large meter on the supply line to each district, all that was necessary with the portable instrument was to tap each supply line with a standard 1-in. corporation cock, and the flow meter was moved from one gauging point to another as the occasion demanded.

This system was first used in Terre Haute, Ind., in 1897, and later in Columbus, Ohio, in 1902. Since that time over 200 cities of the United States have adopted this method of controlling water waste, and from year to year the system has become more complete until at the present time its efficiency is unquestioned.

Probably the most successful results of recent years have been obtained in Trenton, N.J., and Buffalo, N.Y. In Trenton, the daily consumption had gradually increased from 9,000,000 gals. in 1902 to 21,000,000 gals. in 1913. This was partly due to increase in population and industrial use, but in most part was due to the fact that waste conditions were becoming greater as no steps were taken to curtail them. In 1914, when the population supplied was approximately 125,000, the "Pitometer system" of controlling water waste was installed, with the result that in a year's time the consumption had been reduced to 15,000,000 gals. a day. If nothing had been done to stop the waste, the consumption would have been about 27,000,000 gals. per day, based on the average rate of increase for the ten preceding years. This means that by installing the system of waste control, a saving of $4.40 a day was made in coal alone. In addition, the need of a new reservoir and a new pump was put off indefinitely, together with the resulting necessity for larger mains. These extensions would have cost approximately $1,000,000. By repeating the district house-to-house inspections under the supervision of the "Pitometer," this reduction in waste has been made permanent up to the present time.

City.	Population.	Average per capita consumption, gallons daily.
Aberdeen	155,000	54.0
Ashton	140,000	24.0
Belfast	360,000	39.6
Birkenhead*	104,920	40.8
Birmingham*	775,502	33.6
Blackburn*	130,000	30.0
Bolton*	237,159	32.4
Bournemouth*	85,920	27.6
Bradford*	450,000	54.0
Bristol*	353,374	26.4
Cardiff*	190,000	30.0
Darlington	46,000	25.2
Derby*	129,500	26.4
Dublin*	333,300	43.2
Dundee*	202,000	60.0
Edinburgh*	435,500	49.6
Glasgow*	1,075,735	67.2
Halifax*	224,933	18.0
Leeds*	430,000	42.6
Liverpool*	850,000	37.7
London	6,304,653	40.8
Manchester*	1,082,000	34.8
Newcastle*	485,000	45.5
Northampton*	120,000	18.8
Nottingham*	301,000	24.0
Oldham*	223,000	27.0
Paisley*	101,000	83.2
Plymouth*	132.326	55.2
Portsmouth*	200,000	48.7
Rochdale	100,000	22.8
Sheffield*	429,552	32.4
S. Essex*	146,000	24.0
Stockport*	135,000	27.0
Stockton*	230,000	62.4
Swansea*	110,000	34.8
Wakefield*	138,000	21.6
Wolverhampton*	136,000	26.4
Grand average,		37.6

*Adjacent communities also supplied.

The results obtained by the city of Buffalo have been perhaps even more remarkable, inasmuch as it was necessary to carry on the work on a much larger scale than in Trenton. For a great many years Buffalo had the distinction of having the highest per capita consumption of any city in the United States. In 1917, just prior to the start of the water waste survey, about 180,000,000 gals. a day were being pumped into the mains, or a per capita of approximately 360 gals. In June, 1917, the "Pitometer system" of waste control was installed, and the daily consumption has now been reduced to about 120,000,000 gals. a day, or a per capita of 240 gals., although the first inspections have not been extended over the entire city. Of this amount, 100 gals. daily per capita are sold to the industrial consumers, leaving a domestic per capita of about 140 gals. This is still far in excess of the actual need of domestic consumers, but is being reduced day by day, and within the next year will undoubtedly reach a reasonable figure. What these results will mean to the city of Buffalo may be seen from the following facts:—

One Pumping Station Eliminated

The water is pumped from two pumping stations, each containing five 30,000,000-gal. pumps, with an approximate capacity of 150,000,000 gals. a day. The present daily pumpage is within the capacity of one station, and for the past six months only one pump has been in operation in the second station. When the margin of safety becomes a little greater, this station will be put into reserve and the entire load carried by one station. An enormous saving will result in operating costs.

For the purpose of the survey, the city was divided into ten sections and each section subdivided into a number of districts. The flow was then measured into each district by the "Pitometer," and further investigations made by subdividing each district at night, so that the rate of flow between each pair of valves was determined. Wherever this seemed excessively high, inspectors were sent into the blocks to locate and stop leaks. Each inspector was equipped with a blank form, which enables him to report the number, location and cause of all leaks discovered on the services or on the premises of consumers. Notices were left with the property owner, and a duplicate filed in the water works office, which required that the leaks be stopped within a designated number of days, with a penalty of shutting off the service in case repairs were not made. After re-inspections had been made to determine that all waste had been stopped, a remeasurement was made of the entire district and the results recorded. These results demonstrated the efficiency of this system.

Periodical Remeasurements

In order to discover the permanancy of the reduction in the various sections of the city, re-measurements were made of the flow in typical districts after periods of six, twelve and eighteen months had elapsed. In this way it was determined that in some sections of the city the waste had not returned in a sufficient amount to warrant reinspections until a period of eighteen months had elapsed. In other sections the investigations proved that in order to control waste, yearly inspections should be made; while in still other sections, notably those containing the poorer class of consumers, with exposed plumbing and anti-freezing toilets, inspections every six months, or even oftener, were necessary in order to control the waste.

In some cities it has been found practical to combine a system of selective metering with house-to-house inspections, which has been productive of even more satisfactory and permanent results. This system permits the metering of all wasteful commercial users of water, such as garages, livery stables, laundries, bakeries, saloons, etc., as well as metering the domestic consumer in cases where the officials are convinced, by repeated inspections, that this is the only way of compelling the owner to keep his plumbing in repair.