DOCUMENTS FILED WITH MESSAGE.

Nova Scotia Board of Fire Undewriters.

Halifax, N. S.. Feb. 4th, 1908.

R. T. MacIlreith, Esq., Mayor,

Re Halifax Water Supply.

Dear Sir,—I have been directed by this Board to address you regarding the report made by Mr. Willis Chipman, C. E., in February, 1907, on the above subject, and to ask you if you will kindly advise what steps have so far been taken to carry out the recommendations made by this gentleman

Ever since this report was issued, about a year ago, some of the Companies have been rather anxious regarding the state of the water supply, and which Mr. Chipman characterizes as "Having the lowest pressure and the weakest fire supply of any Canadian City with which he is acquainted."

You can readily understand that a report of this kind made by a non interested party, and one qualified to criticise, has an alarming effect on the Insurance Companies having large interests at stake, especially when said report was issued by the City without any comment. I will thank you to kindly let me have the information asked for above, also please permit me to emphasize the importance of adopting measures to speedily overcome the present difficulty.

I trust you will be able to place this matter before the Council at an early date, and in such a way that immediate steps will be taken to have the present unsatisfactory state of affairs regarding the water system remedied, and so that the remarks of Mr. Chipman in his report—"Your preservation from a disastrous conflagration has been nothing less than miraculous"—may not again be applied to our City when considering the Water Works question.

Trusting to be favored with a reply from you showing what has so far been done and the likelihood of immediate steps to complete Mr. Chipman's recommendations, I remain

EDWARD J. FAHIE, Secretary.

Halifax, N. S., Feby., 24th, 1908.

To His Worship the Mayor and Board of Fire Commissioners:

Gentlemen,—We most respectfully beg to call your attention to the lack of water at the recent fire in the Robert Taylor Company's premises on Brunswick Street. We understand until the arrival of the engines there was a total want of water. This emphasizes the necessity of something being done towards carrying out the improvements, recommended in Mr. Chipman's report, and we will be obliged if you will advise us what action you are taking in this matter and whether the report of the Board of Firewards bears out the point regarding the want of water as above.

EDWARD J. FAHIE, Secretary.

Office of Chief Fire Department,

November 15th, 1907.

His Worship the Mayor:

Sir,—Complying with your verbal request for a statement as to inefficient water supply at fires, I beg to report that the Fire Department was handicapped through this cause at recent fires in different parts of the City, as follows:

Crump & Perrier's, Barrington St.

St. Luke's Cathedral, Morris Street.

Provincial Exhibition Grounds, Willow Park, on three occasions.

Willis' carriage factory, Brunswick Street; and Snow's store room on Edward Street.

I only give these cases as illustrations of a trouble we have to contend against in different parts of the City.

P. J. BRODERICK,
Chief Fire Department.

Halifax, N. S., March 2nd, 1908.

R. T. MacIlreith, Esq.,
Mayor City of Halifax.

Dear Sir,—We notice in the columns of the daily press that you are about to send a message to the City Council on Tuesday evening in reference to the water service, and in this connection would like to call your attention to the absolute lack of anything like adequate protection from fire which exists to-day in the vicinity of Brunswick, Duke and Albemarle Streets where our works are located and which was amply evidenced by the fire from which our factory had such a narrow escape from total destruction on February 7th. The work of Chief Broderick and his men on that occasion was all that could be desired, but until the steamers got to work they were absolutely powerless, the hydrants barely throwing a stream of six feet from the nozzle.

Now, we pay for fire protection, but do we get it? At least so far as the water service is concerned? What the cause may be we of course do not pretend to say. It may be waste, improper or old mains, poor supply, etc., but whatever it be when the existence of any one of the few manufacing industries which our City contains is threatened in this way it is surely the duty of those who control civic affairs to see in the interests of the artisan as well as the employer that ample protection is afforded at such times both to life and property when they are endangered by the fire fiend as both were with us on the occasion referred to.

THE ROBT. TAYLOR CO., LTD.

WATER CONSUMPTION—VARIOUS CITIES.

	Population.	No. of service pipes.	No. of meters in use.	Daily average per capita consumption	Domestic pressure.	Fire pressure.	Supply (Gravity)?
Salem, Mass.....	38,000	6,850	202	88 gals.	45 to 50 lbs	Same	Pumped to reservoir, contains 20,000,000 gals.
Cambridge, Mass.... . ..	99,912	15,197	3,339	110 " Average daily consumption. 11,065,412 gals.	55 to 60 lbs	55 to 60 lbs	From storage reservoirs at Hobbs Brook & Stony Brook through a conduit, by gravity, to receiving reservoir, Fresh Pond, thence by pumping to distributing reservoir, Payson Park, thence by gravity to consumers.
Worcester, Mass....	147,000	15,369	14,775	66 gals.	70 to lbs	70 to lbs	Yes !
Newton, Mass.....	38,700	7,763	6,744	60 "	15 to 20 lbs	15 to 20 lbs	Pump to reservoir.
Hartford, Conn	116,000	10,922	10,797	59 "	68 lbs	68 lbs	Gravity
Providence, R. I.... . ..	219,800	25,709	22,512	68 "	40 to 73 lbs	40 to 115lbs	Yes ! supplemented by direct pressure from pumps in certain sections of City above 90 ft. elevations.
Manchester, N. H.....	73,000	6,300	4,500	50 "	60 lbs	Same	Steam and Water power.
Elmira, N. Y....	43,000	6,300	775	156 "	45 to 55 lbs	Same	Pump from river.
Wilmington, Del....	87,500	17,081	4,353	96 "	20-60	20-60	Pumped from river to reservoirs and thence by gravity to City.
San Francisco	455,000			34,900,000			
Holyoke.....	53,422	3,941	328	105 gals.	70-102	Same	Gravity.
New Westminster, B. C...	10,500	1,850	170	70 "	32-160	32-170	Gravity.
Fitchburg, Mass.....	37,000	4,860	3,235	90 "	80 & 150lbs	Same	Gravity.

Attleboro', Mass	15,000	1,907	1,977	45	"	85-100 lbs	Same	Pumping into stand pipe.
Jersey City	250,000	30,000	1,850	185	"	20-50 lbs	20-50 lbs	Gravity.
Lynn, Mass	85,000	14,000	5,000	65	"	50-60 lbs	40-50 lbs	Pump to reservoir.
St. Louis, Mo	710,000	87,734	5,426	100	"	25-125 lbs.	Same	Pumping.
Rochester, N. Y	190,000	36,618	25,650	88	"	50 lbs	50 lbs Separate system centre of City, fire only, 130 lbs.	Gravity, except on separate system above mentioned, which is.
Hoboken, N. J	75,000	4,500	3,000	110	"	21-45 lbs	Same	Gravity.
Buffalo, N. Y	400,000	75,000	2,000	250	"	20-30 lbs	15-45 lbs	Direct Pumping.
Pittsburg, Pa	37,500	45,000	6,551	218.5	"	10-160 lbs	Not separated from Domestic.	Allegheny River filtration plant nearly completed.
Meriden, Conn	35,000	4,500	450	100	"	50-100 lbs	Same	Partly gravity and partly pumps.
Waterbury, Conn	70,000	6,349	1,294	98	"		Lowservice 110. High 120 to 190 lbs.	
Philadelphia, Pa	1,400,000	300,000	1,730	200	"	20-100 lbs	20 to 100 lbs	From rivers, by pumping.
Richmond, Va	105,000	17,500	9,205	116	"	15-75 lbs	Same	Pumps and reservoir.
Ottawa	67,572	15,631	52	182	gals.	92 "	100 lbs	Direct pressure.
Quebec	70,000	8,300	32	143	"	35 to 60	80 to 1	Gravity.
Montreal	311,799	69,745	1,711	106.23	imp	45 to 100	Same	Supply, St. Lawrence River—steam and water power force pumps, direct to consumer—Reservoir of 37 million imp. gals. capacity serving as head.
Toronto	275,000	63,248	2,512	100	imp gal	80 to 40	80 to 40	Supply—Lake Ontario (Pumping.)
Charlottetown	13,000	2,200	20	55	gal.	60 lbs.	60 lbs	Pumping to Reservoir.
Fredericton, N. B.	7,500	1,200	65	85	"	40 lbs.	85 lbs	Direct pumping supply mechanical filtration plant.

WATER CONSUMPTION—VARIOUS CITIES.—*(Continued.)*

	Population.	No. of service pipes.	No. of meters in use.	Daily average per capita. consumption.	Domestic pressure.	Fire pressure.	Supply (Gravity)?
Taunton, Mass.	30,967	5,043	2,388	68½ gals. inhabitant 74 8/10 consumer.		100-110	Obtain most of supply from a lake of 2000 acres, 10 miles from City. Raise water from lake 33 ft. to a smaller one of about 140 acres. From the latter supply runs by gravity to one local pumping station where pressure is increased by the pumps. Pressure is maintained by continual pumping on what is known as th Holly —a direct pressure system.
Grand Rapids	117,000	16,000	5,000	127 gals.	90-65 lbs.	90-65	Pumped from Grand River.
Albany, N. Y.	100,000	16,584	2,987	214 U. S. gals.	15-80 lbs.	15-80	One-third gravity—Two-thirds pumped from Hudson River.
Springfield	83,020	11,385	5,787	120 gals.	90-120 30-35	Same	Gravity.
Binghampton	45,000	1,125	1,778	6,190,096 gals.	65 lbs.	80 lbs	Direct pumping from Susquehanna River through filtration plant.
Cleveland, O.	476,000 & Suburbs 25,000.	72,500 in Suburbs 5,400	63,250	58,880,350 & per cap. 117.5 U. S. gals.	35 lbs. 20-85 lbs. 58-137 "	Same	Pumping directly into pipe system with reservoirs or water tower at end of system
Milwaukee, Wis.	350,000	56,000	45,000	93 gals.	25-55 lbs.	Separate fire pipes, fire tugs pumping. 250 lbs	Pumping from Lake Michigan.

Fall River, Mass.....	115,000	7,956	7,788	42.09 gals.	21-128	Same	Pumping direct to Storege Tanks, capacity of over 5,000,000 gallons.
Galt, Ont.....	9,149	2,100	200	100 "	95 lbs.	155 lbs	Artesian wells — Pumped to stand pipe.
Cincinnati, O....	360,700	41,037	5,341	141 "	15-180 lbs.	Fire engines are used	Pumpage with reservoirs as as relief.
Teledo, Ohio....	186,000	18,000	14,000	65 "	65 lbs	90 lbs	Direct from stand pipe.
Mineapolis.....	300,000	32,000	23,000	58-6/10 "	40-75	Same	Gravity.
Poughkeepsie	25,369	3,803	3,337	600 " per tap.	35-120	280 ft. above high tide	From Reservoir.
Boston, Mass	602,000	93,942	5,190	157 "	30-80	Steam fire engines	Gravity and pumped.
Syracuse, N. Y.....	125,000	20,829	18,014	98 "	15-100 lbs.	Same	Gravity.
Indianapolis.....	235,000	20,000	2,300	100 "	50 lbs.	100-110	Direct.
Detroit, Mich.....							
Washington....	335,000	60,000	13,000	180 "	30-70 gals.	Same	All pumped to filters; 30% pumped from filters to consumers; balance gravity.
Vancouver.....	75,000	11,100	600	100 "	110 lbs.	110 lbs	Gravity.
Winnipeg	120,000	16,500	11,400	40 "	40 lbs.	80 lbs	Artesian well system.
Victoria, B. C....	30,000	5,215	1,420	2,000,000	30-70		Gravity and pumping.
Brockton, 1906.....	50,000						
1903.....	44,704			33.0 gals.			
1904.....	46,248			35.0 "			
1905	47,792			35 0 "			
Rate of consumption per cap. which it was assumed in 1901 would be used :—							
1905				35 "			
1910.. ...				37 "			
1915.....				39 "			
1920.....				41 "			
1925.....				43 "			

WATER CONSUPTION—VARIOUS CITIES.—(*Continued.*)

	Population.	No. of service pipes.	No. of meters in use.	Daily average per capita consumption.	Domestic pressure.	Fire pressure.	Supply (Gravity)?
1930				45 gals			Pump. to dis. reservoir.
or in other words it was assumed that never over 45 gals, per capita would be used.							Gravity.
							Direct pumping. regulated by water-tower pressure
Yonkers, N. Y	7,500	6,637	6,660	102 "	50-130	Same	Driven well water pumped into a reservoir. Gravity from the reservoir. At times water pumped directly into the pipes from the driven wells.
Troy, N. Y...	76,000	12,156	350	200 "	50 lbs.	50 lb	
Jacksonville, Fla	50,000	5,376	3,555	70 "	62 lbs.	100 lbs	
Lowell, Mass...	96,380	11,968	8,804	55 "	40-70 lbs.	Same	Both gravity and pumping. Greater part gravity.
							Domestic supply for the greater part gravity, reinforced for higher areas by pumping stations.
Baltimore, Md.....	560,000	112,000	3,718	129 "	20-110	Same	
New York.....	2,541,000	166,719	49,000	135 "	Low service 10-45 High 15-75 lbs.	Sams as Dom. except high pressure fire system, 300 lbs. electrically driven centrifugal pumps	

Average Daily Per Capita Consumption European Cities.

London, England	20	gallons.
Leicester, "	20	"
Sheffield, "	21	"
Hull, "	25	"
Dublin, Ireland	50	"
German cities, average	50	"

Average Daily Per Capita Consumption Canadian Cities.

Winnipeg	40	gallons.
Charlottetown	55	"
Victoria, B. C	66.6	"
New Westminster, B. C	70	"
Fredericton	85	"
Toronto	100	"
Vancouver	100	"
St. John, N. B.	101.9	"
Montreal	106.23	"
Quebec	143	"
Ottawa	182	"

TESTS OF SUPPLY MAINS.

SUPPLY MAINS.

City Engineer's Office, Feb. 17, 1908.

His Worship the Mayor:

Sir,—During the inspection and testing of the water works system we have tested the supply mains and found the 27 inch. main from Chain Lake to Gottingen Street, nearly three miles in length, perfectly tight. The 24 inch. main from Chain Lake to the Willow Tree, nearly three miles in length,when tested developed a leak near the Arm. There was also a leakage through the valve at the Willow Tree and a satisfactory test could not be made. The leakage at the Arm was repaired and the main again tested, closing valves nearer town than the one at the Willow Tree. The meter at the lake showed the 24-inch pipe to be tight and also the main running from the Willow Tree down Cogswell Street to Gottingen Street The high service main was also tested, but the extra pressure also developed leakage near the Arm which was subsequently uncovered and repaired, so that all the supply mains are now tight.

F. W. W. DOANE,
City Engineer.

Halifax, N. S., Feb. 28th, 1908.

R. T. MacIlreith, Esq., Mayor:

Sir,—In the recent test of the low service 24 inch main Mr. Doane went out to the lake to make observations there while I superintended the work in town. In shutting off the 24 inch main at the Willow Tree, the main valve would not close properly and I could hear the water passing through it. Next morning in going over the line to see if there was any leakage in consequence of the shutting off of the main I found a leak in the field between Chebucto Road and Dutch Village Road, which, in my opinion, was caused by the shutting off of the water as there was no leak showing before the test was made. After the leakage at the joints was stopped the pipe was again tested, and in turning off I used the valves on the distribution pipes instead of the main valve on the 24 inch pipe. I could not close the valve at St. Andrew's Cross on the 12 inch pipe running down Cogswell Street and had to close the valve at Gottingen Street on this pipe instead.

E. MORRISON,
Foreman Water Dept.

CONDITION OF MAINS IN CITY.

Halifax, Feby. 28th, 1908.

R. T. MacIlreith, Esq., Mayor:

Sir,—In reply to your enquiry, we took up old pipe last year and laid new pipe instead

On Morris Street, between Hollis and Pleasant St.
On Barrington Street, between Proctor St. and Cornwallis St.
On Proctor Street, from the east side of Barrington to the west side.
On Lockman St., from Cornwallis St. to North St.
On Gerrish St., from the east to the west side of Lockman St.
On North St., from the east side to the west side of Lockman St.

And in 1906 we took up 6 inch pipe on Gottingen St., between Cogswell St. and Cunard Street and laid new pipe. The total length is about 5,400 feet, or over a mile. All these pipes were found in good condition, and there was no leak discovered in mains or service pipes in carrying out the work. During the last three years we have made about 1,300 service pipe connections in laying new pipes and renewing old ones. There is not a single instance in connection with this work in which leakage was discovered in the mains or at the stopcocks.

E. MORRISON,
Foreman Water Department.

Halifax, N. S., Feby. 28th, 1908.

Mr. E. Morrison, Foreman Water Dept.:

Sir.—As I have already stated to you, I found no leaks in the mains or services while carrying out the work of taking up old mains and laying new ones during 1906 and 1907 or putting in service pipes and renewing old ones during the last three years; but in each case where the main was exposed in carrying out this work the pipe was in good condition, and there was no leakage at the joints.

D. J. McLEAN,
Sub-Foreman Water Department.

Halifax, N. S., Feby. 28th, 1908.

Mr. E. Morrison, Foreman Water Dept.:

As I have already stated to you, I found no leaks in the mains or services while carrying out the work of taking up old mains and laying new ones during 1906 and 1907 or putting in service pipes and renewing old ones during the last three years; but in each case where the main was exposed in carrying out this work the pipe was in good condition, and there was no leakage at the joints.

JOHN McASKILL,
Sub-Foreman Water Department.

Halifax, N. S., Feby. 28th, 1908.

Mr. E. Morrison, Foreman Water Dept.:

Sir,—In laying new service pipes and renewing old ones during the last three years there has not been one case in which leakage was found in the mains where they were uncovered in carrying out this work, but in every case the pipe was found in good condition, and there was no leakage in the joints.

D. J. McLEAN,
Sub-Foreman Water Department.

Halifax, N. S., Feby. 28th, 1908.

Mr. E. Morrison, Foreman Water Dept.:

Sir,—In laying new service pipes and renewing old ones during the last three years there has not been one case in which leakage was found in the mains where they were uncovered in carrying out this work, but in every case the pipe was found in good condition and there was no leakage in the joints.

JOHN McASKILL,
Sub-Foreman Water Department.

QUANTITY OF WATER DELIVERED THROUGH 1-2 INCH PIPE.

City Engineer's Office, Feby. 18, 1908.

His Worship the Mayor:

Sir,—I made a test to-day in a meter measuring tank to ascertain the quantity of water which a 1-2 inch pipe will deliver. The 80-gallon tank was filled in five minutes and seventeen seconds, the pressure at the time at the City Hall being 24 lbs., which is considerably less than the average pressure in the City at the last time that I made it up. At that rate 458 1-2-inch service pipes would deliver 10,000,000 gallons, and 585 1-2-inch pipes would deliver 12,760,000 gallons maximum consumption.

F. W. W. DOANE,
City Engineer.

STATEMENT PREPARED BY CITY COLLECTOR.

Meter Rates from March, 1907, to Nov., 1907—6 months	$11,690
	2
" " for one year	$23,380
Specials.	
W. C.'s	16,400
Urinals	150
Cows and Horses	800
Taps	1,000
Sundries	315
	$42,045
Estimated.	
Pipe Rate	11,400
Domestic Rate	19,000
	$72,445

EXTRACTS FROM OPINIONS OF EXPERTS.

Common Cause of Low Pressure.

Leaky fixtures in general and wanton waste of water are the most serious drawbacks to the success and efficiency of water works systems, and the action of your honorable board in increasing the number of meters is a move in the right direction.—Annual Report Water Board, Lowell, Mass. ,1901.

IS PUBLIC HEALTH ENDANGERED.

This is a very old and moss-grown argument against the use of meters. It has been used with some effect in many places, but is easily controverted when the facts are available, as they always are after proper investigation.

It was one of the many objections urged against the use of meters, and was considered a very formidable one here in New York years ago. A limited supply of water seems to have a very slight relation to public

health. This is proven by the mortality records of European cities. Most of them get along comfortably and healthfully upon a daily consumption per head of half and even quarter the quantity of water American cities consume. London, notwithstanding its many local and climatic disadvantages, has a mortality record as low, if not lower, than New York Boston, Philadelphia, Buffalo, or Chicago, and in this record the deaths from zymotic diseases are not as numerous, we think, as they are in the three last-named cities, all of which consume and waste between one hundred and three hundred gallons of water per head daily, against the consumption in London of from eighteen to twenty-six gallons. The Italian cities are proverbially healthy, and in many of them not only are the service pipes metered, but each floor of the many apartment houses in them is supplied through a meter. Worcester, Mass., has not an unfavorable reputation from a sanitary point of view. It is a metered city, and the per head daily consumption there ranged from twelve to twenty-five gallons. Fall River, Mass., a city which would probably receive from any sanitary commissioner a clean bill of health, consumes from eight to twenty-six gallons per head per day, and Newton, in the same State, and in the same category, from six to twenty-seven gallons. This refers to a consumption by meter measurement. A dozen metered cities could be named, the statistics of which would prove that their reputation from a sanitary point of view is quite as high, if not higher, than is enjoyed by those who have what is known as an "unlimited supply" of water.—Water and Gas Review, November, 1902.

LEAKAGE.

It has been a pet theory with some one who writes editorials on this subject for the paper named that the percentage of leakage from mains underground is one of the principal causes for the large per capita consumption in this City, and statements to that effect have occasionally appeared in its columns. Whether the intention in the present instance is to adhere to that theory, it is impossible to say, but the indefiniteness of the term would justify such an inference on the part of the reader. The absurdity of the statement (underground leakage) has been so completely exposed, however, that all engineers familiar with the water supply system of the city—especially since the extensive underground work in connection with the rapid transit system has been in progress, during which the mains have been exposed in nearly every section of the city, and very few, if any, leaks of consequence have been found—ridicule such an assertion. No, the leakage which it is necessary to correct in this City, as in all other unmetered cities, is above ground and easily discernible. Nearly every intelligent individual who knows anything of the subject knows where to locate and how to remedy it.—Water and Gas Review, October, 1902.

LEAKAGE IN THE FORCE MAIN.

There being but very little published information on the actual leakage in water pipes, it was decided to test this leakage in the force main.

As the pipe was laid from Brockton towards Silver Lake, it was possible to turn the water in as soon as the work was completed. A by-pass of 1-inch pipe with a 5-8 inch disc meter was placed on the 24-inch main at a 24-inch gate, and the gate was closed here and at the end of the construction. The total distance was 22,476 feet, and the following observations were taken: From August 31 at 2.15 p. m. to September 1 at 7 a. m., about nine hours, the leakage was at the rate of 285 gallons per day; from

September 1 at 7 a. m. to September 13 at 12 p. m., about twelve days, the leakage was at the rate of 277 gallons per day; the latter being at the rate of 65 gallons per day per mile of 24-inch pipe under an average pressure of 68 pounds. There had then been added 3,334 feet of pipe, making the total length 25,810 feet.

The gate was opened and the following results were observed:

Average for first 2 1-4 days, the meter showed 100 gal. per day per mile.
Average for next succeeding 1 1-4 days, 82 gal. per day per mile.
Average for next succeeding 4 days, 58 gal. per day per mile.
Average for next succeeding 13 days, 32 gal. per day per mile.
Average for next succeeding 50 days, 20 gal. per day per mile.

The noticeable decrease may have been due to the stopping up of minute leaks, or possibly to the compression or expulsion of air in the summits.

After this it became inconvenient to make further tests; but desiring to get a test on the whole line, 61,000 feet in length, in combination with a friction test, after the pumps had been running about a year, all gates leading from the main were closed and observations were taken of the lowering of the water in the standpipe. This necessitated closing about 50 services, and about 50 other gates, comprising sizes 6-inch, 8-inch, 12-inch, 16-inch and 24-inch, with one house service open. This indicated a leakage of 285 gallons per day per mile under an average pressure of 71 pounds While this does not show conclusively that the leakage in the force main was not less than 285 gallons per day per mile, it shows that it was not more than that.—The New Water Supply of the City of Brockton, December, 1906.

METERS PREFERABLE TO HOUSE TO HOUSE INSPECTION.

For extravagance or waste in the use of water it is only right that payment should be made according to the amount of water required in excess of the liberal allowance on which the minimum is based; this excess is measured by the meter. If the meter system is not adopted, some system of guessing at the amount of water drawn by each consumer must be introduced and inspectors must be kept at work looking for leaks. The meter system is more expensive to introduce, but it is less open to the objection due to frequent rummaging of inspectors through a house, and it is probably less expensive in maintenance than a really thorough system of inspection. The meter system is accurate and certain, while the system of flat rates with constant inspection is so uncertain as to deserve little support.—Engineering Record, Sept. 19th, 1905.

The fact, remains, however, that if we are going to stop the waste of water we must educate the people up to the use of the meter, no matter what the result is, and I thoroughly believe that meters are the only legitimate means to stop the waste. You may talk about inspectors all you please. Why, there would have to be one stationed at every house.—Geo. Cassell Journal of New England Water Works Association, June, 1907.

WASTE THROUGH SMALL APERTURES.

"It is astonishing how much water will pass through a small hole. Enclosed find a table which corresponds to our pressure in Hartford (60 pounds) 1-16 inch leak will represent 465,595 gallons per year.—Ed. H. Judd. Water Commissioner, Hartford, Conn.

The contant dribble from a single leaky faucet may easily become, in the course of twenty-four hours, more than the legitimate use of an entire

family. By actual measurement, the quantity of water thus escaping ranged from 100 to 300 gallons per day, depending on the head; and as experience has demonstrated, that from 35 to 50 gallons of water per head a day is ample for all ordinary purposes, the registration of avoidable leakage by the meter induces the thrifty householder to make repairs promptly,and incidentally causes the available supply to serve a larger population.—Mr. Emil Kuichling, Consulting Engineer, former Superintendent and Engineer of Water Works, Rochester, N. Y., August, 1904.

"One leaky hopper closet (or one that is allowed to run continuously) in some small property that paid perhaps $6 or $8 per year on the assessed rate, will waste water enough to supply half a dozen fine residences and sprinkle an acre or two of lawns besides. In cheap houses, or where there is cheap plumbing, by letting the water run to prevent freezing in cold weather, enough is wasted to furnish baths galore to the whole population.

"Considered solely as a cold-blooded business proposition, not taking into account the equity, justice and other good reasons for its introduction, the meter system in Atlantic City has proved a success."—Atlantic City, N. J.

Leaky fixtures in general, and wanton waste, are the most serious drawbacks to the efficiency and financial success of our department. A faucet left running for twenty-four hours will waste between 15,000 and 30,000 gallons, a leaky faucet from 300 to 700 gallons, and a leaky ball cock on closet tank will waste 1,000 gallons per day. This is a matter that should have your early consideration.—Henry E. Perry, Supt. Water Works. Dover. N. H., Annual Report, 1905.

FIRE PRESSURE.

The sooner municipalities and individuals recognize the real facts concerning water waste and its prevention, the sooner our water-work officials will be enabled to give better water pressures, to extend the distributing pipes to new sections, to improve the quality of the water and to affect a betterment of the service in every way, and all with a reduction in a great majority of the present rates. Heavy waste often means deficient house and fire pressures, as is obvious to any engineer or water-works superintendent. It often means, also, that such funds as are available for extensions must be spent for larger pumps, reservoirs and mains instead of for mains in previously unsupplied quarters, or for the improvement of the quality of the supply.—Water and Gas Review, December, 1903.

We had been pumping 6,000,000 gallons per day, but when meters were put in the daily pumpage immediately fell to 1,250,000 gallons, and the pressure rose to such an extent that we could throw ten or more streams from the street hydrants over the tallest buildings without using the fire engines at all.—John C. Trautwine, Jr., Philadelphia.

To prevent undue restriction, we charge a minimum rate. With us the use of meters has resulted very satisfactorily. Plumbing is of a better class and our pressure is kept up.—Utica. N. Y.

At the commencement of this year we had about 1400 meters in use I have so far, set about 500 meters this year, with the result, taken with those perviously placed, that the pressure has increased five pounds at the high points, enabling many consumers who had no water on their second floors during the hours of the day to use water on those floors. Our pumpage has been decreased about 25 per cent. from what it was four years ago, and we have a larger number of consumers.—Richmond, Va.

When taken into consideration that by far the largest consumption in

the community is for domestic use, it would seem that every provision should be made to furnish all consumers an abundance of water at good pressure, and unless safeguards in the shape of the meter are placed upon the service so as to restrict the waste on the part of careless and improvident water takers, a large number will be deprived of their legitimate use of water for want of pressure.—Harrisburg, Pa.

The value of the meter was plainly manifested last winter. During the severest cold weather, our gauge showed only a decreased pressure of 2 1-2 pounds from the average. Before the installment of meters, at such cold seasons, the pressure frequently fell to only 2 1-2 pounds in some of the thickly populated sections. I trust appropriations of sufficient amount will annually be made until the whole City is metered.—Charles E. Bolling Superintendent Water Works, Richmond, Va., Annual Report, 1905.

HIGH PRESSURE WATER SYSTEMS.

The increasing of the rates of insurance twenty-five cents per hundred dollars naturally raised a stormy protest from the business men, and the matter was immediately taken in hand by the Trade League, a committee of whom waited on the Underwriters to obtain information. The Underwriters replied inadequate water supply and fire fighting inefficiency. Both bodies recognizing this waited on the Mayor of the City with a proposition that if a more cient fire service could be had the Underwriters would bring their insurance back to the old rating. The Mayor of the City feeling the hardship of such an increased rate made upon the business community, immediately instructed me, as Chief of the Bureau of Water, to devise a method of water supply for conflagration purposes that would be effective in not only reducing insurance rates, but increasing the efficiency of the fire department, so as to enable them to cope with large conflagrations for all time to come, that is to say, be adequate enough to keep pace with increased size and area of new structures.

Again, the increase of fire department efficiency by purchasing more engines for a certain district is a misnomer unless the water supply is correspondingly increased. Many cases occur at fires (requiring three alarms to be pulled) which brings to the fire grounds some twenty-five engines, with the resultant effect that less than one-half of them if in fair working condition, will drain the average distribution main in a district nearly dry, therefore, water and fire department efficiency should, for correct working advance together.—F. L. Hand, Late Chief Bureau of Water, Philadelphia.

Water meters at Richmond, Va., still continue to increase in favor despite the vigorous opposition to their introduction some years ago. Superintendent Bolling, of the Water Department, has reported a steady increase in the water pressure at hydrants, due to decreased waste.—Engineering Record, August 22nd, 1903.

STANDPIPE AND PRESSURES.

We have a static pressure of 50 pounds on over 70 per cent. of the hydrants, only 6 per cent. having less than 30 pounds, with about 4 per cent. over 70 pounds. A much higher pressure would, of course, be desirable.—Brockton, Mass., Dec., 1906.

COST OF METERING.

It is gratifying to me to report that, although the work of the office has been greatly increased by the adoption of the meter system, the

operating expenses are $1,721.43 less than last year. In my report of two years ago I estimated that the net increase of cost of maintenance under the meter system would be about $1,000, but I think now that we can allow 10 per cent. per annum on the cost of meters for their depreciation and repair and still make no increase at all in the operating expenses.—Water and Gas Review, May, 1902.

The cost of setting meters varied in different houses, but as a general thing, a man and helper set from eight to ten meters per day.

A few words in relation to the maintenance and care of meters. Our experience shows that it costs less to read and change meters than it did to inspect the water fixtures and see that the regulations governing the use of hose, etc., were properly observed. It is our custom to so plan our work that the reading can be done by our regular men. It has always been our policy to keep the meters in good repair so that they shall measure the water accurately so long as they are in service. We do not wait for a meter to break down or wear out. Once each year we look over the record of all meters carefully, and if there is any indication, or even a suspicion, that the meter is registering less than it should, it is taken out and tested, and repaired if necessary. When a 5-8 inch meter has registered one hundred thousand cubic feet, it is removed and thoroughly repaired, even though it appears to be in good condition.—F. F. Forbes, Supt. Brookline, Mass., Sept. 14th, 1906.

The use of meters in Wellesley has been entirely satisfactory and their use has saved the town many times their cost in putting off the time when great expense will be required for a new or increased supply. Our meters have been carefully attended to, and the cost last year for maintaining a little over 1,000 meters was $270, or less than 27 cents each.—Robt. J. Thomas, Journal of New England Water Works Association, June, 1907.

INCREASE SUPPLY OR STOP WASTE—WHICH?

Is it better to meter every water service in New York, at an expense of a couple of million dollars, or go on from year to year spending many millions yearly in increasing the supply by acquiring new water sources, erecting pumping engines, laying new mains, paying enormous coal bills, and contributing in so many costly ways to the never-ending scheme to provide an abundant supply of water, in order that the people may continue to waste more than half the quantity furnished them.—Water and Gas Review.

"What is necessary to be done to get a sufficient supply and to inquire into the respective merits of the water meter system in place of increased pumping capacity and additional mains?"

"Our conclusion is in favor of the former, and this to be accomplished by the use of the meter, for the following reasons:

1. Because more economical.

2. Because a supply without limit promotes the wasteful extravagance which has led to the present state of affairs.

3. Because the absence of any check fosters indifference to leakage and careless workmanship, both in the street mains and in the household distribution.

4. Because, when the water reaching the consumer is measured, a comparison between this and the work done by the pumps is inevitable, and will arrest attention by indicating the leakage from the mains and connections under your control. The amount of this, we feel satisfied, will

be sufficiently startling to ensure scrutiny and the discovery of many hidden defects.

5. Because by the water meter system the community is free from the otherwise inevitable and more or less odious house-to-house inspection, and the water department is forced to keep a close eye on the City pipes.

6. Because we regard it as neither equitable nor judicious, because voluntary metering has accomplished something, to depend upon it for results. Suggestions have been made and considered as to this, and as to their enforced application to points of suspected waste only, and to such points temporarily, as a lesson to the improvident consumer; but they have been regarded as impracticable.

7. Because the good effect of meters will be felt pari passu with their application, which cannot be said, at any rate, of the alternative remedy, however effective the final outcome.

8. Because with the present capacity for storage, unheeded waste renders a speedy transit of water from the pumps to the consumer essential and allow no time for the arrest of the heavier impurities, even if not the removal of the stain, of excessively turbid water.

9. Because as a device the water meter has passed the experimental stage, and is established as a reliable and durable automatic register.

It is to be borne in mind that, in the ordinary household supplied with water "toted" from the spring or lifted from a well by the bucketful, the quantity used does not, in all likelihood, exceed five gallons per capita per diem. Further, it has been observed that premises supplied by the City, but without sewers, cess-pools or proper drainage, where wasting water becomes a nuisance to the occupants, are apt to draw upon the faucet which supplies them to the extent of but six or seven gallons per capita per diem.—Richmond, Virginia, Water Commission, August, 1902.

RESULTS OF METERING.

Much could be said in favor of the universal meter system for all water works plants. But having had a practical experience for the past 20 years in the use of meters here, I will confine myself to what they have done for Atlanta.

Prior to 1885 there were no meters in Atlanta. The rate charged for water was regulated by the number of outlets used by consumers.

The consumption of water became so great that it resulted in the necessity of adding to our pumping machinery in order to supply the demand for water and at the same time to give the necessary fire pressure. After a new pump was added and put in operation it was found that the force main leading from the pumping station to the city was too small for the demands made upon it. The loss by friction was enormous, resulting in a great strain upon the pumps and the pipe in the immediate neighborhood of the pumping station, and it was found impossible to give adequate fire pressure.

The only remedy left was to put in an additional and larger main. But the cost of putting in this main was only to be had by an extra rate of taxation being levied upon the people. This was extremely unpopular and the idea was therefore abandoned, and an effort to arrive at some other remedy was considered. In the meanwhile the insurance companies complained of the insufficiency of fire pressure; and then it was determined to try the meter system. It was known that a large per cent. of the water

pumped was allowed to run to waste; and to effectually stop this waste it would be necessary to make the consumer pay for it. So we adopted then the universal meter system.

Much complaint was made at the time, it being argued that it was unjust to require water consumers to pay for meters to measure the water they paid for. But the Board contended it was the only equitable way.

The introduction of meters saved money for the general taxpayers of this City, for without their use the rate of taxation would have been increased in order to raise a sufficient amount of money to pay for an additional main, more pumping machinery and larger reservoir and other necessary additions to the plant, estimated at that time to cost approximately $150,000 or more.

As an illustration of the result of the introduction of the meter system here, the pumpage for the month of November, 1884, when we had no meters, was 132,679,900 gallons, and the coal consumed was 575,000 pounds being an average pumpage of 4,442,663 gallons per day, and the consumption of 19,166 pounds of coal per day.

For the month of November, 1885, with the meters in service, the pumpage was 48,130,000 gallons, showing a decrease in pumpage of 84,549,900 gallons for the month. The coal consumed was 256,000 pounds, showing a reduction in the consumption of coal of 319,000 pounds for the month. The reduction in pumpage was 2,818,330 gallons per day, and in coal of 10,633 pounds per day. If meters had not been introduced our daily pumpage now would be about 25,000,000 gallons per day instead of 8,000,000 as it is, and the outlay necessary to put the plant in condition to meet the demands would have been over a million dollars more than has been spent on it.—Park Woodward, General Manager Atlanta, Ga., Water Works, June, 1904.

"Unless the City succeeds in metering the majority of consumers so as to reduce the present consumption and waste from 169 gallons per day per capita, to 100 gallons, which has been found a liberal allowance in other cities, it will be necessary to build a new pump every three years, and soon to enter upon a further enlargement of our tunnels, which have already cost so much money and so many lives. By the general introduction of meters, at the expense of the water department, now just beginning, and by stopping such waste as may exist in public buildings and street mains, the consumer can easily reduce his water rent while still enjoying an ample supply; and the City will save $3,000,000 in extensions that will otherwise have to be made during the next ten years."—Mayor Johnson, Cleveland, Ohio., May, 1902.

I do not know what the condition of the Wellesley water supply would have been at the present time if meters had not been introduced. Before meters began to be generally used, the pumpage practically doubled every second year. The town would have been compelled to go outside of its own limits to secure a new supply, or would have been driven to the expensive expedient of installing a plant for the filtration of the water of Rosemary Brook or Charles River. With all consumers metered, the town of Wellesley now has a sufficient supply for some years to come.—Robt. J Thomas, Journal of New England Water Works Association, June, 1907.

SUPPRESSION OF WASTE.

In all my previous reports I have alluded to the extremely large consumption of water, and last year I drew attention to the fact that the consumption was steadily increasing. This year the increase in consump-

tion over the previous year is again notable, and the amount of increase necessary to supply the services added during the year is so small in comparison with the total amount of increase recorded, that I can only be forced to the conclusion that the habit of wasting water is growing on our cconsumers. I have gone into the subject of waste so fully in previous reports that I feel it would be useless to again repeat my statements. I feel it my duty, however, to represent this fact in each annual report, as I regard it of the utmost importance. I have already indicated the only effective remedy that I know of, namely, the introduction of meters for all services, and unless this is done I am afraid the waste will soon reach such proportions that the City will be forced to deal with the question. When it is considered that one half the water at present supplied to the City would be a rather large consumption, it can readily be seen what a what a very large amount is allowed to go to waste in the City.—Report City Engineer, Sydney, N. S., 1906.

A reduction of the rate of supply per capita by the suppression of water is clearly justifiable. Experience has proved that the use of water meters and the charge for water according to meter measurement is the most effective means to suppress waste. When the owner or occupant of a house is compelled to pay for the water he wastes he will realize the necessity of using the water supply with the same care as other necessaries of life. The meter rate of 10 cents per one hundred feet is perfectly fair to the consumer. He may use the water liberally for all purposes of comfort, health and even luxury, and still keep within the fixed charges for frontage rates and extra rates, for baths, water-closets, additional families, etc. When he oversteps this by neglectful waste, which is no benefit to anyone, but is harmful to the honest consumer and the general public, because it reduces the pressures in the distributing mains, it is right and just that he should suffer the penalty by the payment of increased meter charges."

It has been the experience of every muncipality that has had to deal with the water question that the average water consumer will allow his faucet to run open, and will otherwise waste water, unless some restraint is placed on him, or he is made to feel that he will be put to a financial loss by reason of such waste . So long as the City bears the expense he will cheerfully waste water, but make him bear the expense of the water personally, and he will at once see to it that the waste is stopped. Now, the best and surest way to check waste of water is by placing meters on all consumers. Every intelligent person will agree that the only way to sell a commodity is by actual measure of the article sold, and water is no exception to this rule.

From statistics at hand, based upon the experiences of other cities, we have no reason to doubt that by the universal adoption of meters the per capita consumption of water could be reduced from 199 gallons, as it is now, to 50 gallons, or possibly 30 gallons per capita per day.

While this reduction is in the right direction, it does not go anywhere near as far as it ought. It is safe to say that over one-third of our daily supply runs to waste, and does no one any good. The reduction of waste to its lowest terms will follow as a matter of course in inverse ratio to the placing of additional meters. Reduction of waste means maintaining the daily consumption within reasonable limits. The latter means postponement of the time when additional supplies will have to be secured at a heavy expenditure. Good water supplies are fast becoming scarce, and cities and towns are realizing that fact as circumstances compel them to husband their resources. Several cases can easily be cited where there

has been quick action in the placing of meters for the purpose of keeping the consumption within proper bounds. Take the case of Cambridge: In recent years they, like ourselves, found themselves with a short supply. Additional sources of supply were secured and heavy expenditures made in new construction. They have far exceeded our outlay in this direction. Yet, after all this has been done, they now find difficulty in attempting to keep pace with the increase of the consumption. So they have now taken hold of the other phase of the question, i. e., the stopping of waste and consequent reduction of consumption. Heretofore, they have not advocated the meter system. Now they are among the most earnest in that direction. They had only a few meters. Within a short time they have installed over 1,000 meters at their own expense, and they pronounce the result thus far satisfactory. This policy they propose to continue until practically all supplies are included.

The City of Hartford has had a similar experience. A few years ago they expressed themselves as opposed to a general meter system. They are supplied by a good gravity system, obtained from a series of storage reservoirs. Of late they have been perplexed in obtaining supply in sufficient quantity to meet the increased consumption. Last year the Commissioners voted "to adopt the meter system as a means to prevent the enormous waste of water." They are now engaged in installing meters upon all supplies. They will have in use some 11,000 to 12,000 when the work is completed.

The City of Cleveland has also taken up this matter vigorously. At the time of this writing they have just placed an order for over 11,000 meters.—Mayor Charnley, La Salle, Ill., June, 1902.

Much attention has been given by the Association to the subject of the prevention of waste, and I judge by the several papers presented at your meetings and by the discussions that followed them, that you are practically of one mind as to the measure to accomplish it. I have tried about everything that usually suggests themselves to the mind of a manager, and I agree most emphatically with your conclusions that the meter is the only efficient and reliable means that will produce the desired results. Whether the meter is to be paid for by the purveyor or the consumer depends largely on local conditions and local opinions, and, if surrounded with proper regulations, is of no importance as far as results are concerned. The main thing is to get the meter on, and the evil is cured. I came to the conclusion very soon after my appointment in Detroit, the latter part of the year 1888. We commenced the introduction of meters the following year and continued systematically until the close of the year 1897.

A brief comparison of the operations of 1888 with those of 1897 will show the aggregate of the results obtained:

Water pumped in 1888, 14,380 million gallons; water pumped in 1897, 12,929 million gallons; population supplied 1888, 189,475; population supplied 1897, 282,417; per capita daily supply 1888, 208 gallons, per capita daily supply 1897, 125 gallons; decreased quantity pumped, 1,451 million gallons; decreased daily per capita, 83 gallons; increased population supplied, 92,942.

This experience is not unusual; in fact, it is universal wherever meters are introduced; and it certainly seems as if it had become such a self evident truth that it needs no discussion.—Manager Detroit Water Works.

The evils due to wasting water, and the proper remedies therefor, constitute the hardest problem coming before municipal and company water works managers.

Where the character and intelligence of the community enables it to co-operate with the management, the results is comparatively easy.

Where it is otherwise positive measures must be used.

In both cases the result is the use of meters to a greater or less extent. Water costs money, as also do meat, flour, potatoes, fuel and the like, and if it is just to the seller and not unjust to the buyer for any one of these commodities to be measured or weighed to determine its equivalent in money, then it is alike fair that every one of them or all may be measured or weighed to determine its equivalent in money, and it is as senseless and foolish that a grocer should accept $25 a month for all the groceries a family may take home to use, waste and distribute among his neighbors as to accept $8.00 for the water one family may use, waste and distribute during one year. There is actually no difference in effect. That water has been sold in this manner is due to the fact that its sale commenced a long time ago when there were no reliable meters for measuring its continuous or intermittent flow, and of recording such accurately.

It does tend to check him if he has been wasting and makes his bills larger if he continues to waste, just as his butcher makes him pay more money if he carries away or wastes more meat but his bills are nearly uniform if he always uses only what his needs require.

Each 1,000 gallons of water costs a certain amount of money, depending entirely upon local conditions. When it is taken from the faucet why should one not pay a reasonable price for it, and why should one expect to take 2,000 gallons and pay for only 1,000 gallons, if he be fair and honest? If one thinks, he must appreciate that his neighbor must help pay the cost of the extra 1,000 gallons, or that he must help pay for his neighbors 1,000 gallons wasted.

The City has the power to regulate the rates charged for water, and does, so the charge to him is fair. The consumer regulates the volume he uses or wastes, or both hence it is fair that he pay for all. The use of a meter is the best method known for determining this volume; then why is it not fair to use a meter?

If it is unfair to insist that a meter be used, or is wrong in any sense, then it is equally unfair and wrong that the dealer use the yard stick, the scales and the measure. This conclusion is legitimate, and there is no fair escape from it.

Of the causes mentioned as tending to diminish the volume of supply, the only one which it is within the power of the city and the company to control is that of excessive waste.

Of the three remedies for, or means of, increasing the volume of available supply, either actually or relatively, the most sensible and rational one is that of decreasing the waste, and it will beyond question involve the least expenditure.

The first effect of this waste of water is to tax the source of supply beyond the necessary extent, and the result is to rapidly hasten the time when the limit of its capacity is reached. The drying up of the river flowing through the city whose dry-weather flow comes almost entirely from the formation yielding the city supply, and which to-day is but a fraction of that of ten years ago, combined with the fact of the natural head, or pressure, at the wells has decreased very greatly in the same period and the need of lowering the suctions, all point unmistakably to the conclusion that the limit of capacity of the formation yielding water may be within sight, and perhaps not far away unless the waste be stopped or other and much more expensive means be employed for collecting water.

There are many cities in the United States having a population in excess of that of San Antonio, where the actual consumption of water for each individual of the population during each twenty-four hours is less than sixty (60) gallons. Among these from reports during the same year:

NEW ORLEANS, LA., supplied 35 gallons to each person.
FALL RIVER, MASS., supplied 35 gallons to each person.
ATLANTA, GA., supplied 42 gallons to each person.
DES MOINES, IOWA, supplied 43 gallons to each person.
DAYTON, Ohio, supplied 50 gallons to each person.
PROVIDENCE, R. I., supplied 57 gallons to each person.
ST. PAUL, MINN., supplied 60 gallons to each person.

Since not one of these cities has a population less than that of San Antonio, and since in each of these cities all needs are abundantly supplied, it is reasonable to infer that a volume equalling a supply of eighty (80) gallons each twenty-four hours for each man, woman and child in San Antonio will serve all reasonable uses and needs, even when allowance is made for the hotter and dryer climate and the great need of sprinkling streets and lawns.—Chester B. Davis, C. E., Sept., 1902.

CONCERNING THE WATER SUPPLY OF NEW YORK.

This is a subject concening which the average citizen cherishes illusions and shuts his eyes to the truth. At the last annual meeting of the British Association of Waterworks Engineers, the President, Mr. Frederick Griffiths, of Leicester, showed that the consumption of that City by good management had been gradually reduced to 20 gallons per head for all purposes, without curtailing in any way the legitimate use of water to any inhabitant. Sheffield, a great manufacturing city, finds 21 gallons per head sufficient for all uses, municipal, industrial, commercial and domestic. Hull has reduced its consumption from 48 to 28 gallons per head, and is still reducing it without inconvenience to the people. Dublin requires 38 gallons, having reduced it some 43 per cent. since 1893. London manages very well with a consumption only about one-third of ours per capita.—Mr. Benjamin S. Church, former Chief Engineer of the Croton Aqueduct.

It is then of the utmost importance to husband the water by preventing waste. Water unnecessarily let run is wilful waste. Where there is no curb or restriction on a service, one fixture out of order, or one wasteful consumer, may let enough water flow to waste to supply ten families. In my experience in water works management I have found no basis on which an estimate can be made as to how much water a consumer uses that would do justice to the department or the consumer. The only course open then is the water meter to which no possible objections can be offered.—Mr. Charles E. Row, Superintendent of Water Works, Dayton, Ohio.

SUPPRESSION OF WASTE.

Speaking of the excessive consumption of water in Waltham, Superintendent Brown says:

"The consumption of water by our people has reached somewhat extravagant proportions, being no less than 95 gallons a day per capita, or if the water used for public and for mechanical purposes be deducted,

it is about 82 gallons a day for every person in the City; this lavish and heedless use of water cannot be defended by any process of reasoning, nor by any code of ethics.

I suppose that a remedy may be found for this waste in the gradual introduction of meters till all the taps are so provided, then the wasteful family will pay for its waste, and the careful user will not be called on to help pay for his neighbor's negligence. The arguments in favor of meters are so well known that they need not be repeated; any commodity offered for sale, and water is no exception should be measured or weighed to the purchaser in known quantities, at a known price.

"Average daily consumption 2,291,528 gallons; gallons per day to each inhabitant, 94.7; gallons per day to each consumer, 96.6; gallons per day to each tap, 685.—Water and Gas Review, May, 1902.

I am strongly in favor of increasing by all practical means the meter control of the city water, and recommend the immediate purchase of a number of meters, having the superintendent of water-works place them to the best advantage on the services of large consumers. The meter system is considered the true principle of successful water selling, as it prevents reckless waste and insures the City being paid for the water consumed.

That much of this large consumption is due to waste is very evident from the fact that great increases in consumption coincide with marked drops in temperature during the winter months. Hartford, Conn., (80,000 population), may be cited as an example of the excessive waste of water in American cities. This city receives its water from a gravity system, and until four years ago the consumption was about 15,000,000 gallons. At that time a drought confronted the people with a water famine and awakened them to a consideration of the waste problem, with the result that the city was metered. At the present time the consumption is about 7,000,000 gallons daily, the quantity formerly consumed being decreased by half.

It seems to the writer that plenty for use, none for waste and quality of the best, should be the standard, as is the best practice at present in most European cities.

The quantity consumed per capita in the City of Albany, for instance, would astonish those familiar with the best German practice, where the consumption seldom exceeds 50 gallons per capita. It is only too apparent to those in charge of water supplies that to supply unlimited quantities of water of the best quality becomes almost impossible at water rates acceptable to the public.—Water and Gas Review, January, 1906.

The Board are as firmly convinced of the propriety of installing water meters as when they last reported. Thousands of gallons of water are wasted daily, for which the City receives no revenue and which is annually increasing the cost of pumping at the sewerage station and filtering at the beds. The largest amount of water necessary should be allowed to insure sanitation, but when authorities agree that this is from 40 to 60 gallons per capita per day, while we were using from 150 to 200 gallons per capita per day, shows that there is something radically wrong in the use of water here. It should be borne in mind that when meters are installed throughout the system the rates would be revised to meet the existing conditions. The taker would then be charged only for what he used, with a reasonable addition for fixed charges, such as interest, maintenance and payments on water debt. The taker who ruthlessly wastes water would pay for his waste, which is, after all, the primary object in installing meters.—Board of Public Works, City of Pittsfield, Mass., Annual Report. 1905.

When you look at it, in the City of Chelsea, 82 gallons per capita in November and 173 gallons in these last two months (or since we have had this cold snap), 91 gallons waste per capita going through the sewers, costing $150 a day, for what? To allow men who own houses—who won't exert themselves to put the plumbing in so as to protect it from frost—to allow them to accomplish their object at the expense of others who do not have to waste the water in this manner. The work of protecting pipes from freezing can be accomplished in one house just as well as in another if it were not for the fact, as my friend before mentioned said, "You cannot educate them up to it."—Geo. Cassell Journal of New England Water Works Assn., June, 1907.

SELLING WATER ON BUSINESS PRINCIPLES.

"Selling a man water at an annual rate, varying with the size of attachment, is about as scientific as selling a man groceries at an annual rate varying with the size of the door through which they are carried out." "And he might have added," says another prominent engineer, "when one-half the groceries are lost on the way."—Chief Engineer John C. Trautwine, Jr., Philadelphia Water Works.

"In the sale of any commodity, and water is a commodity, there must be, in all fairness, some basic principle upon which its cost of production and sale can be established so that each individual interested may receive equitable results. Is it fair trading to sell, at the same price, one family 5,000 gallons of water a year, and the next door neighbor 15,000 gallons? Yet such instances are many throughout the City where schedule rates prevail. There can be no fairness in a family of two (2) paying as much for water necessities as a family of seven (7).

Measure the water for each and each will pay the same rate per gallon or cubic foot, and then let each use whatever quantity he wishes and pays for. This method would be selling water on business principles.

"Why then should we not sell all water by the gallon or cubic foot, in order to know what we are doing, and give those who use the lesser quantity the benefit in reduced water bills, and require those who consume the greater quantity to pay what they legitimately owe. Why let those who willfully waste water do so to the detriment, both in cost and in service of their neighbors who avoid waste and see that their plumbing is in proper repair."—Water Commissioners, Reading, Pa.

I suppose that a remedy may be found for this waste in the gradual introduction of meters till all the taps are so provided, then the wasteful family will pay for its waste, and the careful user will not be called upon to help pay for his neighbor's negligence. The arguments in favor of meters are so well known that they need not be repeated; any commodity offered for sale, and water is no exception, should be measured or weighed to the purchaser in known quantities, at a known price.—Annual Report Supt. John B. Heim, Madison Water Works.

My constant advocacy of the general meter system for selling, with a successful experience under it of nearly fourteen years, naturally tends to lead me away from the schedule rates.—Mr. John B. Heim, Supt. Water Works, Madison, Wis.

In 1900 a commission consisting of such well-known engineers as Messrs. John W. Hill and Samuel Whinery, of Cincinnati, O., and George H. Benzenberg, of Milwaukee, Wis., were engaged to examine into and report upon certain questions affecting the water supply of the former

City. In that portion of their report in which the use of meters was discussed they say:

"With reference to the use of meters, it may be well to state that these are not intended to restrict the proper use of water in any City, but to correct the abuse of the water privilege, and to avoid the enormous waste which we know is now occurring in nearly every city where the water is supplied under survey rates.

The same rule that applies to the use of gas from the street mains should apply to the use of water. The theory that the use of water from the public mains should be as free as air is altogether wrong. If the supply of air to any community required that it be pumped, purified and distributed as is water, then no one can doubt that it also should be subject to such regulation as will prevent abuse of the privilege of drawing upon the public supply.

The pumping, purification and distribution of water represents a large relative cost to any community, and if one person is permitted to use or waste large quantities at no greater cost to himself than to his neighbor, who is careful to draw only so much water from the public mains as may be needed in the proper supply of his residence, store or factory, an injustice is perpetrated which affects the whole water consuming population.

With the use of meters, the present great waste of water through defective plumbing and connections would be avoided. Few consumers, if required to pay for their water by the gallon, would tolerate for a day the large loss which they would have to pay for through neglect of bad connections and fittings in their houses. On the other hand, it is not likely that anyone would forego the proper and necessary use of water when the cost to him is less than one cent. per hundred gallons.—Water and Gas Review, December, 1902.

"The only effect of meters is to reduce waste, not to reduce legitimate consumption, and a sufficient answer would be to reduce your price for water to any desired amount, ten cents (the Philadelphia rate is four cents) or less if necessary, but let the principle be the same, that each one pays for what he uses or wastes. I have not, in eight years' experience, found that the use of meters deterred anyone in the slightest from the free and unrestricted use of water.

"The large majority of our consumers now prefer the meter system as being more equitable and avoiding the espionage and censorship inseparable from the schedule system."—Lexington, Ky.

"We overcame popular objection by teaching people that the only objectors to meters were those who wanted to get water without paying for it. You know, of course, that more than half of your pumping plant would be idle if you supplied water equitably by meters."—Harrisburg, Pa.

"Again, like any other commodity, the only equitable method for furnishing water is by measure. We have had the meter system in use about seven years, and about 45 per cent. of our taps are metered."—Harrisburg, Pa.

To allow unrestricted water means a heavy tax on the taxpayers, and in many places where water cannot be had in great abundance without excessive cost, it would almost bankrupt the City.

As a business proposition it was decided that the only equitable method of charging was by meter measurement.

In regard to meters on tenement houses, as the landlord pays the water bills the tenants do not restrict themselves in the use of water, for the landlord's sake the charge for it does not come out of their pockets; on the other hand the putting in of meters has the effect of

making the landlord use the very best appliances to prevent waste, hence there is better sanitary condition than running water will ever bring about. I believe that the only equitable way to furnish water is by meter measurement, and with a proper allowance for a minimum rate there will be no trouble from a sanitary point.—Mr. R. N. Ellis, Superintendent of Water Works, Jacksonville, Fla.

Nearly all the evils of waste can be cured by placing a meter on every service. It would hardly be expected in any community that illuminating gas would be furnished to takers except through a meter, notwithstanding the fact that gas is cheaper than water. In Providence gas is sold at $1.10 per thousand cubic feet, while for water $1.50 per thousand cubic feet is paid.— Herbert Shedd, Consulting Engineer, Providence, R. I., April, 1904.

Third—The measurement of the amount of water delivered to a taker forms the only basis for the payment of a water rate. This advantage of a system of water supply for the general protection against fire is a proper cause for a public tax, and, generally, this should yield about half the revenue for a system of water works. Other public and general uses may also be provided for by a tax upon the whole community, but the private consumer should pay according to the quantity of water he uses, with a proper provision for a minimum rate.—J. Herbert Shedd, Consulting Engineer, Providence, R. I., April, 1904.

A common mistake is made by people not having a practical knowledge of water-works matters, in assuming that meters are intended to curtail the legitimate use of water, instead of being aimed at the unjustifiable waste of an extremely valuable commodity. And by trying to save this commodity, the number of baths taken, or the amount of cleaning done would not decrease to an extent deleterious to the public health. A further consideration is the fact that a saving in water is equivalent to enlarging the mains, hence a direct saving in the cost of construction.

All services ought to be charged for by meter measurement. Then the consumer pays only for just the amount of service he voluntarily takes. The Department places a service at his own command and control, and a service thus rendered should make it impossible for a cosumer to justly complain, and no extra cost is added to any consumer caused by the careless waste on the part of others. In other words, careful and economical users of water would not be required to pay for the waste of their neighbors.—S. Y. High, Superintendent Water Dept., Kansas City, Mo.. Annual Report fiscal year ending April 16, 1906.

"Present conditions, however, point to the extension of our meter system as the rational solution of an equalization of the water charges, and, at the same time, of a conservation of the water supply. It is generally admitted that the only truly equitable basis of charging for water is that of assessing the consumer according to the quantity that he uses; it is well known, also, that the meters used for measuring water are now so perfected as to be practically accurate in their registration. Under the meter system we should furnish, under our present schedule of fourteen cents per 100 cubic feet, 53,573 gallons of water, an abundant supply for an average family for a year, for the sum of $10. As this quantity represents about one barrel of water per day for each member of a family of five persons, there would seem to be no reason to fear any insanitary or unhygenic conditions as a result of metering. As a business proposition, it would seem better for the Metropolitan water district, in which Somerville is a factor next in importance to the City of Boston, to restrict the wasteful use of water which we have already procured at so great cost, than to be compelled in a comparatively short time to incur a further large indebtedness

for the construction of new works. The general adoption of water meters throughout the district would probably postpone the necessity of further extension of the Metropolitan works for many years."—Commissioner Merrill, Somerville, Mass., May, 1903.

Aside from the statement that the use of meters for stopping the waste does not accomplish the purpose, I believe that it is the only legitimate way in which to sell water to people who want to use it; especially in those cities that are in the Metropolitan district and where the water is purchased by measure. The old method of assessing by the fixtures, or otherwise, is antiquated and gone by. There is no justice in it; it is all guess work.—Geo. Cassell, Journal of New England Water Works Assn., June 1907.

There can be no doubt that the general use of meters is a further check upon the excessive waste of water and tends to keep its use within reasonable limits, and the meter system is the simplest and most equitable method of distributing the water tax.—X. H. Goodnough, Journal of New England Water Works Assn., June, 1907.

There is one phase of the meter question which is often overlooked, viz: the equity of paying for water in proportion to the quantity used There is no commodity, except water, which is sold at one price regardless of the quantity used. The injustice would be apparent if two bushels of potatoes were sold to one man for the same money as one bushel was sold to another man. Yet in the case of water at schedule rates the careful man pays not only his proportion of the expense of furnishing water, but also for the cost of furnishing his neighbor with water to waste; whereas, under meter rates, each pays for the benefit he receives and further pays for his neglect of consideration for his neighbor.—Mr. W. H. Richards, Journal of New England Water Works Assn., June, 1907.

EFFECT OF METERS ON REVENUE.

The year just closed has been a successful one for this department The efficiency of the pumping stations has been maintained, more people than ever before have been supplied with ease and with less demand upon the water supply, while the revenues have been increased.—E. B. Spaulding, Superintendent Water Works, Sioux City, Ia.

"We are getting nearly the same income from seven million gallons consumed as compared with ten million gallons before we installed the meters.—Edward H. Judd, Water Commissioner, Hartford, Conn.

One argument against the use of meters is that it reduces the income This, of course, depends on what is charged.

The revenue here under the meter system has grown from $32,000 in 1886 to $178,000 in 1903, and it will be over $200,000 in 1904.—Park Woodward Supt. Atlanta, Ga.

"This reduction of bills in Atlantic Cty, N. J., has made the meters quite popular, though there is still occasionally heard the wail of some one who did not have repairs made when he should.

"(In Atlantic City the meter rate has been reduced from 18 and 14 cents per 1,000 gallons to 12 cents, three times the Philadelphia rate)."—John C. Trautuine, Jr., Consulting Engineer, Philadelphia, Pa., August 1904.

"Although it was up-hill work for the first two or three years, meters soon became popular. The revenue has steadily increased, the consumption per capita gradually decreased, and the expense of operating kept at

about the same figure for the last five or six years. It has removed the necessity of very materially increasing our pumping plant."—Milwaukee, Wis.

The introduction of meters resulted in causing a great deal of poor plumbing to be overhauled or torn out completely, and replaced by more modern and better fixtures. The results to the town have been most satisfactory. Considerably less water has been pumped and the revenue has not been decreased, although the books show about $2,000 less collected for the year ending February 1, 1906, than for the preceding years, but this difference is fully explained by the fact that meter rates are not due until the water has been used, whereas fixture rates were payable in advance Brookline sends no bills until the water has been used.—F. .F Forbes Superintendent of Water Works, Brookline, Mass., September, 1906.

RESULT OF METERING.

It has been most thoroughly demonstrated that a community receiving its water by meter and paying for it accordingly, can have an abundance for all purposes, and yet get along in comfort with less than one-half or often one-fourth, of that which the same population uses and wastes under unlimited supply conditions.

When one realizes that the City of London uses an average of thirty-five to forty gallons per inhabitant per day for all purposes; that many of the best European cities use much less than compared with American cities--New York over 100 gallons; Philadelphia 150 to 200—there seems to be some discrepancy which cannot all be ascribed to increased cleanliness.

There are two ways of putting a common saying, certainly the second form is the more manly and represents the best citizenship:

First—Get what you pay for!

Second—Pay for what you get!

—Louis Tritus, C. E., New York.

"Ten years ago this City, with a population of 40,000, furnished water by a schedule of flat rates and used daily 8,500,000 gallons. Now every consumer is metered and with a population of 50,000 the daily consumption is 2,500,000, being a direct saving of 6,000,000 gallons daily.

"Could there be a fairer illustration of the justness of a meter system?' —D. B. Bayless, President of the Water Commissioners of the City of Covington, Ky.

"Do away entirely with the excessive waste of water, decrease our pumpage expenses and fuel account and if thought advisable the cost of the meters could be rebated to the consumers so much each year as desired, until the entire amount was refunded.

"The immediate effect of metering the City would be to decrease our present pumpage about 50 per cent., relieve the taxpayers of the necessity of purchasing a new engine and permit of more extensions of the water mains throughout the City, and lengthen the usefulness of our present source of water supply."—Superintendent Willis N. Calkins of the Rockford Water Department.

"The comparison between meters and flat rates here will be appreciated when the previous situation is explained. For ten years we have been on the verge of a water famine every August, and two or three times the verge was really passed. In 1899 we had ten days when the water was down to twenty-five feet in the standpipe. On August 15, 1900 a large fire drained us to the extent of 300,000 gallons, and we were about twenty hours

in recovering from it. From June to September we have heretofore been obliged to operate the compressor engines the entire day run and several hours of the night run: now we are shut down four hours a day and all night. The firemen have a chance to clean fires without being in danger of collapse, and, although we are paying 16 per cent. more for coal this year than last the actual cost is much less.

"Meters met with violent opposition from many of our people, but it is gratifying now to witness the extent of the change in opinion. Any serious attempt to remove them now would result in a local civil war."—Supt. John L. Coffin, Ashbury Park, N. J., May, 1902.

The important fact established by these results (installation of meters) is that the building of a new pumping station or increase of water supply is avoided for some time to come. The water supply now is more than double the demand although but a few years since, it will be remembered, it was difficult for the water department to supply at all times the consumers it then had.

Inasmuch as the meter system has been recommended by former superintendents for the past seven years and is being adopted by the more progressive cities of the country with such splendid results, it is time we took action which will be to the advantage of all concerned and lengthen the life of our present plant."—E. B. Spaulding, Supt. Water Works, Sioux City.

"The 600 meters purchased by your Board last Spring have been installed during the summer on the premises of such water takers as would be likely to produce the best results in the saving of water. The fact that there have been 716 new families added to your consumers the past year, and that the daily average of the amount of water pumped has been one-quarter of a million gallons daily less than the year previous, should satisfy the mind of any fair-minded and reasonable person as to the efficiency of a meter system to curb the waste of water. I respectfully recommend that water meters be procured as fast as funds can be furnished to buy them, until every water taken in the City is supplied through a meter."—Supt. Geo. T. Ingersoll, Schenectady, N. Y.

"The success of the meter system is most gratifying. The consumers have become used to it and appreciate its advantages. A large majority of water takers pay less under the meter system than they did under the assessed rate. Those who use more than they formerly paid for, have to pay more for it, which is only just and right, and not a reasonable basis for complaint. Those who allow leakage or waste have to foot the bills therefor. The result is that more care is taken to keep plumbing in repair and prevent waste."—Supt. Lewis M. Bancroft, Reading, Mass.

A point well worth recording is that many of those who were radically opposed to meters two years ago are now just as emphatically in favor of them. Experience has shown them that we were not practising parsimony, but only stopping the waste, and they now find that they can have an abundance of water for less than they were paying before. All that the meters have imposed upon them is a little additional care of fixtures. When we consider that a plant worth $250,000 has been practically enlarged 40 per cent. at an expense of $9,000 for meters there is scarcely room for complaint.—John B. Heim, Supt. Madison Water Works.

They were all set so as to begin the water year from April 1st, the date when the annual schedule rate expires. The result was as expected. It shows that out of 425 meters set, 189 were using water at less than the faucet rate and 236 were using more than they were paying for by faucet rate. The total charges by rates for the 425 meters were $18,132, and the first

quarter showed the use of water at the rate of $35,345 per year, the second quarter at $24,942 per year, and the third quarter at $15,589 per year.—Annual Report Water Board of Lowell, Mass, 1901.

The good results from water meters maintain all that was claimed for them. The pressure is still improving, the revenue increasing, and the popularity of this method of paying for water by consumers is shown by the number of applications for meters presented to the committee each month. We now have 4,978 meters.—Report Superintendent Chas. E. Bolling, Richmond Water Works.

"The subject is one which has received your attention, and is probably the one that is given as much thought by Superintendents of Water Departments over the entire United States as any one subject, and the same opinion seems to have been reached (judging from their writings in the various water journals) as the one you have arrived at, viz: That water meters must be applied where wilful waste is found. I believe this to be the only remedy and recommend that the placing of meters be continued.

"By referring to Water Maintenance Report it will be seen that the average consumption of water by each person in the village of Herkimer, and allowing that all families use city water (which many do not) is eighty-six gallons per day, or about two and three-quarter barrels. Any person, after a moment's consideration, must admit that this quantity is not used but wasted, entailing upon the village extra expense in maintenance, which includes wear and tear of the pumping plant, extra fuel, etc., besides an additional outlay for increased supply."—American Report, Municipal Commission, Herkimer, N. Y., October, 1902.

One thousand three hundred and nineteen meters were added to the service during the year, the total in use now being 6,950. These meters are all owned by the Department, and are valued at nearly $100,000. Of the total services now in use about 60 per cent. are metered.

In this connection it can be said that many cities are metering their entire output, and they find same very advantageous, as they are thus enabled to control their supply.

The meter system, as far as it is extended in this City, has proven very satisfactory to both the Department and the consumer. They prevent waste of water, and readily detect fixtures that are out of order; also leaks in service pipes.

From the experience of other cities, we find it very fortunate that the City owns, controls and sets its own meters.—Annual Report Water Board, Dayton, Ohio.

"The number of water meters set this year was 664, making the total number now in use 5,609. The good results of the meter system still continue. There are few complaints on account of high bills, and as evidence of the popularity of the meter system there are many applications for meters. The pressures at the fire hydrants were taken for this report and showed a marked increase. The results from water meters have verified all that was claimed for them. **They have not affected the revenue, have increased the pressure by stopping useless waste and have not proved burdensome to the consumer.**"—Superintendent Charles E. Bolling, Richmond, Va., Water Works, 1903.

The benefit to the City in the economical use of the water is apparent, and if every tap was metered the per capita consumption for domestic purposes, instead of being 60 gallons, would be very materially reduced.—Board of Commissioners, Harrisburg, Pa., 1903.

In Yonkers the meter system has been very satisfactory to all concerned. Prior to 1885 the use of meters was optional with the consumer;

from 1885 to 1892 all new services were required to be metered, and June 1, 1892, a resolution was adopted requiring all services to be metered. Experience had shown, as had been anticipated, that service by meter was more satisfactory in every way, and, with few exceptions, notably the carelessness and inattention of the owners of tenements in regard to leaks, consumers were satisfied with the change as time demonstrated to them that it was the only just and equitable method.

Our per capita use for last year, after deducting the amount used for manufacturing purposes, was 64 gallons, which is generally conceded to be more than is required for proper sanitation.

To those not accustomed to the meter its installation appears to be a restriction because the plumbing must have due attention and prompt repairs. Where this is the rule the bills under our rate of fifteen cents per one hundred cubic feet average less than under the old frontage rates.

Years of experience have convinced our Commissioners of the justice, equity and efficiency of a metered system of public water supply.—A. W. Kingsburg, Clerk of the Water Board of Yonkers, N. Y.

In short, the net result from metering a water supply appears to be first, in restricting waste; hence, second, in decreasing the annual cost of operation, and, third, in equitably apportioning the charges for water, as under any other system the water wasted by one taker is largely paid for by his more economical neighbor.—Kenneth Allen, C. E., Water Works, Atlantic City, N. J.

In common with nearly all modern advancements the water meter has its enemies The one first in evidence is the man who does not want to pay for what he gets. Like Pat, in the story, he doesn't want justice because he is afraid of it. Another is he who thinks that to sell water by measure—to peddle out to suffering humanity one of God's best gifts to man, to charge by the pint for that vital commodity which should be as fresh air—is nothing short of sacrilege.—Mr. John L. Coffin, Supt. Water Works, Ashbury Park, N. J.

The most eagerly sought commodities are those that cost the recipient nothing, and waste is practiced upon other people's goods and properties always in preference to his own. This is merely a more or less disgraceful phase of human nature for which we blush; and, still blushing, we join the multitudinous procession. The 'flat rate' or 'so much a year' system of supplying water for domestic use affords an opportunity for the display of the common propensity that is even more enticing than the "skip-your-fare" conductor, but it is also meaner. The conductor is on the spot and should have collected your nickel, but the water department or water company is simply at the mercy of your conscience. There are six little deceitful words oft quoted by those of selfish and shallow mind that are responsible for the throwing away of millions of dollars every year. "Water should be free as air!" I have been told this many times and some of the devotees to this idea have really not liked it when I have intimated that they could at once obtain the fullest realization of their dreams by slipping down the avenue and jumping into the Atlantic Ocean!

"Come easy, go easy!" is a saying as true as it is brief and homely. The tendency of nearly every human habit is towards excess. What satiates us to-day will not satisfy us to-morrow. Whether it be liquor, or dainties, or drugs, or free passes, the average man wants more and more, gets more if he can, and is finally restrained either by his inability to procure, or in less numerous cases, the re-instatement of his will or conscience. Can there be found any water works man, any student of poli-

tical economy, any intelligent person, even, who believes that a limit can be placed on the cost of absolutely unrestricted use of water? To be more explicit, take a city of a given population, give the inhabitants to understand that they are at liberty to use, without additional cost, all the water they wish, for all purposes and at all times; that waste is healthy and will be winked at; could an engineer be found who would dare estimate the supply necessary? The one great water-works fallacy of the past century has been the persistent attempt to overcome the effects of waste by increasing the supply, forgetful of, or blind to, the plain fact that the race is the worst kind of a stern chase. Double the supply and machinery, enlarge the mains, and repeat the operation ad libitum and the situation will remain the same Water famines and crippled fire service will be in constant evidence whether the per capita is one hundred or one thousand gallons.

A water service is essential to urban communities for the preservation of health, for personal comfort and enjoyment, and for the protection of property against fire. To serve all these purposes it must be continuously abundant and under the requisite pressure. Waste is a foe to these vital conditions and the water meter is the corrective agent that renders cities immune.—Mr. John L. Coffin, Superintendent Water Works, Ashbury Park, N. J.

I have found that water-taking communities are roughly divisible into two great classes:

(1). Those who know something of the water meter, and who have only a compassionate smile for communities still adhering to the antiquated schedule system, and

(2). Those who are uncompromisingly opposed to the installation of meters.'

"There never was a better illustration of the duty so constantly pressing upon municipal authorities to save and protect the unthinking public against themselves and against the consequences of their own want of knowledge as in this instance The reform was met by a storm of protests, and so great was the opposition that nearly 400 consumers ordered the water cut off. Soon, however, finding that the pressure and service were so greatly improved and the rates with meters really less than they were without, they all came trooping back, admitting their error and full of thanks and praises.

"It was a fight, and a sharp one at first, when we put in the meters and filters. Such, however, has been the effect of experience and education, with demonstration of success, that now I make bold to say it would not be merely a fight, but a revolution, if we attempted to abolish meters and filters.

"In 1835, with about 2,000 (1-3 its consumers), we pumped about the same amount of water per day as we do now in 1895, with over 6,000 consumers). Our experience is that, with a minimum rate, consumers use nearly the full amount of water allowed them. The sanitary condition of our City has not suffered by reason of scarcity of use of water."—John C. Trautwine, Jr., Consulting Engineer, Philadelphia Pa., former Chief of the Bureau of Water of that City.

"The per capita pumpage has been reduced from a maximum of 200 per day to about 75 gallons per day.

"The results accomplished by the meter system have exceeded all expectations. The waste which has been stopped was greater than anyone surmised. Stopping this waste has been a hardship to very few, while

the benefit reaches every taxpayer in the City. No one is deprived of an abundant supply."—Atlantic City, N. J.

"The consumers soon become convinced that the system is equitable, and it meets with general approval.—Poughkeepsie, N. Y.

"The practical experience of this city in using meters on an extensive scale indicates that the advantages claimed by the advocates of the use of water meters are not in the least exaggerated."—Providence, R. I.

8th Meters lead consumers to stop the great source of waste which does not come from the water they drink or use for cleaning, but what they waste through leaking pipes and trickling streams in closets. Any such leaks are no benefit, but rather tend if there are leaks in pipes to cause mold and unhealthful dampness in a house or basement. The renovation of plumbing which generally comes in such houses after meters are set would be pronounced by any sanitary expert to be an improvement on the former conditions of the house.

9th. Nearly every report of any expert commission upon the improvement of the water supply of any City in America has been accompanied by a recommendation for meters, and never by a recommendation against them. Of course, no expert commission or engineer would recommend meters if they were going to destroy the value of the improved water supply, which they recommended in the same report.—Mr. Edward W. Bemis, Superintendent of Water Works, Cleveland, Ohio.

We adopted the general meter system in 1888, now nearly sixteen years. We have over 3,400 water takers, 96 per cent of which are metered. Being a university town, we have a great many tenement houses, and we have yet to hear of a healthier city in the country. The main issue of a water supply is a good and wholesome water, a general meter system, because it is not fair to restrict the commercial or ornamental water and allow the wanton waste of water in dwellings. Running water is one of the greatest of all sanitary agents, but it is not necessary to be under constant flow, wherewith it requires a constant adding of pumping machinery, and even with that, reduces the required fire pressure. A city has no right to allow classification of its citizens endangering the property of one against the other by want of sufficient pressure caused by the misuse of allowing the water to run a constant flow.—Mr. John Heim, Superintendent of Water Works, Madison, Wis.

The result of metering shows that during the last six months the amount of water used is less than half as much as in the previous six months, which is due to the installation of meters throughout the town.—George H. Hart, Superintendent of the Water Department of Maynard, Mass.

It seems to be popularly assumed that waste cannot be prevented, because it is not in human nature to submit to the sort of control necessary to limit the supply to useful purposes. But human nature does submit when properly treated, for we have several examples in New England of a contented community, feeling that it has an abundant and free supply of all the water it cares to take and yet its per capita supply is far below that furnished to other communities similarly situated and of smaller character. Whether human nature will submit may depend upon how it is approached.

The City is pre-eminently a manufacturing place, and has many large users of water. An examination of the experience of the Water Department of Providence would therefore seem to be useful. I will take this City as an example illustrating a method of satisfying the water takers, and as showing the amount of water required for a public supply.