in the winter" and after heavy rains in any season.*

TABLE V.—*Chemical analysis of Potomac water—averages 1888.*

[Results in parts per million.]

	Total solids.	Nitrogen as—				Oxygen consumed.	Chlorine.
		Free ammonia.	Albuminoid ammonia.	Nitrites.	Nitrates.		
Highest (1888)	164	.0600	.2720	.018	2.32	4.30	5.0
Lowest (1888)	69	.0000	.0320	.000	.08	.76	3.0
Average (1888)	111	.0178	.1190	.000	.97	1.98	4.2
Highest (1889, to September)	192	.0560	.4520	.012	1.80	3.32	5.8
Lowest (1889)	76	.0000	.0600	.000	.50	.88	3.5
Average (1889)	110	.0190	.2140	.000	.82	1.82	4.2
Highest (1889, to September)	270	.3920	.6520	Trace.	.8	3.80	5.0
Lowest (1890, October)	80	.0000	.0600	.000	.0	.82	4.0
Average	136	.041	.295	.000	.7	1.85	4.3
Highest (1890, to October)	132	.0140	.1200	Trace.	1.0	3.10	4.5
Lowest (1891, July)	76	.0000	.0200	.000	.3	.56	4.0
Average	104	.0043	.0627	.000	.6	1.97	4.3
Highest (1891-'92)	168	.0080	.1600	Trace.	.8	3.96	6.0
Lowest (fiscal year)	82	.0000	.0200	.090	Trace.	.78	4.0
Average	113	Trace.	.0640	.000	.6	1.85	4.3
Highest (1892-'93)	159	.0520	.1240	.000	.6	4.50	5.0
Lowest (fiscal year)	90	.0000	Trace.	.000	.5	.78	4.0
Average	125	.0200	.0661	.000	.6	1.64	4.7

The value of the so-called biological analyses of drinking water is, as Theobald Smith says (Medical News, Philadelphia, April 9, 1887), still very unsettled. As the result of one year's observation made by him, a relation was found between turbidity and the presence of bacteria. Bacteria were most abundant in winter, January and February having the highest average; August, September, and October, the months of the greatest prevalence of typhoid fever, having the lowest. Bacteria, most of which were harmless, were most abundant after heavy rains, and their presence in association with turbidity proved the then source to be from the washing of the surface of the soil.

In the latest bacteriological report on Potomac water Theobald Smith adheres to this statement, and says that fecal bacteria and turbidity were coincident; that is, that rainfall carries into the Potomac whatever may happen to be on the surface of the soil, clay, manure from the fields, inorganic or organic matter of any sort. The nature of the country through which the Potomac flows, much of it being mountainous, as well as the absence of large cities on its banks, diminish the risks of infection from this source. As the country comes more and more under cultivation turbidity and impurity from the washing of

* Report of Engineer Department, District of Columbia, year ending June 30, 1892, p. 77.

plowed and manure-covered land will be more common. The possibility of the introduction into the water of the microorganism of typhoid fever is dependent upon its presence in localities washed by the Potomac and its tributaries.

CONTAMINATED WELL WATER.

The question, after all, is not whether typhoid fever can be propagated by the drinking of Potomac water, but whether, as a matter of fact, it is usually propagated in this way. Before this question can be determined other probable sources of origin must be considered.

It is an unjustifiable conclusion that because fecal bacteria are found in Potomac water, therefore typhoid fever is usually propagated by the drinking of Potomac water. Bacteriology may lead us astray here, and data of a very different sort must receive due weight before a logical conclusion can be reached.

Consideration must now be given to the relations of the mortality of typhoid fever and its distribution in different sections of the city to the pollution of the soil by the leakage from privies, and to the drinking of contaminated well water.

The truth of the theory may be considered as established that there is a relationship between pollution of the soil with human excrement and the drinking of well water contaminated with the poison of typhoid fever contained in this excrement. The converse of this has also been absolutely proved that typhoid fever can be diminished—almost eliminated—by a proper purification of the soil and the drinking of pure water. Facts will be alluded to further on which will illustrate this point.

Out of a total of 1,174 squares in Washington and Georgetown deaths from typhoid fever occurred in 426 squares, or one death in about two and two-third squares.

If the city is arbitrarily divided into four sections, Georgetown making the fifth, and the number of deaths from typhoid fever during the last five years be marked in the localities in which they occurred, it will be seen (see Map I) that there is a great difference in the distribution of mortality. In region 1 (all that part of the city south of East Capitol street and the public grounds, including the southeast and southwest parts of the city) there is a very large number of cases. In this area there were 197 fatal cases in 131 squares. In region 2 (east of North Capitol street and north of East Capitol street) in 59 squares there were 84 deaths. In region 3, comprehending all that part west of North Capitol street and east of Thirteenth street and north of the public grounds, in 116 squares there were 179 cases. In region 4, west of Thirteenth street to Georgetown and north of the river to Florida avenue, in 82 squares there were 114 deaths. In Georgetown in 38 squares there were 52 fatal cases. Assuming that each death represents 10 cases of typhoid fever, in the five years there were about 6,260 cases in

Washington, at the rate of over 1,200 cases a year. Of these there were nearly 400 cases a year in the southeast and southwest districts, 170 in the northeast, 360 in the middle region, 230 in the northwest, and 100 in Georgetown, 400 in hospitals and public institutions, and 190 in the county. If we add the cases occurring in hospitals and the county to those in the city proper we have a total of 9,220 cases in five years, an annual average of 1,444 cases.

The percentage of deaths from typhoid fever in each of these divisions to the contained population is:

Region.	Population of region. (Police census, 1892.)	Total deaths from typhoid fever in five years in each region.	Annual rate of mortality to 10,000 population in each region.
I. (South)	62,218	197	6.3
II. (Northeast)	26,278	84	6.2
III. (Central)	70,865	179	5
IV. (Northwest)	49,969	114	4.6
V. (Georgetown)	16,344	52	6.3
County	30,429	95	6.2

The interesting fact is to be noted in this table that the annual rate of mortality of the whole District being 6.2, that of the northwest section is 4.6; central region, 5; south, east, Georgetown, and the county having each the same average, practically, as that of the total District average.

The close relation of a soil polluted by sewage to typhoid fever prevalence is admitted to be a causal relationship, and no argument need here be adduced to support a theory so universally adopted. In Washington and the District there are three modes of infection of the soil with human excreta and sewage:

(1) The overflow and leakage from privies.

(2) The leakage from defective drain pipes in the soil.

(3) The backing up of sewage in the sewers draining the lower parts of the city and the flooding of basements and cellars.

The existence of the privy method of disposing of human excreta in cities is sufficient evidence of a contaminated soil.

Map No. 4 shows the numerical distribution of the privies of Washington. There are in the city limits 8,959 box privies, 5,133 in the county, a total of 14,092.

In the first division (south) there are	3,994
In the second division (northeast) there are	941
In the third division (central) there are	1,086
In the fourth division (north and west) there are	1,761
In the fifth division (Georgetown) there are	1,177
Total	8,959

Squares 743 to 795 in the southeast region may be cited as an exam-

ple of the relative distribution of privies and closets with sewer connections:

Square.	Privies.	Closets.
743	82	13
766	23	6
768	14	3
770	41	14
799	21	19
795	24	22
	289	355

In fourteen squares in the northwest part of the city there were 153 privies and 297 closets.

The report of the inspector shows that for the nine years ending June 30, 1891, there were 42,197 full or overflow privies reported, 6,455 boxes with leakage, and 663 old and dilapidated boxes. In one year, 1892, there were 465 boxes noted with leakage. It is difficult to ascertain the extent to which the saturation of the soil takes place in this way, but the above facts demonstrate that the saturation with excrementitious matter is a necessary result of such conditions.

Every report of the engineer department of the District government contains a statement as to the relaying of pipe sewers. In the year 1892 there were 1,534 linear feet of sewer pipe which were taken up and relaid; 8,438 linear feet of obstructed sewers were replaced.

These sewers were faulty in gradient, alignment, and because of defective joints, allowing the intrusion of tree roots, and in quite a number of cases they were of insufficient size. They were all laid under contracts made with the board of public works, in 1871–'74. (Report upon the sewerage of the District of Columbia, by board of sanitary engineers, June, 1890.)

All pipe sewers laid prior to 1874 require to be replaced by those of suitable construction, with joints protected by concrete. It need not be added that such defective sewerage conditions permit the saturation of the soil with fecal matter.

A third cause, which prevents thorough drainage of the soil and adds to the dangers from saturation with sewage, is found in the fact that from the foot of Capitol Hill westerly to the Potomac River there is a long, flat area only a few feet above high tide. To the north and east the ground rises; the soil of the lower area is moist, that of the elevated territory is composed of compact gravel, clay, and loam, and is comparatively dry. Owing to the absence of slope, and, therefore, of scouring velocities in the sewers in the south and east, accumulations take place in the sewers, which are added to by the entrance of tide water. In the Tiber Creek sewer these deposits reached 2 to 3 feet in depth and several thousand feet in length, reaching nearly to the present District building. The daily effect of the entrance of the tidal current into the sewer is to prevent the complete emptying of the drains,

and in times of flood great quantities of noxious sewage is carried into cellars and basements.

The drinking of the infected waters of wells has long been known to be a mode of propagation of typhoid fever. If the soil of the city is receiving a considerable portion of the excreta of typhoid cases—if much of that soil is badly drained and wet with returned sewage—is it possible to avoid the danger of the fouling of well water?

In that low section of the city in which there is the most imperfect drainage, in which the soil is most contaminated by the defective sewerage, there are many thousand inhabitants, with 3,994 privies, drinking the water from 140 wells.

In the southern region, with 197 fatal cases, there were 140 pumps, now reduced to 87; in the northeast, 84 fatal cases and 47 pumps, now reduced to 29; in the middle area, 179 deaths, 70 pumps, now 42; in the northwest, 114 deaths, 34 pumps, now 22. (The number of pumps here given is taken from map published by District Commissioners in 1889, and list furnished May, 1894.) In Georgetown there were 52 deaths, with 18 pumps.*

It can be assumed that where there are the largest number of pumps there is the largest consumption of well water; that well water is used most largely by the poor, and in those quarters of the city where the water and sewer connections are fewest; and that Potomac water is used chiefly where the water and sewer connections are most numerous.

We know that water from the 310 pumps existing at the report of 1889 was largely used by the people living on the 426 squares in which the 626 fatal cases occurred.

Even by those having access to Potomac water, well water is largely consumed, on account of its being colder during the hot months of the year.

The object of these considerations is to show that the soil underlying the city is being constantly impregnated with human excrementitious matter, and with all microorganisms therein contained, and that the water of wells liable to be contaminated with such material is being constantly and generally used as drinking water by the people.

It is not an assumption that the well water thus consumed is infected and dangerous to health. It is a matter of chemical and bacteriological demonstration.

At the end of 1890 there were 271 public pumps in service; 17 of these were abandoned during the year as being no longer fit for use.

In the report of the engineer of the District for 1889–'90, it is stated

* The number of pumps here given, and as shown in map No. 2, is taken from a map published by the District Commissioners in 1889, and from a list furnished by them in May, 1894. The number may not be strictly correct, as errors have been found in the map of 1889.

that 75 per cent of the water of wells examined was found to be suspicious. In the northwest 71 per cent was bad or suspicious, in the southwest all examined were bad or suspicious, in the northeast 2 out of 3, in the southeast 40 per cent, and in the county 70 per cent. The report adds that the only excuse "for keeping the wells open is the filthy condition of the aqueduct water and the high temperature which it reaches in the mains in summer, often 85 degrees, which is far from palatable to the poorer classes, who are unable to purchase ice."

The following year 9 wells were filled and abandoned. In the year ending June, 1892, of 57 wells examined 24.6 per cent were condemned or declared very suspicious; 14 were filled and abandoned. The wells of the county were, as a rule, more contaminated than the city wells, a condition due to the fact that the soil of the city is better drained by sewerage than that of outlying districts.

The report for the year ending June 30, 1893, states that a larger number of wells were condemned than in the previous year, "owing to the large number examined from the low portion of the city in the southeast and southwest sections." Fourteen were found dangerous. This is the very section of the city in which the number of fatal cases was so great in the five years.

The following report of bacteriological examinations of 13 wells, made for the committee by Dr. J. J. Kinyoun, fortifies these views of the general unhealthfulness of the well waters:

Sample No.	Location of well.	Result of examination.	Condition of water.	Recommendations.
1	East side Seventh street between M and N streets NW.	Sewage bacteria. Colon bacillus isolated.	Bad.....	Well should be closed.
2	L street between Sixth and Seventh NW.	.....do	....do	Do.
3	East side Seventh street between M and N.	.....do	....do	Do.
4	Tenth and S streets NW.....	Sewage bacteria. Fecal bacteria. Colon bacillus isolated.	....do	Do.
5	Sixteenth and Corcoran streets NW.	Ordinary forms usually found in water.	Good	Should be kept under observation.
6	Seventeenth and K streets NW.	Ordinary forms usually found in water, but in considerable quantities.	Suspicious..	Do.
7	Tenth street between B and C NE.	Sewage bacteria. Colon bacillus isolated.	Bad.....	Should be closed.
8	Third street and Indiana avenue NW.	Sewage bacteria	....do	Do.
9	T and Eighteenth streets NW.	Ordinary water bacteria, but in large numbers.	Suspicious..	Should be kept under observation.
10	Twenty-third and G streets NW.	Sewage bacteria	Bad.....	Should be closed.
11	Eighteenth and S streets NW.	Sewage bacteria in great numbers.	....do	Do.
12	K street between Twenty-first and Twenty-second streets NW.	Sewage bacteria. Colon bacillus isolated.	....do	Do.
13	Ninth and H streets NW.....	Ordinary water bacteria in small numbers.	Good	Should be kept under observation.

In the recently published report of the examination of the water of the city wells by Drs. Theobald Smith and Mew, 16 wells were reported

as examined bacteriologically by Dr. Smith, and the conclusions reached were favorable to the general purity of the well water. Five wells only were found to contain fecal bacteria; the water of 4 was in good condition, and that of 7 in need of improvement.

The suggestion is made by Dr. Smith that the wells upon which a favorable report is made should be retained, that others should be improved, and that bacteriological examinations should be made at least once a year to determine the fitness or unfitness of the water for drinking purposes. He also suggests that wells considered safe should be so labeled. But is not the fact that some wells at a particular date contain fecal bacteria a sufficient reason for condemning the whole system?

As long as causes of soil pollution exist, is not one well as liable, or nearly as liable, to contamination as another? And the fact that one well contains no bacteria, another a few, and another many, is no proof that all are not liable in different degrees to become at some time infected. To be under the necessity of labeling each particular well as healthy or unhealthy, after annual examination, is an endless task and a most unscientific procedure, for how many individuals who wish to quench their thirst will be influenced by the published statement impugning the reputation of a particular well? Even if the individual knows that bacteria are found, he will drink and take the risk. As sanitarians we must condemn the whole system, and advise an early abandonment of all wells as the only solution of the question. The advice contained in the report made to the Sanitary League we believe to be mischievous, and to involve a continued menace to health.

It should be remembered that the water of the 16 wells reported upon by Dr. Smith is of those which have been permitted to stay, and that over 80 have within the last five years been condemned and filled up. Dr. Kinyoun finds sewage and fecal bacteria in 9 out of 13 examined. For how long a time will these now reported upon as free from fecal bacteria remain so, with the continued presence of typhoid fever among us? Shall we wait for the infection to take place, or shall we remove the possibility of the dissemination of the disease in this way? These are questions to which we should give no uncertain answer.

The lesson of Vienna should teach us what this answer should be. From 1851 to 1874 well water of an impure character was used to a large extent. During this time the deaths from typhoid fever ranged from 10 to 34 annually in every 10,000 of the population. In 1874 spring water of great purity was introduced, and the well water of impure wells was given up. The annual mortality rate immediately fell to 5, and in three subsequent years to 1.1. A good sewerage system was in existence long before this, but it had no effect in reducing the mortality, as sewerage without the abandonment of the drinking of infected well water is without effect.

One fact to which separate attention should be drawn is that many of our cases of typhoid fever are imported from without. At the end of the summer it is a frequent occurrence for the disease to develop in individuals who have just returned from seashore and other resorts, and a much larger number of our inhabitants go out of town now than formerly. This is one means by which our mortality is increased, and fresh infection is added to that already existing.

INFECTION THROUGH MILK.

The dissemination of typhoid fever by the milk supply in the District has not been investigated fully enough to warrant any extended remarks or conclusions. It would be well to make this a separate matter of study. It is safe to assume, from the experience of many observers elsewhere, that typhoid fever is to a certain extent propagated by milk; there is nothing in the condition of the dairies from which our supply is drawn to make us think that we are better protected from this danger than other communities where epidemics have been traced to milk infection.

There are 65 distinct places in the District where cows are kept and from which milk is supplied.

CONCLUSIONS.

It has been shown that in Washington there is a coincidence between a soil polluted with the leakage of the excreta from typhoid fever patients, the drinking of infected well water, and an extensive distribution of typhoid fever; that where these two first conditions exist to the greatest degree typhoid fever is most prevalent. It remains to be seen whether the purification of the soil, and the abolition of the water supply from pumps, would lessen the disease.

The belief that typhoid fever spreads by "soil contamination" would be much strengthened if other cities, with the same conditions, have diminished the percentage of the disease by draining the soil and abandoning the use of well water.

(1) Typhoid fever increases in proportion to the saturation of the soil with decomposing organic matter, especially human excreta, and to the drinking of infected well water.

(2) Typhoid fever decreases in proportion as a city is well sewered, and in proportion to the abandonment of the drinking of well water and of all contaminated water.

The greatest diminution in typhoid fever has taken place in England and Germany, where expert engineers and liberal municipal governments have combined in the work of sewering the principal cities. In the cities of Spain, Italy, Russia, and Mexico, where the sewerage systems are less complete, the diminution has not taken place.

The history of Munich offers the strongest evidence on this point.

From 1854 to 1859, when no means existed to prevent the fouling of the soil, the mortality was 24 to 10,000 inhabitants. From 1860 to 1865 the sides and bottoms of the pits of the privies were cemented, and the mortality fell to 16.80. From 1866 to 1873, with partial sewerage, it was 13.30; from 1874 to 1880, with improved sewerage, it was 9.26, and from 1881 to 1884, with still greater improvements, it fell to 1.75 to 10,000 inhabitants.

The experience of Berlin is very instructive to Washington, as showing the difference in mortality in houses with sewer connections and in houses without them where privies were used.

In houses with sewer connections there were 15.5 cases and 4.5 deaths to 10,000 population. In houses without sewer connections there were 56 cases and 17.9 deaths. In sewered houses there was 1 case to every 49.3 houses and 1 death to 137.5 houses. In nonsewered houses there was 1 case to every 9.3 houses and 1 death to 43 houses.

In Dantzic, with a wretched system of privies, there were 10 deaths to 10,000 inhabitants. The introduction of an abundant water supply in 1869 produced no effect on the death rate. The city was sewered in 1872. In the following twelve years the average mortality was 2.4 and in the last five years was only 1.5. In Breslau in 1866, without sewers, the mortality was 15.2; in 1876, with sewers, it dropped to 5.5 to 10,000 inhabitants. In the cities of England, before any extensive sewerage systems were introduced, from 1850 to 1871, the mortality was 9; from 1876 to 1884, it was 3.6, the change following upon a general introduc- of sewer drainage.

Chart II, which accompanies this report, illustrates in a most striking way the differences in mortality in sewered and unsewered cities, the percentage being to 10,000 population in five years, 1880 to 1884.

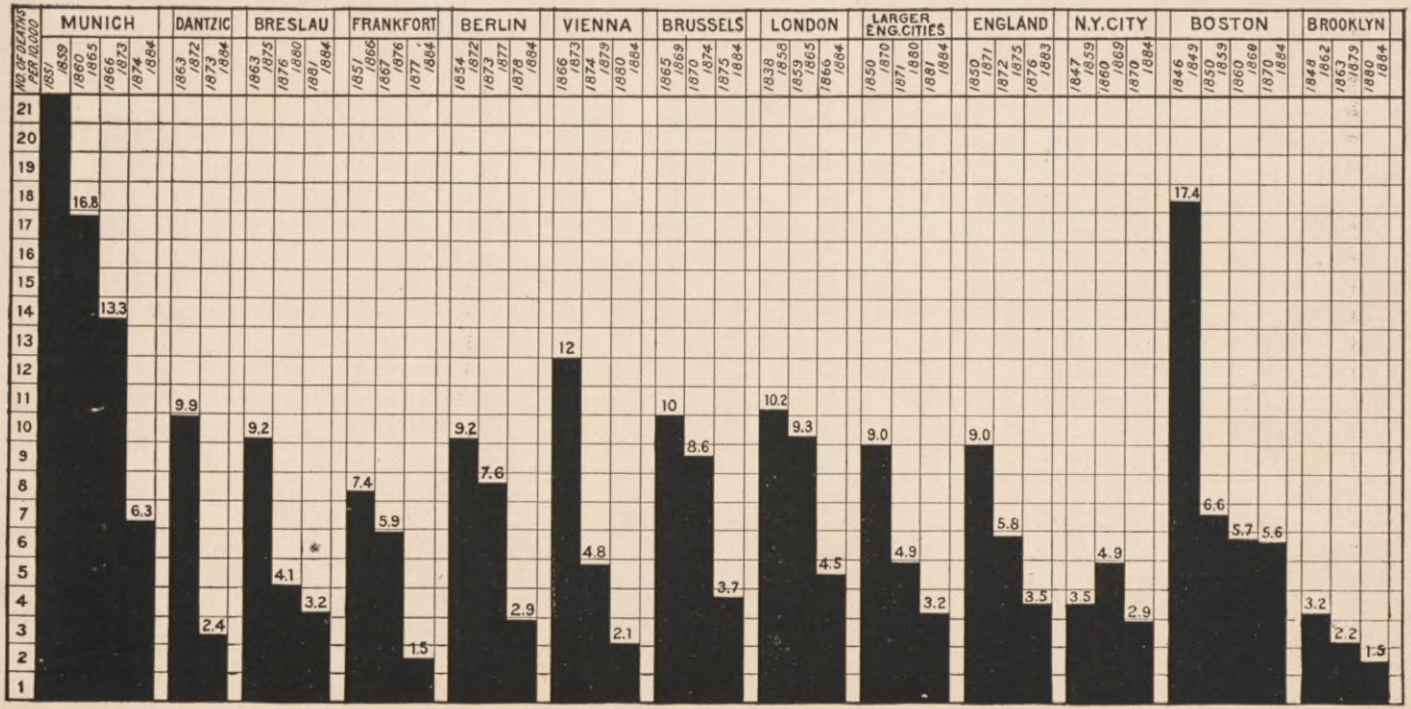
In cities with good sewers and general water supply the averages were as follows: Munich, 1.7; Dantzic, 1.5; Frankfort, 1.4; Breslau, 3.3; Hamburg, 2.6; Berlin, 2.9; Brussels, 3.3; London, 2.3; 28 English cities, 3.2; New York, 3; Brooklyn, 1.5; Vienna, 2.1; Washington, 4.6; Washington (1885–1890), 6.7.

In cities without sewers or very imperfectly sewered the yearly averages for each 10,000 residents were as follows: Paris, 9.9; Marseilles, 12.8; Turin, 9.5; Naples (1881–1884), 7.1; Palermo (1881–1884), 13.1; Catania, 19; 281 cities in Italy (1881–1882), 9.5; St. Petersburg (1883–1884), 9.9; Riga (1881–1882), 15.8; Budapest (1877–1881), 9.2; 20 German cities (1878–1882), 9.8; New Orleans (water supply from cisterns above ground), 2.7; Baltimore (abundant water supply), 4.8; Cincinnati, 7.3.

Chart III shows the reduction of mortality as a result of sewerage.

Brooklyn and New York have the best sewerage systems in this country. New York has 300 miles of sewers, but Brooklyn is perhaps the best sewered large city. New York has a mortality of 3 and Brooklyn 1.5. The mortality of Brooklyn, our best sewered city, is lower

CHART III.—*Deaths from typhoid fever to each 10,000 inhabitants before, during, and since the introduction of sewerage and water-supply.*



ERWIN F. SMITH.

than Munich, Berlin, Hamburg, London, Vienna, which are the best sewered cities of Europe. And when a city is said to be sewered this means that water-closets are substituted for privies and the soil is kept free from contamination.

To turn, now, to other cities in this country, Baltimore, as Osler in his excellent report says, "has practically only surface sewerage. * * * The excreta pass, for the most part, into privy pits, of which it has been estimated there are from 70,000 to 80,000, occupying one-twentieth of the entire surface of the city, exclusive of streets and parks." Leakage, he says, unquestionably occurs in a very large number, with saturation of the ground in the vicinity. Baltimore has a mortality of 4.8, more than three times that of Brooklyn.

Washington, whose sewerage system is very good in most respects, but with fatal defects which diminish its efficiency and with that equally great danger from soil pollution from its 9,000 privies, has an average annual mortality of 6.2 in the last thirteen years. This is four times the death rate of Brooklyn, twice that of New York, and the same as that of Philadelphia.

The daily pollution of the soil by the fecal discharges of our patients suffering from typhoid fever, with the resulting contamination of well water, must be recognized as the chief source of the diffusion of the disease. It is a case of auto-infection. We are daily breeding the poison which poisons us, and the inevitable round from intestine to soil, from soil to well, and from well back to intestine goes on and on with the most tragic uniformity. We sustain all the conditions favorable to rapid and perfect propagation of the bacilli. Granches and Deschamps have experimentally shown that typhoid germs placed on the surface of frequently moistened ground will penetrate nearly 2 feet into the soil, and will there retain life for five and a half months. They multiply rapidly in illy drained soil, live for an indefinite time in privy vaults, and have a much longer existence in cisterns and wells than in running water.

In Washington we supply all these necessary conditions—leaking privies for the reception of the excreta and their contained germs, a damp and illy drained soil for their reception and rapid growth, neighboring wells for the resulting, the inevitably resulting, contamination of drinking water consumed by a thirsty population. What more conveniences can we supply? What more successful means can we adopt to raise our mortality to a point higher than that of Brooklyn, New York, Baltimore, and Boston? We are among the most successful cultivators of the deadly bacillary plant in this country.

RECOMMENDATIONS.

The committee would urge upon the Medical Society the importance of taking the initiative in the effort to control the spread of this

destructive but preventable disease by urging upon our municipal government and upon Congress the prompt adoption of measures to remove the causes to which this report has drawn attention.

The measures to be recommended are:

1. The immediate abandonment of all wells within the city limits, exception only to be made in case of the absence of the Potomac supply, and where the wells, after repeated chemical and bacteriological examinations, have been found to be free from all possible sources of danger. But even these to be abandoned as rapidly as possible.

2. Purification of the sewerage system already existing, by replacing as rapidly as possible all damaged or defective drains.

3. The introduction of new sewers in advance of other improvements in parts of the city not now supplied with drainage, and the extension of the system as far outside of the city limits as the rapidly growing population demands, so as to prevent soil contamination.

4. The adoption of some system by which the lower sections of the city can be more completely drained and the risks arising from the backing up of tide water and sewage prevented.

5. The final and safe disposal of the sewage.

6. To make all existing privies, vaults, or other receptacles of human excreta water tight, and by rigid inspection and penalties to prevent the danger from leakage and overflow.

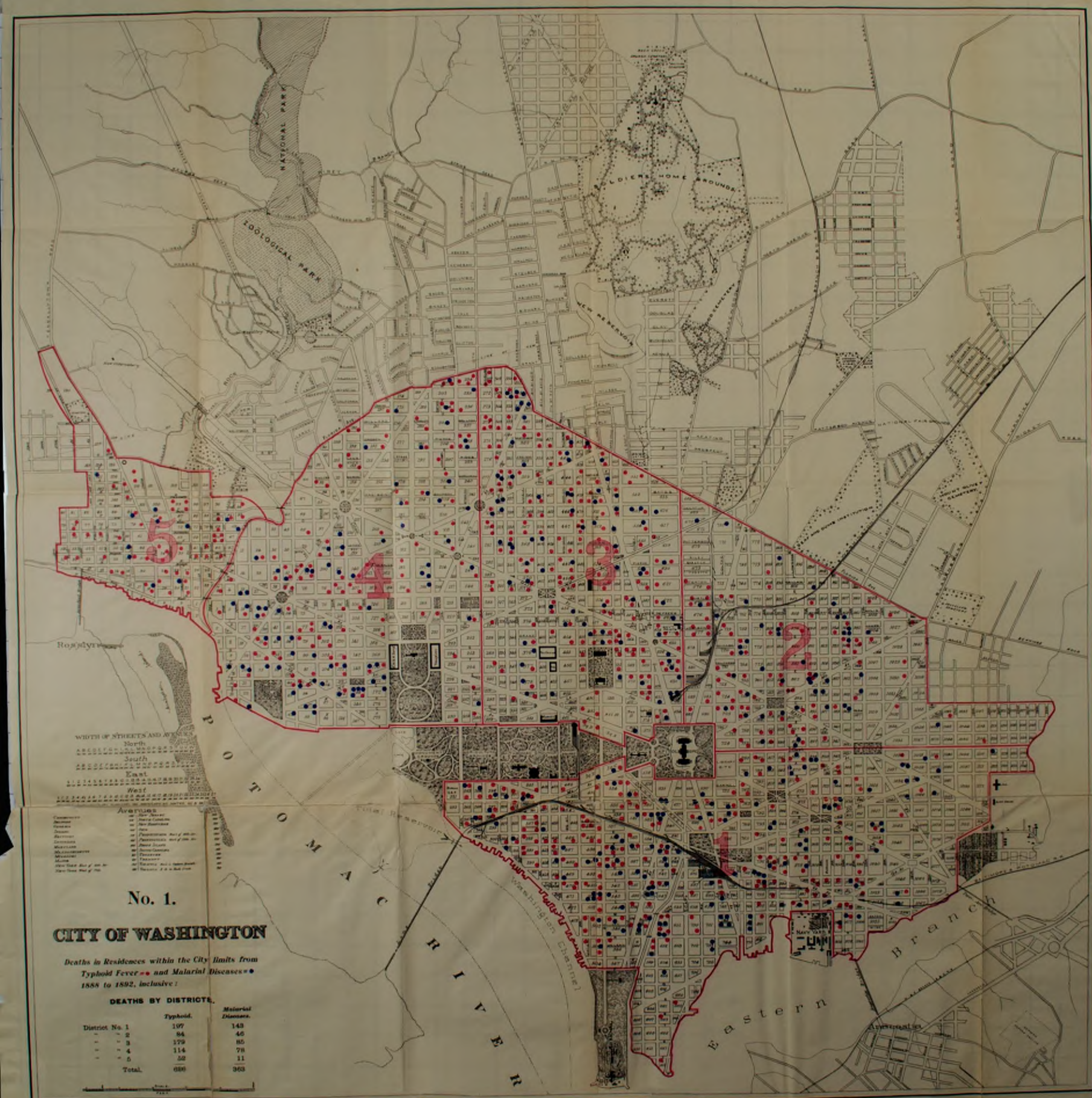
7. The early completion of the plans recommended by Col. Elliot, in charge of the Washington aqueduct, and now in course of execution, which have in view the sedimentation of the Potomac water, and ultimately the completion of works for filtration, the only proper method of purification.

8. The suppression of all privies and the enforcing of the law to make sewer connections.

9. Careful inspection of all dairies in the District from which our milk supply is drawn, and the enactment of a law by which no milk shall be sold in the District without a permit from the health office. The inspection should cover an examination at the dairies of all possible sources of infection, including the water supply.

10. The urging upon the members of the profession of a careful collation of all facts bearing upon the mode of infection in each case, and the advantage of reporting such facts to the society, and the propagation of the doctrine that immediate disinfection of the stools is the first duty of the physician as guardian of the health of the community.

G. L. MAGRUDER,
W. W. JOHNSTON,
C. M. HAMMETT,
Committee.



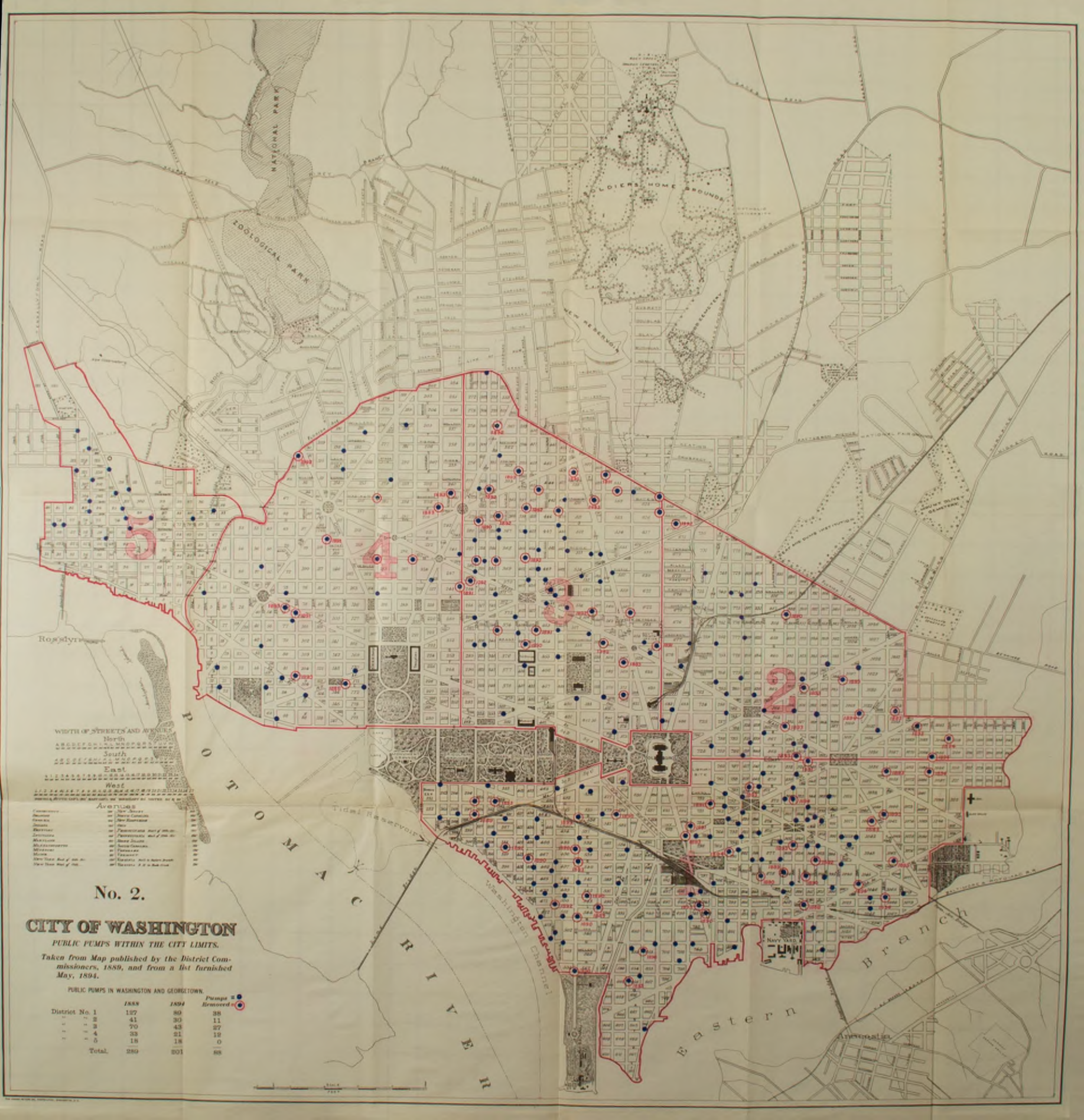
No. 1.

CITY OF WASHINGTON

Deaths in Residences within the City limits from Typhoid Fever ▪● and Malarial Diseases ●▪ 1888 to 1892, inclusive.

DEATHS BY DISTRICTS.

	Typhoid.	Malarial Diseases.
District No. 1	197	143
" " 2	84	46
" " 3	179	85
" " 4	114	78
" " 5	52	11
Total.	626	363



No. 2.

CITY OF WASHINGTON

PUBLIC PUMPS WITHIN THE CITY LIMITS.

Taken from Map published by the District Commissioners, 1889, and from a list furnished May, 1894.

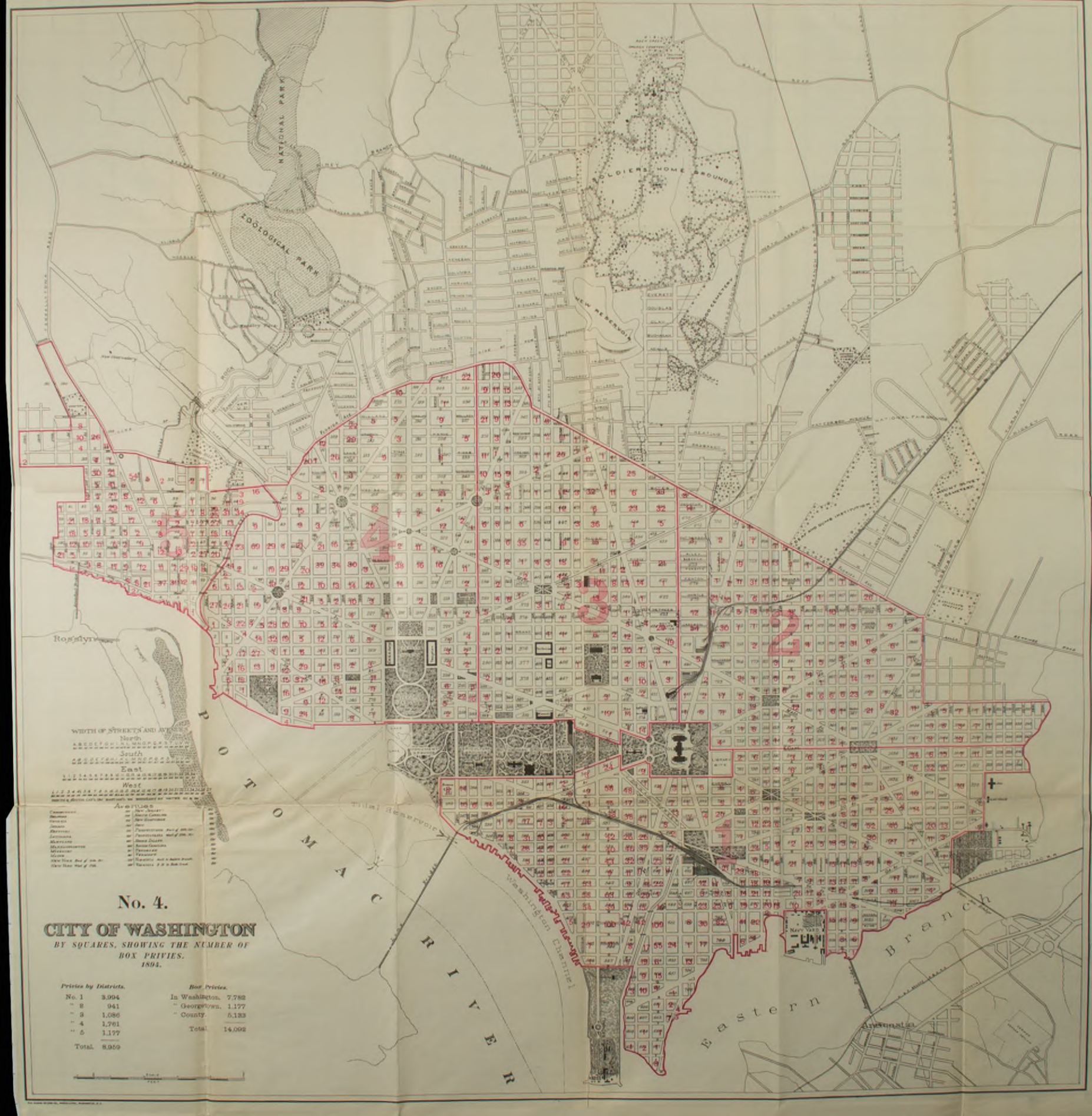
PUBLIC PUMPS IN WASHINGTON AND GEORGETOWN.

	1888	1894	Pumps ● Removed ○
District No. 1	127	89	38
" " 2	41	30	11
" " 3	70	43	27
" " 4	33	21	12
" " 5	18	18	0
Total.	289	201	88

No. 3.

CITY OF WASHINGTON

DEATHS FROM DIARRHŒAL DISEASES IN RESIDENCES WITHIN THE CITY LIMITS FROM 1888 TO 1892, INCLUSIVE.



No. 4.

CITY OF WASHINGTON

BY SQUARES, SHOWING THE NUMBER OF BOX PRIVIES. 1894.

Privies by Districts.		*Box Privies.*	
No. 1	3,994	In Washington.	7,782
" 2	941	" Georgetown.	1,177
" 3	1,086	" County.	5,133
" 4	1,761	Total.	14,092
" 5	1,177		
Total.	8,959		


NATIONAL PARK
ZOOLOGICAL PARK
SOLDIERS HOME GROUNDS
NEW RESERVOIR
Rosslyn
WIDTH OF STREETS AND AVENUES
North
South
East
West
Avenues
POTOMAC RIVER
Tidal Basin
Washington Channel
Eastern Branch
Navy Yard
No. 5.
CITY OF WASHINGTON
OLD WATER COURSES.