

DEPARTMENT OF THE INTERIOR,  
U.S. CENSUS OFFICE.

ROBERT P. PORTER,  
Superintendent.

Appointed April 20, 1889; resigned July 31, 1893.

CARROLL D. WRIGHT,  
Commissioner of Labor in charge.  
Appointed October 5, 1893.

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REPORT

ON THE

SOCIAL STATISTICS OF CITIES

IN

THE UNITED STATES

AT THE

ELEVENTH CENSUS: 1890.

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JOHN S. BILLINGS, M. D.,  
SURGEON UNITED STATES ARMY, EXPERT SPECIAL AGENT.



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Diagram 12 shows for principal cities the population per lamp in 1880 and in 1890.

Table 23 and Diagram 13 show for principal cities using electric lights only the population per lamp and the annual cost per capita.

TABLE 23.

CITIES.	Population per lamp.	Cost per capita.	CITIES.	Population per lamp.	Cost per capita.
Davenport.....	268.72	\$0.61	Topeka.....	168.52	\$0.53
St. Joseph.....	255.24	0.19	Galveston.....	166.19	0.53
Detroit.....	248.94	0.56	Williamsport.....	159.60	0.50
Fort Wayne.....	245.78	0.61	Harrisburg.....	155.06	0.58
Los Angeles.....	244.64	1.15	Toledo.....	152.21	0.66
Seranton.....	233.59	0.39	Terre Haute.....	128.58	0.54
Little Rock.....	233.10	0.21	Tacoma.....	124.16	1.16
Saginaw.....	220.58	0.58	Utica.....	119.91	1.07
Bay city.....	206.21	0.29	Hartford.....	113.98	0.80
Norfolk.....	202.74	0.44	Atlanta.....	105.02	0.65
Lacrosse.....	196.02	0.51	Chelsea.....	93.03	0.58
Sacramento.....	195.45	0.92	Reading.....	85.14	0.56
Dallas.....	190.34	0.50	Portland.....	82.97	0.84
Duluth.....	182.96	0.68	Lawrence.....	82.45	0.49
Peoria.....	179.93	0.81	Denver.....	60.98	0.95
Albany.....	178.76	0.81	Seattle.....	57.12	0.47
Quincy.....	174.97	0.57	Brockton.....	51.99	0.40
Youngstown.....	174.84	0.40	Portland.....	51.54	0.66
Savannah.....	172.76	0.58	Lynn.....	49.06	0.69
Mobile.....	171.69	0.53			

Table 24 and Diagram 14 show for 15 cities using gas only the population per lamp and the annual cost for their use per capita.

TABLE 24.

CITIES.	Population per lamp.	Cost per capita.	CITIES.	Population per lamp.	Cost per capita.
Bradford.....	150.20	\$0.16	Muncie.....	55.89	\$0.23
Fort Worth.....	127.49	0.28	Fort Smith.....	55.72	0.51
Appleton.....	118.69	0.15	East St. Louis.....	52.13	0.43
Ishpeming.....	98.22	0.31	Cairo.....	51.62	0.41
Wilmington (Del.).....	76.22	0.22	Paducah.....	48.84	0.46
Jamestown.....	67.96	0.26	Rockford.....	45.25	0.51
Pensacola.....	59.05	0.34	Saratoga Springs.....	20.97	1.53
Oil city.....	57.24	0.35			

## WATERWORKS.

Table 66 shows for the cities that made returns the conditions of their waterworks as follows: ownership, capacity of the supply, number of reservoirs and their capacity, average daily consumption of water, the distribution system, total cost of works, with average annual cost of maintenance for the past 10 years and the average annual receipts from water rents, the total cost of the works per capita of the population, and the number of miles of water mains to each mile of sewer. Key West, Fla., is the only city that reported "no waterworks".

Of the 345 cities in the list, 288, with an aggregate population of 16,020,612, reported the character of the supply and the average daily consumption. The supply has been grouped under four heads: "Rivers and lakes", "Surface water", "Driven wells", and "Artesian wells". As the names imply, the first includes large bodies of water, the second all small streams, springs, etc., where the water is impounded in reservoirs, while the third and fourth are self explanatory. The source of water supply for each of the 288 cities was as follows:

## RIVERS AND LAKES.

There were 146 cities having an aggregate population of 11,614,909, or near 73 per cent of the total population, which obtained their water supply from rivers and lakes. These were as follows: Alpena, Mich.; Alton, Ill.; Anderson, Ind.; Atchison, Kan.; Auburn, Me.; Auburn, N. Y.; Augusta, Ga.; Aurora, Ill.; Austin, Tex.; Baltimore, Md.; Bangor, Me.; Bay city, Mich.; Beatrice, Neb.; Beverly, Mass.; Biddeford, Me.; Boston, Mass.; Buffalo, N. Y.; Burlington, Iowa; Burlington, Vt.; Cairo, Ill.; Camden, N. J.; Chattanooga, Tenn.; Chelsea, Mass.; Chicago, Ill.; Chillicothe, Ohio; Cincinnati, Ohio; Cleveland, Ohio; Cohoes, N. Y.; Council Bluffs, Iowa; Covington, Ky.; Dallas, Tex.; Danville, Ill.; Danville, Va.; Davenport, Iowa; Decatur, Ill.; Denver, Colo.; Detroit, Mich.; Duluth, Minn.; East St. Louis, Ill.; Easton, Pa.; Eau Claire, Wis.; Elgin, Ill.; El Paso, Tex.; Erie, Pa.; Evansville, Ind.; Fall River, Mass.; Findlay, Ohio; Fort Scott, Kan.; Fort Smith, Ark.; Grand Rapids, Mich.; Hannibal, Mo.; Harrisburg, Pa.; Hoboken, N. J.; Indianapolis, Ind.; Ironton, Ohio; Ishpeming, Mich.; Jeffersonville, Ind.; Jersey city, N. J.; Kansas city, Kan.; Kansas city, Mo.; Keokuk, Iowa; Knoxville, Tenn.; Lacrosse, Wis.; Lafayette, Ind.; Laredo, Tex.; Lawrence, Mass.; Leavenworth, Kan.; Lewiston, Me.; Little Rock, Ark.; Lockport, N. Y.; Logansport, Ind.; Los Angeles, Cal.; Louisville, Ky.; Lowell, Mass.; Lynchburg, Va.; Manchester, N. H.; Marinette, Wis.; McKeesport, Pa.; Menominee, Mich.; Milwaukee, Wis.; Minneapolis, Minn.; Moline, Ill.; Muscatine, Iowa; Nashville, Tenn.; Nebraska city, Neb.; Newark, N. J.; New Haven, Conn.; New Orleans, La.; Newport, Ky.; New York, N. Y.; Norristown, Pa.; Ogdensburg, N. Y.; Oil city, Pa.; Omaha, Neb.; Oshkosh, Wis.; Oswego, N. Y.; Paducah, Ky.; Passaic, N. J.; Paterson, N. J.; Philadelphia, Pa.; Pittsburg, Pa.; Port Huron, Mich.; Portland, Me.; Portland, Ore.; Ponghkeepsie, N. Y.; Providence, R. I.; Pueblo, Colo.; Quincy, Ill.; Racine, Wis.; Raleigh, N. C.; Richmond, Va.; Rochester, N. Y.; Rock Island, Ill.; Sacramento, Cal.; Saginaw, Mich.; San Diego, Cal.; Sandusky, Ohio; Schenectady, N. Y.; Seattle, Wash.; Shreveport, La.; Sheboygan, Wis.; Sioux Falls, S. D.; Spokane Falls, Wash.; Springfield, Ill.; St. Louis, Mo.; St. Joseph, Mo.; St. Paul, Minn.; Steubenville,

Ohio; Superior, Wis.; Terre Hante, Ind.; Tiffin, Ohio; Toledo, Ohio; Trenton, N. J.; Troy, N. Y.; Vicksburg, Miss.; Washington, D. C.; Watertown, N. Y.; West Bay city, Mich.; West Troy, N. Y.; Wheeling, W. Va.; Wichita, Kan.; Wilmington, Del.; Wilmington, N. C.; Winona, Minn.; Youngstown, Ohio, and Zanesville, Ohio.

SURFACE WATER.

There were 96 cities having an aggregate population of 3,409,063, or about 21 per cent of the total population, which obtained their water supply from surface waters. These were as follows: Akron, Ohio; Albany, N. Y.; Allentown, Pa.; Altoona, Pa.; Amsterdam, N. Y.; Asheville, N. C.; Atlanta, Ga.; Battle Creek, Mich.; Belleville, Ill.; Bradford, Pa.; Bridgeport, Conn.; Bridgeton, N. J.; Brockton, Mass.; Brookline, Mass.; Brooklyn, N. Y.; Butte, Mont.; Cambridge, Mass.; Canton, Ohio; Cheyenne, Wyo.; Chicopee, Mass.; Clinton, Mass.; Colorado Springs, Colo.; Columbus, Ga.; Concord, N. H.; Dover, N. H.; East Portland, Ore.; Elmira, N. Y.; Fitchburg, Mass.; Gloversville, N. Y.; Hagerstown, Md.; Hartford, Conn.; Holyoke, Mass.; Hornellsville, N. Y.; Ithaca, N. Y.; Jacksouville, Ill.; Kingston, N. Y.; Leadville, Colo.; Lexington, Ky.; Lima, Ohio; Lyun, Mass.; Mahanoy, Pa.; Malden, Mass.; Marlboro, Mass.; Medford, Mass.; Meriden, Conn.; Meridian, Miss.; Michigan city, Ind.; Middletown, N. Y.; Mobile, Ala.; Muskegon, Mich.; Nanticoke, Pa.; Nashua, N. H.; New Bedford, Mass.; New Brunswick, N. J.; Newburg, N. Y.; Newburyport, Mass.; New London, Conn.; Newton, Mass.; Northampton, Mass.; Norfolk, Va.; Norwich, Conn.; Oakland, Cal.; Ogden, Utah; Pawtucket, R. I.; Peabody, Mass.; Petersburg, Va.; Pittsfield, Mass.; Pittston, Pa.; Portsmouth, Va.; Quincy, Mass.; Reading, Pa.; Richmond, Ind.; Salem, Mass.; Salt Lake, Utah; San Antonio, Tex.; San Francisco, Cal.; San Jose, Cal.; Saratoga Springs, N. Y.; Sedalia, Mo.; Shenandoah, Pa.; Springfield, Mass.; Springfield, Mo.; Stillwater, Minn.; Syracuse, N. Y.; Tacoma, Wash.; Tamnton, Mass.; Utica, N. Y.; Waltham, Mass.; Waterbury, Conn.; Weymouth, Mass.; Williamsport, Pa.; Woburn, Mass.; Woonsocket, R. I.; Worcester, Mass.; Yonkers, N. Y., and York, Pa.

DRIVEN WELLS.

There were 19 cities having an aggregate population of 466,115, or near 3 per cent of the total population, which obtained their water supply from driven wells. These were as follows: Binghamton, N. Y.; Bloomington, Ill.; Dayton, Ohio; Denison, Tex.; Elkhart, Ind.; Fort Wayne, Ind.; Fort Worth, Tex.; Hamilton, Ohio; Hastings, Neb.; Jackson, Tenn.; Joliet, Ill.; Lincoln, Neb.; Long Island city, N. Y.; Manistee, Mich.; Muncie, Ind.; Newark, Ohio; Plainfield, N. J.; Sioux city, Iowa, and Topeka, Kan.

ARTESIAN WELLS.

There were 27 cities having an aggregate population of 530,525, or near 3 per cent of the total population, which obtained their water supply from artesian wells. These were as follows: Alameda, Cal.; Appleton, Wis.; Cedar Rapids, Iowa; Charleston, S. C.; Clintou, Iowa; Fond du Lac, Wis.; Freeport, Ill.; Fresno, Cal.; Galveston, Tex.; Houston, Tex.; Jackson, Mich.; Jacksonville, Fla.; Jamestown, N. Y.; Janesville, Wis.; Kalamazoo, Mich.; Madison, Wis.; Mansfield, Ohio; Massillon, Ohio; Memphis, Tenn.; Montgomery, Ala.; Natchez, Miss.; Pensacola, Fla.; Rockford, Ill.; Savannah, Ga.; South Bend, Ind.; Stockton Cal., and Waco, Tex.

Table 25 shows for these cities the distribution of the population in relation to the source of supply; also the average daily consumption of water, both by the total and by geographical divisions.

TABLE 25.

GEOGRAPHICAL DIVISIONS.	Number of cities.	Population.	AVERAGE DAILY CONSUMPTION OF WATER.	
			Total. (In 1,000 gallons.)	Per capita. (Gallons.)
Aggregate .....	288	16,020,612	1,443,564	90.11
Rivers and lakes.....	146	11,614,909	1,112,080	95.75
North Atlantic.....	43	5,219,735	513,686	98.41
South Atlantic.....	10	910,806	105,181	115.48
North Central.....	69	4,408,120	389,969	88.47
South Central.....	16	742,893	53,850	72.49
Western.....	8	333,355	49,394	148.17
Surface waters.....	96	3,409,063	250,429	73.46
North Atlantic.....	62	2,409,641	175,105	72.67
South Atlantic.....	7	174,008	8,050	46.26
North Central.....	12	208,528	11,124	53.35
South Central.....	4	100,940	5,250	52.01
Western.....	11	515,946	50,900	98.65
Artesian wells.....	27	530,525	50,830	95.81
North Atlantic.....	1	16,038	1,500	93.53
South Atlantic.....	4	127,095	9,000	70.81
North Central.....	13	197,602	14,810	74.95
South Central.....	6	153,383	22,300	145.39
Western.....	3	36,407	3,220	88.44
Driven wells.....	19	466,115	30,225	64.84
North Atlantic.....	3	76,778	5,098	66.40
South Atlantic (a).....				
North Central.....	13	345,264	20,127	58.29
South Central.....	3	44,073	5,000	113.45
Western (a).....				

a No driven wells.

The greater portion of the population included in these cities depended on rivers and lakes and surface water, about 94 per cent receiving their water from these sources. There were 146 cities on rivers and lakes, and of these 43 were in the North Atlantic and 69 in the North Central division. There were 96 cities which depended on surface water, and of these 62 were in the North Atlantic and 12 in the North Central division. Of the 19 cities which depended on driven wells, 13 were in the North Central division, while for the artesian wells, 13 of the 27 cities were in the same division.

The number of gallons of water daily supplied for each person was, for the 288 cities in round numbers, 90.11; 95.75 gallons daily to each one of the population is used in the supply taken from rivers and lakes, 73.46 gallons in the surface water supply, 64.84 gallons in that from driven wells, and 95.81 in that from artesian wells. By geographical divisions, the total average consumption per capita is, in the North Atlantic, 88.91 gallons, ranging from 2 gallons in Chieopee, 14 in Woonsocket, and 23 in Ithaca and Marlboro each to 251 in Saratoga Springs, 199 in Nanticoke, and 196 in Buffalo. In the South Atlantic division the average daily number of gallons to each person is 101.56, ranging from 18 in Charleston and 19 in Portsmouth to 177 in Washington and 152 in Lynchburg. In the North Central division the average daily consumption to each head of population is 85.40 gallons, ranging from 6 gallons in Findlay and 19 in Anderson to 198 in East St. Louis and 171 in Detroit. The South Central division ranges from 19 in Vicksburg and 31 in New Orleans to 519 in Waco and 179 in Memphis, the average being 80.22 gallons daily to each head of population. The Western division has the highest average daily consumption, it being 120.44 gallons per capita, with a range from 9 gallons in East Portland to 288 in Oakland. The largest per capita consumption from the river and lake supply, 148.17 gallons, was in the Western division and the smallest, 72.49 gallons, in the South Central division. From the surface water supply, the largest per capita consumption, 98.65 gallons, was in the Western division and the smallest, 46.26 gallons, in the South Atlantic. Driven wells and artesian wells furnished the largest per capita supply for the South Central division, reaching 113.45 and 145.39 gallons, respectively. The number of gallons daily to each head of population must be based on the total population of each city irrespective of the number living on the lines of the water mains. In Washington the population was enumerated by blocks, and therefore the population living along the lines of the water mains could be determined, and a calculation on this basis develops the fact that the average daily consumption per capita for the population living on the lines of the water mains was 196 gallons instead of 177 gallons. In Saratoga Springs the average daily consumption was given at 251 gallons, but it must be borne in mind that during the summer months, when the consumption of water is at its highest, the population of the city is, probably, increased fourfold. The larger consumption of water in some of the southwestern cities is largely due to irrigation, but it has not been possible to determine what portion was used for this purpose.

Diagram 15, for the largest cities of the country, shows the proportion of water used daily to each head of population.

As an indication of the lavish use of water in nearly all of the cities of this country, Diagram 16 is given, showing the average number of gallons used daily for each head of population in the German cities that have over 100,000 inhabitants each.

There were 266 cities, with an aggregate population of 15,416,689, which reported the total cost of their waterworks and the number of miles of mains. The average cost per capita of the population for construction in these cities was \$22.27, the consumption of water per capita was 89.93 gallons, and the cost of the works to each mile of main was \$21,440.

Table 26 shows the distribution of these figures by population groups and by geographical divisions.

TABLE 26.

POPULATION GROUPS AND GEOGRAPHICAL DIVISIONS.	Number of cities.	Population.	AVERAGE DAILY CONSUMPTION.		Mains. (Miles.)	COST OF WORKS.		
			Total. (In 1,000 gallons.)	Per capita. (Gallons.)		Total.	Per capita.	To each mile of main.
Total .....	266	15,416,689	1,386,356	89.93	16,015	\$343,363,566	\$22.27	\$21,440
10,000 to 14,999 .....	98	1,186,629	91,103	76.77	1,977	23,154,532	19.51	11,712
15,000 to 24,999 .....	64	1,269,603	112,106	88.30	1,906	26,081,290	20.54	13,684
25,000 to 49,999 .....	53	1,823,431	175,130	96.04	2,368	43,537,199	23.88	18,386
50,000 to 99,999 .....	24	1,571,767	130,348	82.93	1,776	32,406,772	20.61	18,244
100,000 and over .....	27	9,565,259	877,669	91.76	7,988	218,189,773	22.81	27,315
Total .....	266	15,416,689	1,386,356	89.93	16,015	343,363,566	22.27	21,440
North Atlantic .....	104	7,559,105	672,069	88.91	7,751	188,449,689	24.93	24,313
South Atlantic .....	18	1,144,402	116,231	101.56	1,069	21,326,090	18.64	19,950
North Central .....	96	4,942,863	422,142	85.40	4,709	80,556,568	16.30	17,107
South Central .....	27	927,448	74,400	80.22	908	18,429,724	19.87	20,297
Western .....	21	842,871	101,514	120.44	1,578	34,601,495	41.05	21,927

The character of the works that distribute the water from the source of supply to the consumers has been divided into 6 groups, comprising: "Gravity", where the whole supply is sent to every part of the city by the natural pressure, "Gravity with pumping to high service", "Pumping direct", "Pumping to reservoirs", "Pumping to standpipes", and "Pumping to both standpipes and reservoirs, combined". In many cities where the last three conditions prevail water can be pumped directly into the mains in cases of emergency or when so desired, the reservoirs being in some cases secondary.

Diagram 17 shows the proportion of the population of 293 cities distributed to each class of waterworks.

From this it will be seen that all the gravity works, either alone or with pumping, did not supply as large a population as those that pumped to reservoir.

#### GRAVITY.

There are 36 cities, with 5.41 per cent of the total population treated, that had their entire water supply distributed by gravity. Of these, 28 are in the North Atlantic, 1 in the South Central, 1 in the North Central, and 6 in the Western division.

Of these cities, 16 had a population of between 10,000 and 15,000, 8 between 15,000 and 25,000, 9 between 25,000 and 50,000, and 3 had between 50,000 and 100,000 inhabitants. The 36 cities are as follows: Altoona, Pa.; Amsterdam, N. Y.; Bradford, Pa.; Brockton, Mass.; Clinton, Mass.; Colorado Springs, Colo.; Concord, N. H.; Fitchburg, Mass.; Gloversville, N. Y.; Hartford, Conn.; Holyoke, Mass.; Hornellsville, N. Y.; Ishpeming, Mich.; Ithaca, N. Y.; Jackson, Tenn.; Kingston, N. Y.; Leadville, Colo.; Los Angeles, Cal.; Mahanoy, Pa.; Medford, Mass.; Meriden, Conn.; New Bedford, Mass.; New London, Conn.; Northampton, Mass.; Norwich, Conn.; Oakland, Cal.; Ogden, Utah; Passaic, N. J.; Pittsfield, Mass.; Pittston, Pa.; Portland, Me.; Salt Lake, Utah; Shenandoah, Pa.; Springfield, Mass.; Utica, N. Y., and Worcester, Mass.

#### GRAVITY WITH PUMPING TO HIGH SERVICE.

The cities that depended on gravity for the main portion of their supply, pumping only for the high service, numbered 22, but the population was 22.54 per cent of the total discussed. Of these, 12 are in the North Atlantic, 3 in the South Atlantic, 3 in the North Central, and 4 in the Western division.

#### PUMPING WORKS.

Pumping works were largely in excess throughout the country, the population dependent upon them being 72.05 per cent of the total under consideration. There are 235 cities represented, with an average population of 49,600 each, and located in geographical divisions as follows: North Atlantic, 67; North Central, 105; South Central, 30; South Atlantic, 21, and Western, 12. Taking the 4 classes of pumping works: "Pumping direct to main", "Pumping to reservoir", "Pumping to standpipe", and "Pumping to standpipe and reservoir", the following conditions prevail:

#### DIRECT PUMPING.

There are 68 cities, with 10.47 per cent of the population, that have an average number of 24,840 inhabitants where pumping directly into the mains was used, and 45 of these cities are located in the North Central, 9 in the North Atlantic, 7 in the South Central, 4 in the South Atlantic, and 3 in the Western division. Minneapolis and Indianapolis, having a population of over 100,000 each, used this class of works.

#### PUMPING TO RESERVOIR.

There are 89 cities, with an average population each of 56,245, that pump their water to reservoirs, the supply passing from there to the mains. These cities, representing 31.03 per cent of the population discussed, are distributed geographically as follows: 35 in the North Atlantic, 25 in the North Central, 12 in the South Central, 11 in the South Atlantic, and 6 in the Western division. Of the larger cities, Brooklyn, Buffalo, Cincinnati, Denver, Kansas city (Mo.), Newark (N. J.), Omaha, Providence, and St. Louis are in this class.

#### PUMPING TO STANDPIPE.

There were 44 cities, with 13.50 per cent of the population, averaging 49,532 each, for which the water was pumped to standpipe, and, as was the case in pumping direct, a majority of the works was located in the North Central division, where 25 cities used this class of works; of the remainder, 9 are in the North Atlantic, 6 in the South Central, and 4 in the South Atlantic division. Of the larger cities, Chicago and Detroit were supplied by this class of works, as were also Charleston, Fall River, Lincoln, and Toledo.

## PUMPING TO STANDPIPE AND RESERVOIR.

There were 34 cities, with 17.05 per cent of the population discussed, that used the standpipe and reservoir in connection with their pumping works, and of these 14 are in the North Atlantic, 10 in the North Central, 5 in the South Central, 3 in the Western, and 2 in the South Atlantic division. The average population of each city was 80,915; the cities of Cleveland, Jersey city, Louisville, Milwaukee, New Orleans, and Philadelphia are included.

Many of the cities reported the character of their works but failed to give the cost of the same, and these can not be used in showing the relative cost of each class of works.

Table 27 shows for 269 cities, with an aggregate population of 15,460,938, the total cost of works, daily consumption, capacity of reservoirs, the distribution of population on mains, cost of works per capita of the population and to each mile of main, and the daily consumption to each person for each class of works.

TABLE 27.

CHARACTER OF WORKS.	Number of cities.	POPULATION.		COST OF WORKS.			AVERAGE DAILY CONSUMPTION.		Capacity of reservoirs. (In 1,000,000 gallons.)
		Total.	To each mile of main.	Total.	Per capita.	Per mile of main.	Total. (In 1,000,000 gallons.)	Per capita. (Gallons.)	
Total .....	269	15,460,938	954.97	\$354,635,373	\$22.94	\$21,905	1,411.5	91	33,430.7
Gravity.....	36	873,233	521.33	26,607,690	30.47	15,885	81.7	94	14,142.0
Gravity with pumping .....	19	3,496,262	1,118.09	114,489,299	32.75	36,613	306.7	88	7,469.0
Pumping direct.....	62	1,586,044	941.27	24,200,204	15.26	14,362	139.0	88	.....
Pumping to reservoirs.....	78	4,668,042	940.95	104,723,250	22.43	21,109	436.0	93	4,988.2
Pumping to standpipes .....	41	2,126,393	1,069.08	29,826,740	14.02	14,996	193.5	91	.....
Pumping to standpipes and reservoirs...	33	2,710,964	984.73	54,788,190	20.21	19,901	254.6	94	6,831.5

From this it will be seen that the cost of works to each head of population and each mile of main is the largest in those cities having gravity works with pumping to high service. In the pumping works the cost is higher in those cities where reservoirs are used, the least expensive to build appearing to be the pumping direct and the pumping to standpipe. It will also be noted in the consumption daily to each head of population that gravity with pumping and pumping direct to mains used the same proportionate consumption, while gravity alone and pumping to reservoir and standpipe were the same and the highest.

Table 66 shows the ownership of the waterworks, whether by the municipalities or by private parties, for the individual cities. Of the 292 cities reporting, 168, having a population of 12,650,460, owned and operated their own waterworks, while 124, with a total population of 3,473,020, depended on private parties for their water supply. Of the population, 78.46 per cent was in the cities owning the works.

The average population of each of the cities owning the waterworks was 75,300. The waterworks owned by private parties existed mostly in the smaller cities, as the 124 cities thus supplied had an average population of but 28,008 each. Of the cities having a population of 100,000 and upward, San Francisco, New Orleans, Omaha, Kansas city (Mo.), Denver, and Indianapolis have their waterworks operated by private parties.

Though the ownership of the works was reported for 292 cities, but 215, with an aggregate population of 13,422,223, made complete returns on all points desired for Table 28, which gives for these cities the cost of works, average annual cost of maintenance, average annual receipts from water rents, cost of works to each mile of main and to each tap, and the population to each mile for the city, and the private ownership, by population groups and geographical divisions.

# WATERWORKS.

TABLE 28.  
OWNED BY THE CITIES.

POPULATION GROUPS AND GEOGRAPHICAL DIVISIONS.	Number of cities.	POPULATION.		COST OF WORKS.			Taps. (Number.)	Mains. (Miles.)	AVERAGE ANNUAL— (FOR 10 YEARS)	
		Total.	To each mile of main.	Total.	Per capita.	To each mile of main.			Cost of maintenance.	Receipts from water rents.
Total .....	149	11,599,966	1,040.73	\$244,328,379	\$21.06	\$21,921	1,293,456	11,146	\$5,883,619	\$16,818,287
10,000 to 14,999 .....	40	494,142	537.11	9,198,653	18.02	9,999	54,017	920	269,890	564,895
15,000 to 24,999 .....	38	759,608	680.65	15,484,242	20.38	13,875	73,040	1,116	452,533	868,292
25,000 to 49,999 .....	36	1,259,343	846.90	24,462,742	19.43	16,451	134,773	1,487	562,655	1,469,127
50,000 to 99,999 .....	15	982,406	976.55	19,419,969	19.77	19,304	105,119	1,006	429,400	1,230,477
100,000 and over .....	20	8,104,467	1,224.79	175,762,773	21.69	26,562	926,507	6,617	4,169,141	12,685,496
Total .....	149	11,599,966	1,040.73	244,328,379	21.06	21,921	1,293,456	11,146	5,883,619	16,818,287
North Atlantic .....	76	6,747,665	1,023.46	107,797,509	24.87	25,451	797,675	6,593	4,060,340	11,526,743
South Atlantic .....	10	569,835	1,045.57	9,612,090	16.87	17,637	65,930	545	169,125	484,202
North Central .....	51	3,826,525	1,089.87	56,856,820	14.86	16,194	389,993	3,511	1,267,652	4,280,065
South Central .....	6	300,698	992.11	7,658,170	25.48	25,274	22,156	303	304,595	363,460
Western .....	6	155,333	800.69	2,403,750	15.48	12,391	17,702	194	81,967	163,817

PRIVATE OWNERSHIP.

Total .....	66	1,822,257	710.99	48,142,161	26.42	18,784	139,961	2,563	1,403,973	4,653,384
10,000 to 14,999 .....	36	428,822	627.85	8,290,337	19.33	12,138	33,892	683	307,836	516,056
15,000 to 24,999 .....	10	188,756	734.46	3,736,614	19.80	14,539	12,206	257	102,978	224,848
25,000 to 49,999 .....	14	482,051	621.20	17,663,210	36.64	22,762	40,155	776	318,858	765,273
50,000 to 99,999 .....	2	100,708	330.19	3,325,000	33.02	10,902	15,950	305	128,442	209,372
100,000 and over .....	4	621,920	1,147.45	15,127,000	24.32	27,910	37,758	542	545,859	2,937,835
Total .....	66	1,822,257	710.99	48,142,161	26.42	18,784	139,961	2,563	1,403,973	4,653,384
North Atlantic .....	15	316,351	578.34	9,471,220	29.94	17,315	31,508	547	138,831	467,444
South Atlantic .....	6	85,173	925.79	1,114,000	13.08	12,109	3,682	92	61,008	83,016
North Central .....	27	699,462	999.57	16,882,748	24.14	21,954	39,632	769	722,196	2,916,903
South Central .....	13	493,784	1,132.53	8,412,000	17.04	19,294	31,729	436	284,496	554,649
Western .....	5	227,487	316.39	12,262,193	53.90	17,055	33,410	719	197,442	631,372

It will be seen from the above table that the cost of works to each head of population was lower in the total for the city ownership, while the cost to each mile of main was lower for the private corporations. In the North Central division the cost of the city works to each head of population was largely below the cost of private works, as was also the case in the Western. This is probably due to the fact that the returns from private corporations generally gave the total capital stock instead of the actual cost of the works.

In connection with the above, Tables 29 and 30 give in detail the receipts and expenditures connected with the water supply in their relations to population, mains, and taps for 49 of the largest cities in this country, and for 18 German cities, so far as such details can be obtained from their reports. In the cities of the United States the cost of maintenance and the annual receipts from water rents are the average annual for the past 10 years, and as the ratios per capita and to the mains and taps can not therefore be accurately ascertained, they are omitted from the tables.

## SOCIAL STATISTICS OF CITIES.

TABLE 29.

CITIES.	POPULATION.		Number of meters to each 100 taps.	COST OF WATERWORKS.			Average annual cost of maintenance. (For 10 years.)	Average annual receipts from water rents. (For 10 years.)	Annual charge for water for an average dwelling.
	To each mile of main.	To each tap.		Per capita.	To each mile of main.	To each tap.			
New York	2,295.91	15.95	20.53	\$26.40	\$60,606	\$421.05	\$530,000	\$2,300,000	\$6.00
Chicago	1,622.20	7.33	2.18	12.48	20,243	91.50	80,000	1,261,386	14.00
Philadelphia	1,125.77	6.13	0.18	17.67	19,892	108.24	545,667	1,688,508	9.00
Brooklyn	1,938.32	9.38	2.04	19.20	37,224	180.14	430,084	1,197,222	8.00
St. Louis	1,344.55	12.52	8.00	18.04	24,258	225.89	241,783	807,554	14.00
Boston	710.74	5.80	4.99	49.34	35,070	286.14	401,700	1,504,790	12.00
Baltimore	1,067.42	(a)		23.25	24,816	(a)	100,000	600,000	7.00
San Francisco	874.26	8.03	31.65	50.17	43,860	402.75	(a)		20.00
Cincinnati	1,095.60	7.94	3.80	11.79	12,915	93.59	229,100	530,931	12.50
Cleveland	868.28	8.51	5.62	21.75	18,885	185.07	83,946	316,975	11.25
Buffalo	909.84	7.09	0.33	23.47	21,352	166.38	90,000	402,978	12.00
New Orleans	3,227.19	23.47	0.29	10.00	32,267	234.70	44,365	132,854	25.00
Pittsburg	1,242.80	13.45	0.24	14.67	18,229	197.25	92,392	406,476	16.00
Washington	944.08	7.52	0.26	17.61	16,628	132.46	26,556	133,704	4.50
Detroit	573.47	5.46	2.02	21.39	12,269	116.75	70,610	298,477	10.00
Milwaukee	1,161.75	12.04	28.14	15.34	17,823	184.68	89,694	207,724	11.00
Newark (N. J.)	1,033.13	8.44	2.58	17.12	17,692	144.61	87,369	264,470	13.75
Minneapolis	1,160.13	19.44	4.39	13.78	15,986	267.91	45,000	88,529	9.00
Jersey city	1,630.03	9.27	1.39	32.36	52,753	299.94	650,000	466,000	12.85
Louisville	1,067.08	13.01	6.82	26.33	28,100	342.66	195,303	236,400	14.60
Omaha	989.10	23.41	16.67	42.72	42,254	1,000.00	50,000	150,000	12.00
Rochester	622.77	5.78	8.90	31.01	19,312	179.39	51,845	166,967	7.00
St. Paul	802.14	14.71	3.91	21.47	17,219	315.78	20,000	100,000	8.60
Kansas city (Mo.)	1,061.73	12.70	17.35	22.60	24,000	287.16	401,494	2,354,981	16.75
Providence	597.95	8.57	58.00	45.85	27,418	392.85	6358,092	306,395	16.00
Denver	533.57	9.70	0.77	34.74	18,535	337.00	50,000	300,000	17.00
Albany	999.19	6.27	0.35	(a)	(a)	(a)	93,873	178,098	14.00
Syracuse	2,098.64	29.38	17.33	9.08	19,048	266.67			19.00
Worcester	742.59	9.41	88.03	22.36	16,601	210.28	50,000	124,000	15.00
Toledo	1,163.34	23.27	10.71	15.35	17,857	357.14	20,000	48,600	11.00
Richmond (Va.)	1,114.90	7.68	1.08	24.57	27,397	188.68	30,000	95,000	11.50
New Haven	640.14	(a)	(a)	21.43	13,717	(a)	170,279	186,721	12.00
Paterson	1,119.24	11.80	0.05	40.18	44,971	474.17	(a)		14.00
Fall River	1,180.92	15.50	72.92	25.02	29,547	387.80	25,754	70,560	15.00
Cambridge	660.64	6.89	2.27	36.60	24,182	252.34	31,843	182,768	17.00
Atlanta	1,820.36	21.84	88.33	10.63	19,357	232.28	20,000	30,000	(c)
Memphis	838.55	9.49	6.60	29.81	25,000	283.02	100,000	175,000	17.00
Wilmington (Del.)	830.15	5.26	0.15	16.28	13,514	85.68	34,000	90,577	10.00
Dayton	1,155.09	24.14	4.02	16.49	12,113	253.15	28,150	46,509	10.00
Troy	1,088.50	10.76	3.94	19.63	21,362	211.09	48,400	63,130	10.00
Grand Rapids	972.23	19.22	12.56	13.62	13,246	261.87	22,084	41,839	15.00
Reading	1,066.56	4.19	0.04	21.31	22,727	89.29	40,000	90,000	16.00
Camden	1,023.04	5.32	0.14	11.15	11,404	59.31	16,000	86,434	11.00
Trenton	820.83	(a)	(a)	10.14	8,320	(a)	12,000	57,978	10.00
Lynn	640.54	6.48	3.76	29.78	19,072	192.81	20,000	110,000	11.00
Lincoln	2,757.70	36.77	3.60	3.52	9,700	129.33	10,614	14,421	11.50
Hartford	665.38	8.90	5.77	32.75	21,790	291.30	32,555	136,699	9.00
Evansville	1,180.37	(a)	(a)	9.85	11,628	(a)	26,000	35,000	15.00
Los Angeles	205.69	4.73	3.00	36.21	7,449	171.36	28,442	34,372	24.60

a No data.

b Includes interest on debt.

c Meter measurement only.



TABLE 30.

CITIES.	POPULATION.		Miles of main.	RECEIPTS AND EXPENDITURES FOR YEAR 1891.						
	Total, 1890.	To each mile of main.		Receipts.				Expenditures.		
				Total.	Above expenditures.	Per capita of population.	To each mile of main.	Total.	Per capita of population.	To each mile of main.
Total.....	5,320,196	2,579	2,066	\$4,565,384	\$3,224,977	\$0.86	\$2,210	\$1,340,407	\$0.25	\$649
Berlin.....	1,578,794	3,613	437	1,488,975	1,138,069	0.94	3,407	350,906	0.22	803
Hamburg.....	569,260	2,124	268	560,809	332,155	0.99	2,093	228,654	0.40	853
Leipsic.....	357,122	3,160	113	142,530	87,924	0.40	1,261	54,606	0.15	483
Munich.....	349,024	2,585	135	190,913	92,448	0.55	1,414	98,465	0.28	729
Breslau.....	335,186	3,162	106	314,030	201,605	0.94	2,963	52,425	0.16	495
Cologne.....	281,681	3,095	91	245,379	183,915	0.87	2,696	61,464	0.22	675
Dresden.....	276,522	2,609	106	233,514	186,695	0.84	2,203	46,819	0.17	442
Magdeburg.....	202,234	2,466	82	132,730	90,639	0.66	1,619	42,091	0.21	513
Frankfort on the Main.	179,985	1,353	133	372,811	271,704	2.07	2,803	101,107	0.56	760
Hanover.....	163,593	2,045	80	102,751	27,290	0.63	1,284	75,461	0.46	943
Königsberg.....	161,666	3,299	49	105,280	84,502	0.65	2,149	20,778	0.13	424
Düsseldorf.....	144,642	1,854	78	101,956	79,968	0.70	1,307	21,988	0.15	282
Altona.....	143,249	1,685	85	156,985	111,447	1.10	1,847	45,538	0.32	530
Stuttgart.....	139,817	1,554	90	127,570	88,092	0.91	1,417	39,478	0.28	439
Strasburg.....	123,500	2,628	47	53,827	40,128	0.44	1,145	13,699	0.11	291
Barmen.....	116,144	1,873	62	91,118	47,472	0.78	1,470	43,646	0.38	704
Crefeld.....	105,376	2,151	49	57,173	34,634	0.54	1,167	22,539	0.21	460
Halle.....	101,401	1,844	55	87,033	66,290	0.86	1,582	20,743	0.20	377

From Table 29 it will be seen that the average cost to each head of population for the American cities was \$22.47, the range per capita being from \$50.17 in San Francisco to \$3.52 in Lincoln. The annual charge for water for an average dwelling ranged from \$4.50 in Washington, \$6.00 in New York, and \$7.00 each in Baltimore and Rochester to \$20.00 in San Francisco, \$24.60 in Los Angeles, \$25.00 in New Orleans, \$30.00 each in Fresno and Stockton, \$31.00 in Dallas, and \$48.00 in East Portland, Ore. The average dwelling in this case means a house of 7 rooms, with hot and cold water in the kitchen sink, a bath tub with hot and cold water, and a water closet.

There were 258 cities, with an aggregate population of 15,413,618, which reported as to the annual charge for water for an average dwelling. For 11 of these cities, with 15.84 per cent of the population, the charge was below \$8.00 per dwelling; for 30 cities, with 17.94 per cent of the population, it was from \$8.00 to \$10.00; in 45 cities, with 12.68 per cent of the population, it was from \$10.00 to \$12.00; in 55 cities, with 17.29 per cent of the population, it was from \$12.00 to \$14.00; in 36 cities, with 17.19 per cent of the population, it was from \$14.00 to \$16.00; in 36 cities, with 8.14 per cent of the population, it was from \$16.00 to \$18.00; in 20 cities, with 3.13 per cent of the population, it was from \$18.00 to \$20.00; in 18 cities, with 5.32 per cent of the population, it was from \$20.00 to \$25.00; in 7 cities, with 2.47 per cent of the population, it was \$25.00 and over per dwelling.

## SEWERS.

Table 67 shows the total length of sewers, divided between pipe and brick or stone, with the diameters of each class, and the largest and smallest diameter, the number of outlets, the several parts of the system, the total cost of sewers, the cost per capita, and the average annual cost of maintenance, repairs, and cleaning for the 10 years ending December 31, 1889, with the cost of cleaning separately shown.

Of the 345 cities, 281 made returns on this subject. Of these, 57 cities, with an aggregate population of 1,107,262, reported "no sewers", and are as follows:

## NORTH ATLANTIC DIVISION.

POPULATION 10,000 TO 14,999.—Bridgeton, N. J.; Clinton, Mass.; Columbia, Pa.; Dover, N. H.; Easton, Pa.; Hornellsville, N. Y.; Ithaca, N. Y.; Medford, Mass.; Nanticoke, Pa.; Peabody, Mass.; Plainfield, N. J.; Weymouth, Mass., and Woburn, Mass.

POPULATION 15,000 TO 24,999.—Gloucester, Mass.; Jamestown, N. Y.; Malden, Mass.; Meriden, Conn.; Newton, Mass.; North Adams, Mass.; Orange, N. J.; Quincy, Mass.; Shenandoah, Pa.; Waltham, Mass., and Woonsocket, R. I.

POPULATION 25,000 TO 49,999.—Brockton and Taunton, Mass.

## SOUTH ATLANTIC DIVISION.

POPULATION 10,000 TO 14,999.—Alexandria and Portsmouth, Va.

POPULATION 15,000 TO 24,999.—Columbia, S. C.; Key West, Fla., and Wilmington, N. C.

DIAGRAM 15.—AMOUNT OF WATER USED IN THE LARGER CITIES IN ACCORDANCE WITH THE POPULATION.

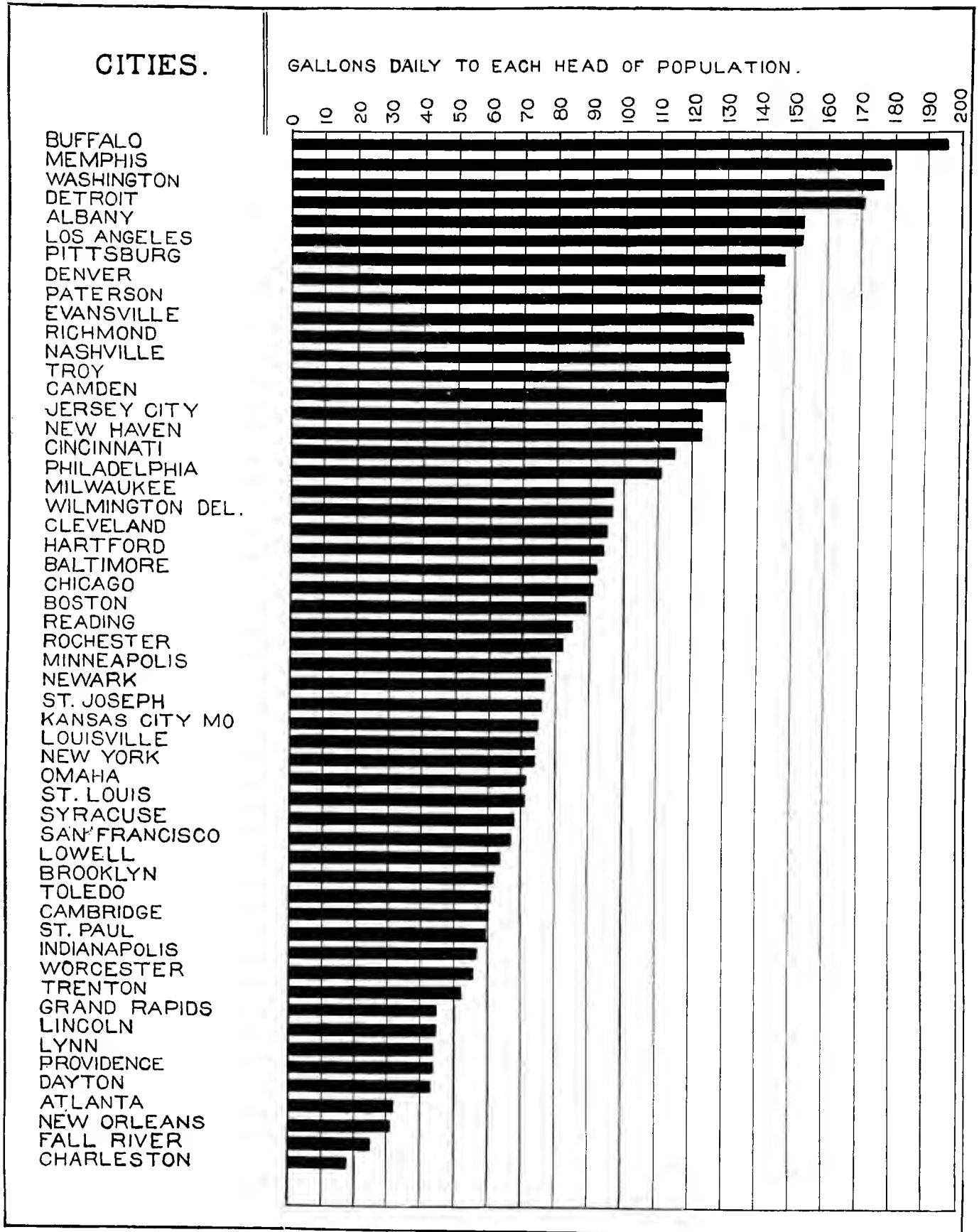


DIAGRAM 16.—CONSUMPTION OF WATER IN GERMAN CITIES.

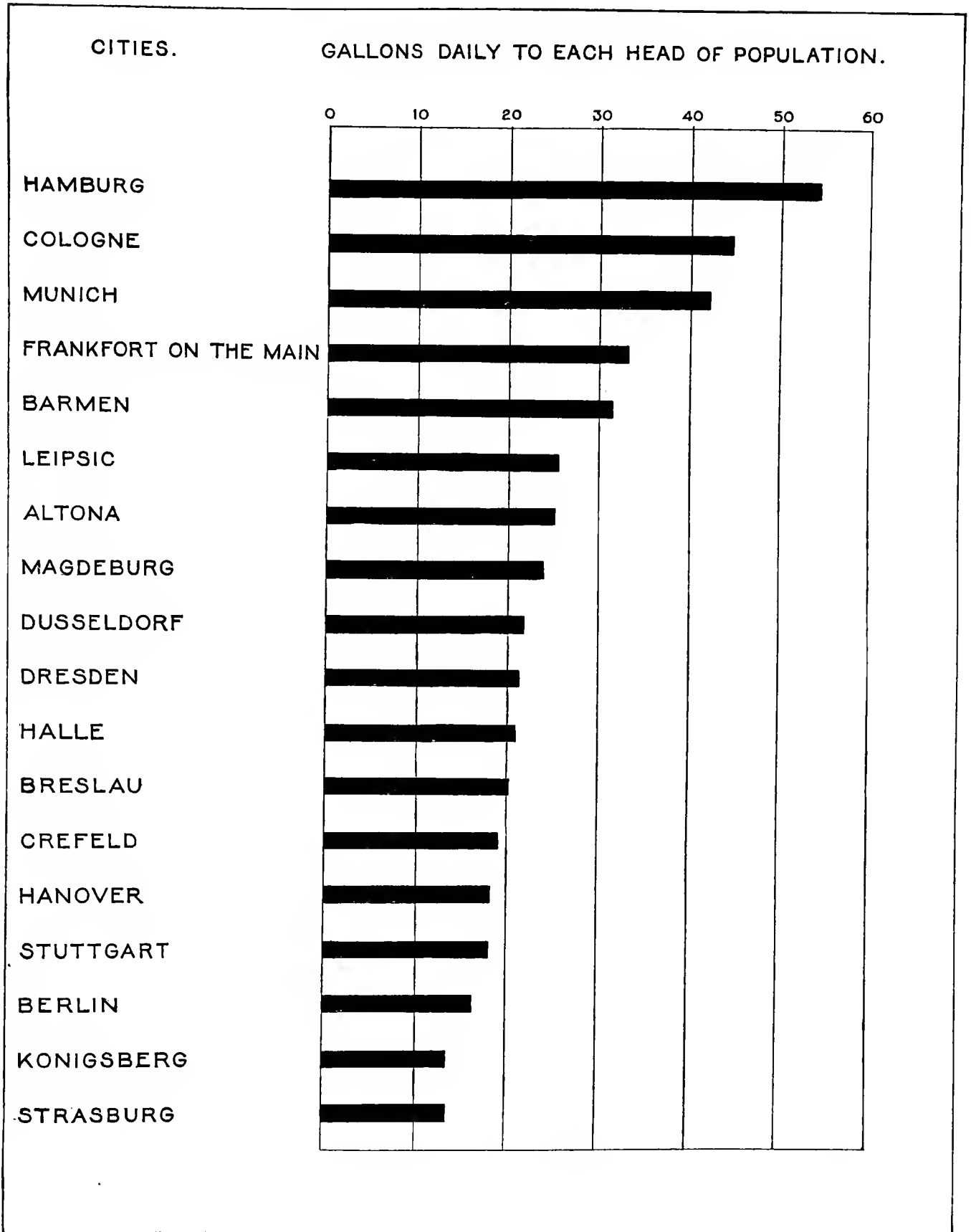







DIAGRAM 17.—DISTRIBUTION OF POPULATION ACCORDING TO CHARACTER OF WATERWORKS.

Character of works.	Per cent of population.	293 CITIES. Total population 16,134,747
Pumping to reservoirs	31.03	
Gravity with pumping	22.54	
Pumping to stand pipes and reservoirs. )	17.05	
Pumping to stand pipes	13.50	
Direct pumping.	10.47	
Gravity.	5.41	