WATER DEPARTMENTS'

Net Cash Price List of Gem Meters.

Connections for Setting furnished without additional charge.

Size.	Weight of Meter.	Quantity of Water discharged under 60 pounds pressure.	Price.
½-inch,	5 pounds,	2 cubic feet, or 15 gallons per minute,	$17.50
¾ "	6 "	6 " " 45 " " "	22.50
1 "	7 "	8 " " 60 " " "	30.00
1½ "	11 "	18 " " 135 " " "	55.00
2 "	15 "	32 " " 240 " " "	85.00
3 "	40 "	96 " " 720 " " "	150.00
4 "	80 "	128 " " 960 " " "	275.00
6 "	125 "	288 " " 2160 " " "	600.00

☞ Boxing Extra.

8-inch, 10-inch, 12-inch, 14-inch, 16-inch, 20-inch, and larger sizes made to order.

☞ *The Piston Meter referred to on page* 30 *weighs at least* THIRTY *times more than the* GEM METER *; the* 1-*inch weighing* 210 *pounds, the* 4-*inch* 2,500 *pounds, and other sizes in like proportion.*

JUSTICE AND ECONOMY

IN

PUBLIC WATER SUPPLIES,

BY USING THE

With Compliments of

JOHN C. KELLEY.

95 JOHN STREET, NEW YORK.

NEW YORK:
TOWER, GILDERSLEEVE & CO., PRINTERS,
76 & 78 CHAMBERS STREET,
1874.

JUSTICE AND ECONOMY

IN

PUBLIC WATER SUPPLIES,

BY USING THE

GEM METER,

MANUFACTURED AND SOLD BY THE

NATIONAL METER CO.,

95 JOHN STREET, NEW YORK.

NEW YORK:
TOWER, GILDERSLEEVE & CO., PRINTERS,
76 & 78 CHAMBERS STREET,
1874.

NATIONAL METER COMPANY.

ORGANIZED JANUARY 5th, 1870.

CAPITAL, $200,000.

President,

JOHN C. KELLEY.

Vice-President,

JOHN GRAHAM.

Treasurer,

JOHN I. HOLLY.

Secretary,

EUGENE PITOU.

Trustees,

JOHN C. KELLEY, DAVID H. GILDERSLEEVE,
JOHN I. HOLLY, EUGENE PITOU,
JOHN GRAHAM.

WATER SHOULD BE FREE.

Water, one of the essentials of life, should be free to all—yes, as free as when quietly resting in a lake, running in a river, or babbling in a mountain brook. That it *is* free in either place will not be denied, and yet, when we come to utilize it for domestic purposes, it will cost either money, time, or labor, and will have a fixed value per gallon. It cannot be obtained from *any* source without an investment that has a moneyed value, be it either time or labor. If we go to the lake, river or brook, where it flows as free as the air we breathe, we cannot procure it and carry it home without labor, and we find that it *does cost* something. Under *no circumstances* can we obtain it without it having a fixed value represented by money.

When, then, we speak of *free water*, it must be understood to mean water delivered in dwellings, workshops and elsewhere at the *absolute cost* of introduction. Every good citizen will feel it *a duty* to pay his proportion of the cost for the convenience and the labor of taking care of the works, interest of money invested, &c. Theoretically, every consumer of water does assent to this; but practically he ignores it entirely. Water Boards throughout the world are made to feel, day by day, and year by year, that many consumers who are supplied with water at an assessed valuation, have no conscience in this matter. It is not unfrequent for consumers to use *many times the amount of water allotted to them*, seeming to be utterly oblivious of the fact, that they are doing a great moral wrong to their fellow-citizens, who are made to pay for *their* individual waste.

Municipal authorities themselves have often been to blame for much of the waste of water complained of. Having first determined that they would furnish water to the citizens, they have been accustomed to boast of their unlimited supply; of their ability to furnish all that will be possibly called for during the com-

ing quarter of a century, &c. These promises of more than an abundance, begat an extravagance in the use of water, and like every other extravagance, it has become difficult to reform. It seems but right that the use and distribution of water, with all its blessings, should be subjected to the ordinary principles of equity and economy. No person will then be charged for more than he consumes, nor will any be allowed to use water at the expense of their neighbors.

In New York City, where we will for convenience estimate the whole number of inhabitants at one million, the latest report of the Croton Department shows the daily consumption of 104,000,000 gallons, or 104 gallons per day for each man, woman and child on Manhattan Island! Can there be any pretence that there is a *legitimate use* for that amount of water? It cannot be otherwise than that myriads of small streams throughout the whole city are permitted (unobserved and out of sight) to flow into the sewer, the water serving no useful purpose. At least 50,000,000 of the 104,000,000 gallons are *wasted* in this manner daily. The history of the Croton Board, as well as that of Water Boards of all cities having a public supply of water, shows that this *lavish waste* is on the increase—that all known methods of preventing it have most signally failed, unless delivered by actual measurement, and charged at a fixed rate per gallon, for the number of gallons used.

There are on New York Island at least 65,000 dwellings. Now, let us suppose that a pump in the street be allotted to each block of houses, for *all* purposes, does any one believe that there would be a *per capita* consumption of 25 gallons of water per day? Let us go a little farther, and suppose a pump placed in every kitchen, for the sole use of the family, where water might be obtained for the mere expenditure of labor in pumping. Would not servants "strike" against pumping fifty gallons for each inmate of the house? Again, let us suppose that with water as now supplied there were *no sewers*, and that all waste water had to be carried into the street, can there be one who is so credulous as to believe that an average of 104,000,000 of gallons daily would be consumed by the million of people in New York?

WASTE OF WATER.

Supplies of everything but water are regulated by law and by custom. Everything, except water, has its fixed value as to kind, quality and quantity. Every commodity, except water, is sold by fixed quantities, at fixed prices—always at prices agreed upon by mutual consent—the buyer knowing how much he receives, and the seller the amount of money paid him therefor. "So much for so much" is the rule; everyone demanding *all that he pays for*, while the seller is equally particular that his customer shall *pay for all he gets*. That is the only equitable and satisfactory method of conducting exchanges. Why, then, should the sale of water be an exception? When it is brought into the dwellings of consumers by artificial and expensive means, it has a *fixed value*—a value equal to its cost—and for that reason alone it should be sold at a rate per gallon that will pay the expense of introduction, repairs, interest of money invested, &c.

Wherever water is supplied to cities by artificial means, the authorities in immediate charge of the works supplying it are made sensible of the fact that most consumers waste as *much*, if not *more*, water than they apply to any useful purpose. In confirmation of this statement, some extracts from the Annual Reports of Water Boards are here given. They could be extended indefinitely, but those given here will astonish the reader who is not already informed of the facts:

NEW YORK CITY.—"The most unremitting and zealous exertions of the department to abate the *intolerable waste* of water have produced an effect scarcely perceptible to the public eye, and it frequently happens that the reservoir is drawn down to half its capacity, making an aggregate of 40,000,000 gallons for a day's consumption, or ninety gallons to each individual. This Board now warns every citizen that the last drop of water which the works, in the present state, can supply, is daily delivered in the

city—a supply more than equal to the legitimate wants of a million and a half. With some little regard to reasonable economy, the daily quantity is amply sufficient for all domestic purposes, for a quarter of a century to come."—*Report of* 1850.

"Millions of gallons are worse than wasted in flooding instead of sprinkling the streets; to those add the hundreds of streams kept running in stores and warehouses, and the catalogue would begin to show its enormity. If it were possible to circumscribe the use of water to indispensable purposes, only furnishing for them the most liberal supply, no addition would be required for the next twenty years, except to guard against accident to the aqueduct itself."—*Report of* 1851.

"So certain are the elements of calculation, that if no systematic effort be made to circumscribe the use of water, *eight years will bring us to the daily consumption of all the capacity the aqueduct can bring, and more than twice as much as the minimum flow of the river can furnish.*"—*Report of* 1853.

"Notwithstanding every effort has been made to check the waste of water, the Board *have every reason to believe that the very great proportion of the water placed at the disposal of the consumer is used for no valuable or practical purpose.*"—*Report of* 1854.

"The waste of water in streets and buildings open to observation, has been repressed and greatly diminished, but the much greater waste which results from the careless, profuse and excessive use of water in families, amounting to an enormous quantity actually *wasted*, cannot be reached without invading a privacy which is too delicate an exercise of authority confided to the Board to attempt."—*Report of* 1855.

"We have no water to spare. For the last twelve days there has not been a drop of water passed the Croton dam. In nine days the water in Croton Lake has fallen eleven inches. From this it is demonstrated that we are now bringing to the city, daily, upwards of 9,000,000 gallons more than the Croton River supplies. The water does not rise in different localities sufficiently high to supply consumers, and the energies of this department are taxed to the utmost to keep a sufficient head in the reservoir to preserve the city from fire, and insure the legitimate demand of the inhabitants. It is indisputable that we have not a gallon of water for any other than present use."—*Report of* 1856.

"Very little can be added to the reports of former years on the subject of waste. No efforts on the part of the Board seem to be of any avail in checking a degree of waste within the doors of private houses and stores, which is as unwarrantable and dishonest in itself as it is unjust to the officers whose duties and cares it renders doubly harassing."—*Report of* 1858.

"The unnecessary and ever-wonted waste of water during the whole year cannot have escaped observation. The necessity for more stringent rules for regulating the use of water will be apparent, when it is stated that very nearly the whole volume of the Croton River has been delivered in the city during many weeks the past summer—a supply three times greater than any legitimate use of it would demand."—*Report of* 1859.

"The average daily consumption of Croton water last year was 88,000,000 gallons. It is remarkable that while the population of New York has little more than doubled since 1848, the quantity of water used is nearly *five* times as large. This would indicate a general and growing waste of water consumers. This waste water almost invariably passes into the sewers through the connections in the buildings where the waste occurs."—*Report of* 1872.

BROOKLYN, L. I. — The Water Purveyor of Brooklyn reports that "It is needless to multiply quotations to prove the palpable fact of *excessive and constantly increasing waste.* It is not too much to state that the size and cost of pipes for city water works, as well as of the reservoir, could be reduced one-third, if the quantity to be furnished could be calculated without reference to the unknown quantity of waste."—*Report of* 1859.

"In our last report we showed that the daily average consumption of water per family, for the six months immediately preceding, was 243 and one-tenth gallons, which, at the time, was considered very extravagant; yet, when we come to compute the daily average use of water for the preceding six months, ending December 31, for the same purpose, we find that the run has reached 316 and six-tenths gallons per family. We are forced to the reluctant, if not alarming conclusion, that an end to the profligate and wanton waste of water is not yet, and that unless some means are adopted to restrain consumers in such recklessness, the daily consumption of water will continue to increase."—*Report of* 1860.

JERSEY CITY, N. J.—"The average for the whole year amounts to nearly 60 gallons for each individual. This is a quantity entirely beyond the wants of the population, and indicates an enormous waste, which can only be checked by strict watchfulness and the enforcement of the most stringent rules."—*Report of* 1858.

"As we are now pumping as much water as was considered necessary for a quarter of a million of consumers, it is evident that its use is characterized by a reckless and increasing wastage. As a proof of this we would state that the amount of water drawn from the reservoir during the night often far exceeds the average used in the daytime."—*Report of* 1872.

BOSTON, MASS.—"The unnecessary waste of water is an annual topic of remark, and confirms the uniform rule that the waste of water is, and has ever been, on the increase. The constant daily draft made upon the supply has been too exhausting to allow the playing of the public fountains except on a few public days. The alternative is imposed of giving up these enjoyments or imposing a scarcity upon some parts of the city."—*Report of* 1857.

"There ought to be water enough for this city, without any additional expense, and the Board are confident there would be, were it not for its wasteful use."—*Report of* 1861.

"The average daily amount pumped for the year has been 733,499* gallons; the daily average for 1871 was 557,634 gallons; the increase is about 31 per cent. Owing to this increase, and to the necessity of furnishing an abundant supply of water for fires within the high-service area, the existing pumping machinery is unable to perform the duty required of it."—*Report of* 1873.

CHARLESTOWN, MASS.—"The largely increased consumption of water during the past year, reminds us of the necessity of strict care to prevent unnecessary waste; especially is it important where, as in our case, the expense of pumping makes an actual additional cost to the city for the amount of water wasted."—*Report of* 1870.

WORCESTER, MASS.—"In regard to the rules for the assessments, when we come to the waste of water from even the best regulated aqueducts, the regulations, exact as they may be in the points of their directions and penalties, still they are next to powerless to correct the evils which they are framed to abate. To effectually prevent all waste requires the interested and vigilant aid of every taker."—*Report of* 1871.

HARTFORD, CONN.—"The quantity of water consumed during the year has equaled the large total of 190,403,000 gallons. This amount is vastly more than it ought to be, and disclosed the fact of an enormous waste."—*Report of* 1858.

"It is estimated that during some portions of the year there has been used and wasted from seven to eight millions gallons daily, which is three times as much as the legitimate use should be. There is no doubt but that there is an abundant supply of good and wholesome water at West Hartford; but our citizens are reckless in the use of it."—*Report of* 1873.

ALBANY, N. Y.—"It is now known that more water is needlessly wasted than is legitimately used; especially is this the case where cities are supplied by gravitation; and it is equally well known that appeals made to consumers, even when a failure is imminent, have little or no effect in securing economy."—*Report of* 1871.

BALTIMORE, MD.—"There are some locations in the city where the mains fail to yield a supply equal to the heavy demand upon them. We regret to say this is attributable in some instances to the wasteful use of the water."—*Report of* 1869.

"The water pressure in the city mains has been failing very much in some localities. This diminution is attributable to the increased demand, without the corresponding increase of population."—*Report of* 1870.

"The necessity of checking waste will be apparent to all, when it is understood that the true cause of our insufficient supply is to be found in the *overdraw on the mains*, and not in any scarcity of water at the lakes or reservoirs."—*Report of* 1871.

* These figures indicate the water used from one reservoir, of which Boston has five. The daily average for the city was 15,063,400 gallons.

CLEVELAND, OHIO.—"Undoubtedly there is every year an equal quantity of water wasted as is used for all needful purposes. It is earnestly recommended to all water-takers to use freely all the water they require, but to allow no waste, as every gallon is elevated at the expense of the works, and water needlessly wasted is a direct loss to the citizens in general."—*Report of* 1861.

CINCINNATI, OHIO.—"During the past year we have been compelled to furnish 16,964,624 gallons more water than the average of the two preceding years. This condition of affairs is chiefly attributable to leakage and waste."—*Report of* 1860.

"The very material increase in the consumption for the last few years is partly owing to the enlargement of the mains, allowing the water to flow more freely to all consumers, and an abundance is now provided. This is equally true wherever waste exists. As the city is gradually being sewered, and all the waste, whether from accident or carelessness, which formerly could be seen running from the alleys, or flowing on the surface of the gutters or streets, now finds its way through drains into the sewer, and passes off unnoticed and unknown."—*Report of* 1871.

LOUISVILLE, KY.—"There is a great waste, useless waste of water by many of the consumers, and the adoption of an ordinance by the City Council prohibiting the same, with proper penalties, would, in the estimation of the Directors, go far to the protection of the interest of the city."—*Report of* 1869.

DETROIT, MICH.—"The increase of water distributed the past year is greater than for several years past; this excessive increase it is difficult to account for; the only probable cause must be a large increase of the quantity running to waste, for no corresponding use of water has occurred."—*Report of* 1863.

"The waste of water in our city, especially during the winter, has become an evil of great magnitude, and if persisted in will compel the Board to adopt some stringent measure to check it. This arises from parties allowing their penstocks to run all night to prevent their freezing."—*Report of* 1871.

"The waste of water continues, and the requests of the Board are apparently unheeded. A change of the weather from moderate to extreme cold requires the pumping of an additional two million gallons of water in twenty-four hours."—*Report of* 1872.

"The present month, January, shows the effect of a cold snap upon the supply, as the maximum is a million gallons in excess of any day last summer. This is due to the fact that at such times many people leave the water running all night to prevent its freezing, and to the bursting of the pipes."—*Report of* 1873.

CHICAGO, ILL.—"The extraordinary rate of increase in the supply of water has been beyond all expectation, and gives rise to most serious inquiries as to how this growing demand is to be met."—*Report of* 1870.

"While the population of the city has been increasing at the rate of about ten per cent. per annum, the consumption of water has increased at the rate of seventeen per cent. per annum, and the average daily consumption by each inhabitant has increased from 32.8 gallons in 1858 to 72.8 in 1870."—*Report of* 1871.

During the year 1872, the reckless and wanton waste of water in New York was so great that the underwriters became alarmed, and united in the following address to the public, in the columns of the *Tribune*, of March 2d, of that year. It was signed by seventy-five gentlemen actively engaged in fire insurance:

"As there is a great scarcity of Croton water in all parts of the city, except those which are not much elevated above the rivers, the supply even in the second stories being in many cases only obtained by pumping, and as this scarcity is said to arise from unnecessary waste, a large proportion of the consumers leaving the water running day and night, it seems to be absolutely necessary that some plan should be devised to prevent this waste. If not remedied, it will before long lead to a repetition of such fires as occurred in 1835 and 1845, but on a much larger scale, as the buildings of the present time are larger and more costly, and the stocks of merchandise of immense value."

A Brooklyn gentleman, who had been a water commissioner of that city, is responsible for saying:

"The source of the supply has been severely tested in dry seasons, and it has never failed. Brooklyn has to-day, up to the extent of its water-works, the most reliable supply of any city in the Union. It is self-evident that there is cruel waste and extravagance in running our water-works. Otherwise, with every annual increase in the income of the department there would be a decrease in its cost to the city. We are satisfied that there are capitalists in Brooklyn to-day who will take our water-works at their cost, insure the same rates we are now paying, and guarantee us an income from this source of $100,000 for the privilege of retaining the revenue."

There is no limit to which we might not extend these extracts from the Annual Reports of Water Boards of the United States alone; but those of Montreal, Canada; St. John, N. B.; London, England; Chester, England; Sutherland, England; Sheffield, England; Nottingham, England; Preston, England; and Glasgow, Scotland, make precisely similar complaints of most lavish and inexcusable waste. In Glasgow it is now feared that Loch Katrine will not continue to supply all the water that will be required for the city. In some of the cities named in England the waste has been so intolerable that the Water Boards only furnish water at specified hours during the day.

HOW WATER IS WASTED.

That water is wasted every where, when the public can have free access to it, is clearly proved by the extracts given in the preceding pages, from the Annual Reports of the Water Departments of the various cities of the United States. It seems incredible that whole communities should recklessly and dishonestly persist in such criminal waste of water, as is found to prevail every where. The evil has grown to such magnitude, that it becomes a serious question whether the guardians of one of nature's greatest blessings—pure and wholesome water—should longer continue to permit so demoralizing and dishonest a custom, as it really has grown to be.

Frequently the very method of carrying the water into the house occasions waste. The plumber, as a matter of convenience and economy, is permitted to place the hot and cold pipes side by side, so that in warm weather the consumer deems it necessary to empty the pipe, wasting gallons for a single cup of cool water.

A more flagrant practice in wasting water is found in the custom of permitting the faucets to run during cold weather, to prevent freezing. The practice is as unjust as it is unnecessary. When it is remembered that most houses are rated for a consumption of 25,000 gallons of water per annum, and that an ordinary faucet will discharge 10,000 gallons daily, it will be readily seen that if it be left running five nights, more water will in that time pass through it than is charged for a year's use; yet there are people who esteem themselves honest, who permit this practice by their families. The experience of the City of Hartford, Conn., during the year 1861, where the average consumption of water during the month of April was 882,807 gallons, and the maximum was 1,292,056 during the month of February—the difference being 409,249 gallons daily,

or nearly 50 per cent. How, otherwise than by permitting the water to flow during the night, to prevent freezing, can we account for the difference? It is the experience of all Public Water Departments, that at night, during extreme cold weather, there is a greater draught upon the reservoir than during the summer. The difference between these two periods, for all legitimate uses of water, should be the other way.

Another method of waste is through water closets and urinals. At the rates charged for water, there can be no good reason why there should not be enough used for all cleanly and wholesome purposes—but there is no justification in permitting the water to flow through them constantly. At a private house in Jersey City, 9,000 gallons, by actual measurement, was found to pass through a water closet during 24 hours. The yearly allowance for the house was 25,000 gallons, and yet it was demonstrated that its inmates were consuming and wasting its yearly allowance every *sixty-seven* hours—less than three days. This was at the rate of 3,285,000 gallons per annum—almost two days consumption of the whole city, and if paid for at the rate allotted for the house, the charge would have been $1,082. In Boston, at a railroad station, where there were five water closets, 24,690 gallons per day were used, which, at two cents per hundred gallons per day, for 365 days, would amount to $1,802.37, while the amount actually charged was $25. In a Boston manufacturing establishment, nine water closets and six sinks used 19,959 gallons of water per day, which, at a tariff of two cents per 100 gallons per day, for one year, would be $1,197.36, and the sum paid was $80.

Much water is wasted by engineers of steamboats in washing their boilers of sediment. They also have a practice of gradually cooling their boilers, after blowing off steam, by letting *out* the hot water, and at the same time letting cold water flow *in*. It may be a practice beneficial to the boiler; but it is questionable whether such a custom would be indulged in, if the water were paid for by the gallon.

In sprinkling streets and yards, and in washing windows and houses, it is right and proper that an abundance of water should be used; but there is no good reason for the lavish waste that

there is known to be in every city that has a public supply of water.

When buildings are being erected, it is customary for the workmen to use the nearest tap for water to mix their mortar, &c., and if the amount used were charged by the gallon, there is little doubt that employees would be required to turn off the water, instead of neglecting it and permitting it to run into the sewer, when called away for other duties.

Stables use, or rather waste, a needless amount of water. That there should be a liberal allowance for stable use, no one will deny; but can the employment of a hose pipe be sanctioned for washing carriages? Its convenience for the purpose has been so shamefully abused, that in many cities its use has been entirely prohibited at stables.

Manufacturers who employ a large number of hands, and have occasion to use a great deal of water, are seldom conscious of *how much* is wasted. This is especially the case in extensive breweries, distilleries, sugar refineries, and other establishments where much water is required for cooling, condensing, &c.

Who has not seen an immense waste of water for mere amusement, wherever a hose has been permitted to be used on a sidewalk? On a warm summer afternoon, after the street in front of the house has been sprinkled, the water has often been allowed to flow for hours, for the gratification of children.

Another lavish waste of water is sometimes permitted in the employment of it as a motor. In elevated positions it is frequently used in a water engine or ram, to pump a supply into a tank at the top of the house. This seems a very great and flagrant abuse of water, and one that should never be permitted, unless it be paid for at the absolute cost of introducing it into the premises. In New York City there lives a millionaire, in whose private dwelling there is one of these water engines, used for the purpose named, and it was found that, during a period of ten months, there was supplied to the premises 352,500 gallons, showing, at the same rate, a yearly consumption of 417,750 gallons.

In Brooklyn there was a boarding-house that was charged $18 per annum for water rent. The mistress of the house believed that the charge was excessive, and complained of the

injustice. She was quite confident that she did not use $18 worth of water; but the Water Board would give her no relief. She, however, convinced her boarders of the injustice of the charge, and one of the gentlemen volunteered to see that she was righted. On calling at the office of the Water Board and stating the case, an offer was made to supply the house by measurement. The offer was accepted, and it was found that that house was using $18 worth of water per month! She and her boarders had been using $216 worth of water per year, and she had objected to paying $18 therefor. This is but one of the many cases of ignorant waste of water that might be cited. Most all Water Boards have had almost similar experiences.

What a commentary upon the injustice of rating houses for water by their size, or the number of their rooms, instead of equitably charging for the number of gallons passed through the service-pipe, and no more!

TABLE

Showing the number of United States gallons of water consumed by each inhabitant in the various cities named.

	London.	Paris.	Glasgow.	Montreal.	New York.	Philadelphia.	Brooklyn.	Boston.	Charlestown.	Albany.	Detroit.	Jersey City.	Washington.	Buffalo.	Cleveland.	Cincinnati.	Louisville.	Chicago.
1829.	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1840.	...	...	...	...	...	28	...	...	...	...	...	...	...	...	...	...	...	...
1849.	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1852.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	...	...
1856.	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1858.	...	...	...	...	...	...	...	...	...	...	...	75	...	...	...	...	...	33
1860.	...	...	...	...	...	...	...	...	...	...	...	77	...	...	...	...	...	43
1861.	...	...	...	...	...	...	...	...	...	...	53	...	...	...	16	...	9	...
1862.	...	...	...	...	...	...	17	...	...	...	58	...	...	...	19	39	14	44
1863.	...	...	...	...	...	...	22	...	...	...	58	...	...	...	21	...	12	...
1864.	...	...	...	...	...	...	26	...	...	...	57	...	...	...	22	...	14	41
1865.	...	...	...	...	...	...	29	...	...	...	55	77	...	...	22	...	17	...
1866.	...	...	...	...	...	...	33	55	...	...	60	...	...	...	22	...	17	43
1867.	38	...	...	...	62	46	36	59	42	...	64	...	...	...	24	...	15	...
1868.	...	29	...	...	...	51	43	62	...	...	67	...	...	...	25	...	16	58
1869.	...	30	...	...	...	51	46	62	...	...	61	...	...	...	27	...	18	...
1870.	...	...	60	...	...	55	47	60	...	...	64	84	...	...	31	...	21	73
1871.	...	...	61	55	85	55	48	54	...	...	73	...	...	51	36	...	19	...
1872.	...	...	...	...	88	54	...	...	...	80	83	99	134	61	40	60	...	75
1873.	...	...	...	...	104	...	...	...	...	...	...	...	...	...	...	...	...	...

THE REMEDY FOR WASTE.

The reader who has perused the preceding pages cannot have failed to have seen that the *waste* of water has been greatest where the supply has been most abundant. It seems to have been the uniform experience of Water Boards, in all cities throughout the world, that *people will waste* in direct ratio of the abundance supplied them; but it is incredible to the uninformed that *more than half* of all the water supplied to private dwellings *is wasted.* Let us cite the case of sober, staid and economical Boston, where water was first introduced in 1848. It was then estimated that 30 gallons per day for each person would be a liberal supply. At the end of ten years, allowing for an increased population of 175,000, it was thought that 5,250,000 gallons would be required daily for the whole city, and at the end of ten years 7,500,000 gallons. What was the result? In *two* years the anticipated demand of *ten* years was exceeded, and at the expiration of ten years, 5,000,000 more gallons per day were used than was supposed would be required for *twenty* years!

Here, then, in the most economical city of the United States, the waste became so intolerable, that the Water Board was forced to the conclusion that

"The *only* remedy must be found in the general adoption, throughout the city, of water meters, and an entire change in the assessment and collection of water rates."—*Boston Report of* 1861.

"The number of meters now applied is ten hundred and twenty-one, being an increase over the previous year of one hundred and twenty-six; and it gives us pleasure to state that we have had fewer complaints from the meter system this year than in any year since their application."—*Report of* 1869.

"*Meters* still continue in use in quite a number of establishments, embracing hotels, railroads, stables, manufactories, saloons, and buildings occupied by several tenants."—*Report of* 1873.

BROOKLYN, L. I.—"There is no way to effectually check the unnecessary waste, except by a general use of the water meter, which will at once render the distribution of water just and equitable. No system can be considered permanent and reliable that is not based upon measuring the water to each consumer."—*Report of* 1861.

"It is undoubtedly true that if but a small percentage of water were wasted, as would be the case were the householders charged by the meter for all which entered their premises, our present supply of water would, without further increase, last for some time yet, and the fact has been strongly urged in some quarters as pointing to the true measure of relief, by the general introduction of the meter."—*Report of* 1870.

CLEVELAND, O.—"The purchase of a few meters is again solicited, chiefly for the purpose of ascertaining the quantity of water consumed in large establishments, where the water is at present used most lavishly."—*Report of* 1861.

DETROIT, MICH.—"Every one should be charged for what they choose to use or require to be delivered, and *no more*. This can be ascertained by requiring all consumers to affix a meter to their service-pipes, which would accurately register every gallon of water delivered, when payments would be made at fixed rates per gallon."—*Report of* 1861.

"Each case has its special controlling circumstances of use or wasteful neglect, and it is certain that the only equitable mode of ascertaining the quantity of water used and wasted in such places, and to determine the proper amount to charge therefor, would be by meter measure."—*Report of* 1863.

BALTIMORE, MD.—"We commenced in March last to connect water meters to such establishments as were using the city water in large quantities; we have twenty-nine in operation. Our experience thus far justifies us in saying that they are working satisfactorily."—*Report of* 1870.

"The Board have now in use one hundred and thirty-one water meters, and are entirely satisfied with their working. They have, to a great extent, checked the extravagant waste of water at large establishments, which was often the main cause of the short supply in certain sections of the city. They have also enabled the Board to rate correctly establishments which heretofore were the subject of guess-work; and when consumers shall have had a fair opportunity to test the relative merits of the two systems, we cannot doubt but that they will approve the action of the Board. *Sixty-three* meters were placed on different establishments at the commencement of the past year. At the end of the first six months they showed that, in *twenty-two* cases, the special rates heretofore charged were too high; while in the remaining *forty-one* cases the special rates had been too low. It further appeared that in *twenty-nine* of these *forty-one* cases the increased charge was comparatively small, while in *twelve* cases the increase was very great. In the case of these twelve consumers there was a saving to the department in the first six months of the year of

$12,000. The value of which was all the greater, from the fact that considerable difficulty had always been experienced in settling for several of these establishments."—*Report of* 1871.

PHILADELPHIA, PA.—"It is very desirable that the use of meters should be commenced in this city, now the only one of any pretension where they are not employed. In Chicago about one-tenth of the whole supply of the place is sold by measure through meters. Difficulty is now experienced in making reliable assessments for manufactories, breweries, distilleries, hotels, &c. Wherever meters have been introduced they have given satisfaction, not only to the supplier, but to the consumer. Without them the proper rent can only be approximated, and it is possible that the consumer may frequently be over-taxed, or the reverse. By the meter system he pays only for what he actually consumes."—*Report of* 1869.

"The necessity for economy in the use of water, and the diminution of all waste, make it more than ever apparent that the city should immediately commence the use of meters for the measurement of all water supplied to large manufactories, hotels, etc., where the waste is now excessive, and where water is the essential element in conducting their business. It is sincerely hoped that authority for the introduction of these valuable apparatuses will be promptly granted."—*Report of* 1870.

JERSEY CITY, N. J.—"As every gallon must be pumped at an increasing cost, economy in its use should be consulted. The only manner in which such can be secured is by the attachment of meters to each place where water is furnished. *The objection urged against such a course—its expense, is not correct, for the saving that would be effected in the cost of running the works would be much more than the interest on the cost of the meters, after allowing a wide margin for repairs and renewals.*"—*Report of* 1872.

ST. LOUIS, MO.—"There are one hundred and forty-five meters now in use in this city; and sixteen more have been purchased and will be put in service as occasion demands."—*Report of* 1867.

"There are now one hundred and forty-two meters in use, of which twenty-three have been put down during the year; water is obtained through them for the supply of hotels, breweries, tanneries, malt-houses, distilleries, pork and slaughter-houses, etc."—*Report of* 1868.

"The extended use of meters, while it enables us to charge an *exact* license, has nevertheless shown that the rates now fixed by ordinance are proportionately greater than the rates would be without the meter. Alteration in this scale of rates should be made with great caution, as the amount affected would be nearly $100,000 per annum."—*Report of* 1869.

CHARLESTOWN, MASS.—"There have been eight new meters set. Seven have been taken out and replaced by others. Two meters have come under our control at the Hospitals in Chelsea, and two in Somerville, at the Bleachery and American Tube Works; making the whole number now in use seventy-nine, and so far have proved satisfactory."—*Report of* 1870.

ALBANY, N. Y.—"One remedy for waste is to charge all using over a stipulated amount for the excess, to be determined by meters. The only objection to the adoption of this measure is the necessary expense attending it. It cannot be questioned that even in 1866 sufficient water was furnished to properly supply a city of 100,000 inhabitants, and yet our works failed, and a large number of our citizens suffered in consequence."—*Report of* 1871.

WORCESTER, MASS.—"There are now in use ninety meters, ten of which have been purchased and applied by private parties. The use of meters is the only possible equitable mode of making assessments. These assessments are levied to pay the interest on the cost of construction and maintenance. And by the makers of the various regulations for its use, and the rule by which the tax shall be levied, the authors have in mind only the equitable distribution of the burden. But, by the present mode, so far as the actual quantity of water enters into the relation between the sum assessed and the quantity used, nothing can be farther from the truth. There are two results which follow from the discrepancy between the established rate at which metered water is sold, and the actual average value obtained by the mixed and common mode of assessing for its use: *First*—The large metered consumer pays pro rata a higher rate for the actual quantity of water used than the general unmetered consumer. *Second*—To increase the rate upon the general unmetered consumer is to increase the waste, for the higher the rate, the more forcible the tendency to lavish, negligent, and profuse use. From each of these disagreeable positions the present method affords no relief. The cause, however, which enters in to affect all efforts at an equalization in this matter is the one before alluded to—that of waste. To all managers of water works this evil is patent. But to apply the sure remedy is the vexatious problem, and cannot be done except by the use of some mechanism which shall indicate the quantity each taker allows to pass through the service."—*Report of* 1871.

NEW YORK.—"Water meters have increased in favor, and the consumer has now a certain and an impartial umpire. The decision of the apparatus is generally acquiesced in."—*Report of* 1854.

"No satisfactory estimate of the consumption of water at some of the manufactories and hotels can be made without the intervention of a water meter."—*Report of* 1855.

"Except where water meters are employed, the amount of water rent charged to consumers is based upon estimates of the quantities consumed. There are at present in use upwards of two hundred water meters. On the 23d of August, 1871, the Department entered into a contract for ten thousand water meters."—*Report of* 1872.

CHICAGO, ILL.—"The Board have found the use of meters in establishments using large quantities of water, both satisfactory to consumers and

profitable to the city. One hundred and fifty-four new meters were added during the year, making the whole number belonging to the water works four hundred and twenty-nine, of which number four hundred are in use."—*Report of* 1869.

"The prejudice which formerly existed against the use of meters is gradually giving place to a feeling of confidence in this method of determining the water assessment, and were it not for the heavy expense, the Board would like to introduce them more generally than they have done heretofore, especially in places where there is an unusual consumption of water. The total number of meters in use is 657."—*Report of* 1871.

"The most equitable method of assessing water rates is by the actual quantity consumed, as determined by meter measurement. Through carelessness or otherwise, a very large amount of water is wasted, which would be determined by the use of meters, and in most cases stopped. A considerable saving to the pumping department would be made in this way each year."—*Report of* 1872.

"Meters are being introduced as far as practicable in all places where service pipes of an inch and upwards in diameter are used. The revenue derived from meter rates during the year was $124,838.42.—*Report of* 1873.

It is altogether impossible to determine how much of all the water supplied to cities is wasted; yet when we see the great disparity in the number of gallons used per person in different localities, and the great increase of quantity supplied for each person in the same city, from year to year, we are forced to the conviction that the supply of water needs to be doubled every five years, after having made full allowance for an increase of population and of manufacturing industries. Individuals and families certainly *need no more water* this year than they did five years ago, and the increase of the domestic consumption of water must be wholly attributable to an ever increasing and lavish waste.

Engineers in charge of Water Works find it very difficult to satisfy a consumer who desires to have a large amount of water. The consumer wishes to have it at the lowest rate, and he will be equally dissatisfied whether charged $25, $50, $100, or $1,000 per year! He does not *know* how much he uses, and he is very confident that the Engineer who has assessed him has been guilty of injustice, and by means of that injustice the Water Board robs him day by day. How simple the remedy! When a consumer wants water, Water Boards should authorize their Engineers and other employees to say that they would furnish it at a

given price per gallon, and that he would only be required to pay *for as much as he consumed, and no more.* Both parties would be better satisfied, because they would cease to *guess*, and would have positive knowledge! They would comply with the usual laws of supply and demand—"*so much for so much.*" The equity of the whole transaction could not be otherwise than satisfactory to all parties interested. On page 16 the reader will find an extract from the Annual Report of the Baltimore Water Board, citing the results of a trial of 63 meters. They found that in 22 cases they were charging *too much*, while in 41 cases they charged *too little.* In 29 of the 41, there was found to be only a slight difference; while in the remaining 12 there was an increased revenue, for the first six months, of *twelve thousand dollars!* See the injustice that was being done the other consumers of water in Baltimore! Each of these 12 consumers was using $2,000 worth of water per year that *he did not pay for*—a sum in total equaling $24,000 per annum. To reimburse the city for that $24,000, it was necessary to assess the amount upon other consumers. This admirably illustrates the injustice of supplying water by assessment.

In 1861 the consumption of water in Boston amounted to 18,187,304 gallons; in 1868 to 14,769,167 gallons, showing a decreased consumption of 3,420,137 gallons. How did this happen? Simply because the Water Board resolved to put on one thousand meters, where large quantities were used. Behold the result; and this result attained against an increase of population equal to about 25 per cent. Does any one in Boston complain? Not a soul. In addition to this the revenue increased $200,000.

Croton water was introduced in 1842, and, until 1848, 18,000,000 gallons per day gave an abundant supply—the population being about 400,000 at the date last named. Now, with a million of people, the quantity supplied is 104,000,000 gallons daily, showing a truly amazing increase of 86,000,000 gallons per day. It will not be possible at that rate of increase for the Croton Department to supply the demand, without an expenditure of more money than it is probable the taxpayers will sanction. The Forty-second street Reservoir has a capacity of twenty million

gallons; the Old Reservoir in Central Park, one hundred and fifty million gallons; the New Reservoir in Central Park, one thousand million gallons—a total storage of one thousand one hundred and seventy millions of gallons below High Bridge. At the Croton Lake Reservoir, at the head of the aqueduct, there is capacity for storing five hundred million gallons, while the new storage Reservoir at Boyd's Corners is estimated to contain three thousand millions of gallons, making a grand total of enough to supply the actual *necessities* of the population of New York for forty years to come, if none be needlessly wasted.

When, however, it is remembered that the utmost capacity of the conduit is only one hundred and fifteen millions of gallons a day, difficulties must soon arise that will tax the resources of the Croton Department, as well as the pockets of the people, to overcome. Most of the immense recent increased consumption of water has doubtless been occasioned by laying a new thirty-six inch main from Forty-second street to Chambers street, and affording opportunities for increased waste from the abundance supplied. Is it not false economy, and a great municipal error, to require more service than the works will bear? One hundred and fifteen millions of gallons being the full capacity of the conduit, should there be any attempt to increase the work done by it? Intelligent public sentiment would probably say NO! Prudent and economical business men, in managing a department like this (if their own private property), would insist on the proper utilization of present supplies, rather than go on increasing it, until the water-shed of the Croton Valley has been exhausted, to the great injury of the rural population of Putnam and Westchester counties.

The experiences of 1859 will doubtless be remembered by most New Yorkers. During November, of that year, the Croton Board were discussing the propriety of shutting off the water at the Croton dam, for the purpose of inspecting the aqueduct. For some reason it was delayed, and on the 5th of December, the two large pipes in Fifth avenue, connecting the receiving with the distributing reservoir, were both broken at Sixty-ninth street. Instantly the distributing reservoir at Forty-second

street was drained within one foot of the bottom—almost its entire supply having flowed back through the ruptured main, and flooded the fields in the vicinity of the broken pipes. From the receiving reservoir there was also a very great loss of water, and for two full days the city was in great peril. Manufacturers were ordered to cease using the water, and the entire supply for shipping, ferries, &c., was stopped. Orders were also issued by telegraph to the police force to excite increased watchfulness as to fires.

Now, had it been concluded to shut off the water at the Croton dam for examination and repair of the aqueduct, this accident would have occurred when the supply was wholly cut off, and the aqueduct in such a state of repair that to have let on water immediately would have been impossible. With the distributing and receiving reservoirs both nearly empty, New York would soon have been without any water, and the city at the mercy of the incendiary's torch.

In December of the year following (1860), it was found that there was a crack through the masonry of the bottom of the aqueduct, the opening extending about four hundred and twenty-five feet in length, and an inch and a half in width. Fortunately, it was soon discovered; but on account of its great length, and the difficulty of making cement set properly in such extremely cold weather, there was great danger of another serious interruption to the supply of water. The Croton Department, with an aqueduct forty miles long, is always liable to just such accidents. For the purpose of illustration, let it be supposed that a serious break should occur *above* High Bridge, and of what *immediate* and present value would be the reservoirs in Westchester and Putnam counties? The consequence would necessarily be, that at the present rate of consumption—one hundred and four million gallons per day—there would soon be *no water at all*, and New York in imminent peril of devastation by fire!

New York is exceptionally situated with regard to water. The Croton river is made to flow into every house by gravity alone, and on the completion of the works, water should be furnished at very moderate prices, for there will then be no expense

for delivery, except the cost of taking care of the works. New York's cheap Croton affords her an immense advantage for manufactories over most other cities. How is it in Brooklyn? The last Annual Report of her Water Board informs the public that the cost of pumping for labor and fuel is $1.27 per 1,000 gallons. There was pumped during last year for the city, 8,288,509,360 gallons, costing for the two items named the sum of $85,143.99 for pumping only! The experience of other cities has been that the use of meters, while increasing the revenue, decreases the waste; hence it is self-evident that if half the Brooklyn water can be saved, it would cost but $42,571.99 *to pump the other half.* The sum last named will pay the interest on more than $600,000, which would in two years meter every building in that city.

A 3-inch GEM METER in Philadelphia discharged 18,216,525 gallons of water from the 7th of March, to October 3d, 1873, or about 101,768 gallons per day. This meter is placed where the annual charge for water has been $1,000, and it demonstrated that if the water be paid for at the rate of two cents per 100 gallons, the charge should be $6,370, showing a gain to the Water Department of $5,370 per annum. Now, here is a meter costing only $150, that returns its cost to the city *more than thirty-five times per year*, and yet Water Commissioners hesitate about introducing meters, on account of the expense.

METERS PRESERVE HEALTH.

Pure water is an indispensable element of life and happiness, to all residents of cities. It supplies an absolute want in their eating, drinking and cleanliness, while it gives them the means of protecting themselves from noxious odors, disease and conflagrations by fire. Health officers so far appreciate and acknowledge its value, and, while they admit the prevalence of *lead poison* in cities, seem to be at a loss as to the actual cause of it. It is here suggested that it may be mainly occasioned by alternately exposing the lead water pipe, in dwelling houses, to the action of water and atmospheric air. When the reservoir is full,

the pipes in the upper stories of houses are also full; but soon after consumption and waste have commenced, the pipes in the upper stories are emptied of water, air taking its place. *Atmospheric air coming in contact with the wet lead pipe, oxidation at once commences, and continues until the water is pressed back, when infinitesimal particles of lead are washed off, and carried into the supplies of the family.* There can be no doubt but in that manner most of the prevalent lead poisoning has been brought about. If cities were metered reservoirs *would always be full*, and much of this danger averted.

Where there is a public supply to cities built on a clay soil, the water, while conferring many blessings, may and often does promote rheumatic and pulmonary diseases, unless there be a well-regulated system of sewerage. How, without sewers, can the people dispose of their waste water? It must be permitted to run into the yards or the streets, in time saturating the ground to the depth of several feet. It will readily be seen that soil, so saturated, will in the spring be subjected to alternate freezing and thawing, begetting a state of atmosphere exceedingly uncomfortable to invalids suffering from the diseases named. In summer, under the rays of a hot July or August sun, the heat will be excessive. The sun's rays will draw the water to the surface by capillary attraction, and impart moisture to the atmosphere, rendering the heat more intense than if it were dry. The lesson here taught is, that meters are indispensable to prevent waste where there are no sewers.

WATER RATES.

THE RATES in St. Louis are 6 cents per 100 gallons for 500 gallons per day, for 80,000 per day, 2⅛ cents; in Cincinnati, 15 cents per 1,000 gallons; in Louisville, 15 cents per 1,000 gallons; in Boston, 3 cents per 100 gallons; in Baltimore, 15 cents per 1,000 gallons; in Cambridge, Mass., 3 cents per 100 gallons; in Chicago, in monthly amounts of 200,000 gallons for $40, and 1,200,000 gallons for $120; in Philadelphia, 20 cents per 1,000 gallons; in Providence, R. I., 3 cents per 100 gallons; in Worcester, Mass., for 1,000 gallons per day 25 cents, for 15,000 gallons per day, 15 cents; Pioche, Nevada, 2½ and 3 cents *per gallon*, or $2.50 and $3 per 100 gallons.

THE GEM METER.

It may be asked, "Why, if meters are so efficient and desirable, have they not been generally adopted?" Because of the great difficulties that had to be overcome in inventing a meter that was accurate, efficient, durable, and CHEAP enough for general use. Until within a comparatively few years, it was thought that supplies of water were inexhaustible, and their use was not deemed necessary; but the greatly increased waste of water in recent years has created a necessity for them. The attention of inventors being called to the subject, they found unexpected difficulties to be overcome, from the various characteristics of the water which they were expected to measure.

The piston form of meter has been found inefficient, because the sand and iron rust cut both the cylinders and the pistons, and although accurate when *new*, if properly constructed and finished, they become less so by use, and have been known *to pass 40 per cent. more water than they registered.* A great many engineers have regarded the piston as a "POSITIVE" meter, *i. e.*, that it would always measure accurately, or cut off the supply. This has been found to be a mistake, for if the piston stops at half stroke, the water will pass through and will *not* be registered. Mr. GEO. WILSON STEVENSON, an eminent English Engineer, in an able report, stated that the piston meter was "positive;" but further experience caused him to say: "It is my duty to qualify my previous report in one respect, viz., that it *can* be made to pass water without registration. I have satisfied myself of this fact, which is common to every meter yet invented." Thus it will be seen that the friends of the piston meter must henceforth abandon all "positive" claims for an invention so *uncertain* in its operation. The diaphram meter was another attempt to meet this great want. It was constructed with a diaphram of rubber or leather, placed between two discs. This meter

was operated by means of valves, changed by weights, the chambers filling alternately: the water, as it passed *in* one chamber, pressed the water *out* of the other. It has the same objections as the piston meter, beside the want of durability of the diaphrams. Another device, known as the tilting meter, was also invented. It had two cups on the extreme ends of a bar, poised on a pivot, and the cups filled and emptied alternately under the pressure of water. Proportional meters (measuring a portion of the water to estimate the whole), were found to be inadequate to meet the want. Bucket meters have failed because their frictional surfaces are very large, causing them to wear rapidly and occasioning leakage of water.

It will thus be seen that until 1869, when the GEM METER was patented, there was no suitable device to meet the want of Water Boards. Every invention, before or since, has failed in some important particular. *It is of the highest importance that a meter should be no obstacle to the passage of water through it* Water should pass as rapidly as if no meter were on the pipe, and should be so constructed as to avoid any accumulation of sediment. It should be open and direct, so that the water may carry with itself every particle of dirt. If it will, from the accumulation of either sand, mud, or vegetable deposits, obstruct the flow of water, it has no business on a service-pipe; for, *if it can not wash itself clean, it will accumulate mud.* The GEM METER will do all this, and is likewise free from every objection urged against all other meters.

The GEM METER is constructed without valves or springs, and no packing is required. Its points of friction are so few and so slight as to be scarcely perceptible, and it has the distinguishing merit of being able to *pass all the water the supply-pipe will furnish*, without reducing the pressure in the slightest degree. Another important feature, peculiar to this meter is, that, if, from any unforeseen accident, it should cease to register, the water will pass through uninterruptedly, and supply the wants of the consumer. Engineers in charge of steam-boilers will appreciate the importance of this, for to them an uninterrupted supply of water is a matter of life or death. When dwellings with hot water boilers in their kitchens are metered, it is equally important, for

the safety of the family, *that there should be no interruption in the supply of water.*

The GEM METER is free from the objections urged against all other meters, inasmuch as all sediment, such as sand, mud, and vegetable deposits, find no lodging-place in it, but flow uninterruptedly through, as free as the water itself. If the meter were filled with mud and dirt, it would wash itself clean, as soon as water was passed through it. Its interior construction of brass and hard rubber renders corrosion impossible, and it is always in condition to adapt itself to all variations of pressure and sizes of stream, accurately registering the water passing through.

The GEM METER has been fully tested in actual use, for the past six years, in different water departments of the country, and during all these years it has been the aim of the NATIONAL METER COMPANY to improve and perfect the GEM by all the inventive and mechanical resources at their command. They flatter themselves that they have succeeded so well as to justify the claim of having the most efficient, durable, and cheap meter yet invented for measuring liquids. The general principle on which the meter acts, is precisely the same as when first invented; but as experience suggested improvements in construction, and a closer attention to details in manufacture, they were given, and no care has been withheld in efforts to achieve perfection in the production of a device for measuring fluids. The records of the Patent Office attest their success in making patentable improvements, while many water departments which have recently purchased the GEM METERS, bear testimony to their superior excellence as compared with those of their first manufacture. It is thought by many who have GEM METERS of the old and the new manufacture, that there is no comparison between them. Those who have seen only the old or first manufacture of the GEM can have little conception of the improvements exhibited in the new ones—improvements that place them beyond all competition for use in measuring water when supplied to the public in cities and villages. All interested may rest assured that in the future, as in the past, no means will be neglected to still further improve the meter, whenever it is found possible to do so. *To show our confidence in our new* GEM METER, *it is here*

stated that we will send to water departments a 1-inch meter, or a smaller one if preferred, to test with any other make of meter, in actual use, for a period of sixty days. At the expiration of that time to be either paid for or returned at our expense.

One of the objections to the general introduction of meters into private dwellings, has been the great expense attending the original outlay. This need no longer be urged as an objection, as will readily be seen by citing New York city in illustration. Here, according to the last report of the Croton Department, the revenue for the supply of water for the year was $1,368,880.51, for an average consumption of 104,000,000 gallons per day. The same report also states that there are 74,241 buildings supplied with water—from which number deduct 65,000 dwellings—to meter which, at $17.50 per house, will cost $1,137,500. It is estimated there are 8,000 stores, warehouses, workshops, manufactories, etc., not yet provided with meters, all of which can be supplied at an average cost of $55, or a sum equaling $440,000, making the whole expense to the city $1,577,500. Now, if 104,000,000 gallons per day for one year, be paid for at the rate of two cents per 100 gallons, the year's revenue will be $7,592,000, or a gain of $4,545,619.49. From this it appears that the total expense of the meters and interest on investment would be returned in one year, leaving a surplus that will astonish the uninitiated.

These figures are suggestive of the great economy as well as the equity of charging for water at a fixed price per gallon. There is no justice in charging a consumer of large quantities of water by the gallon, while inmates of private houses are constantly permitted to *waste as much as they please.* It is quite evident that large consumers in all cities are made to pay for the water wasted in private houses. Equity demands that this should cease—that each consumer should pay only for the water he uses, and for no more. If that were the case, the consumption would be what the actual needs of the people require, and the rates per gallon could be fixed at very low prices, to the great satisfaction of all.

GEM METER ILLUSTRATIONS.

Figure 1 is a perspective view of the meter, showing the index-box on the top. It is shown here as when placed in position—the water to enter at the side near the top, and pass through and out at the bottom. The proper threads at the inlet and outlet make it easy of attachment to the supply and discharge pipe.*

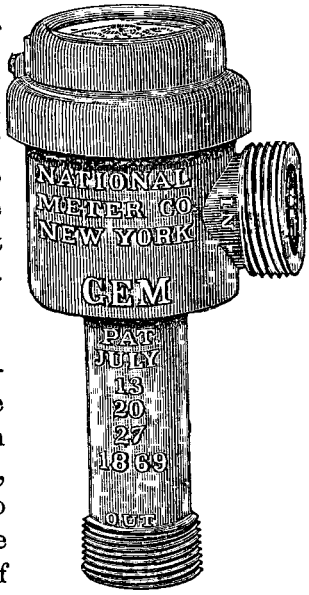


FIG. 1

Figure 2 is a sectional view, showing the interior machinery. In the lower part of the cylinder will be seen a propeller, made of hardened rubber, with wings so nicely adjusted as to just clear the inner walls of the cylinder, and the material being of about the specific gravity of water, will move as the water moves. Opposite the inlet will be seen the main-wheel of the index-box. Each revolution of the propeller causes the wheel to turn, which, being connected with other wheels suitably adjusted for the purpose, will accurately register the number of cubic feet passed through.

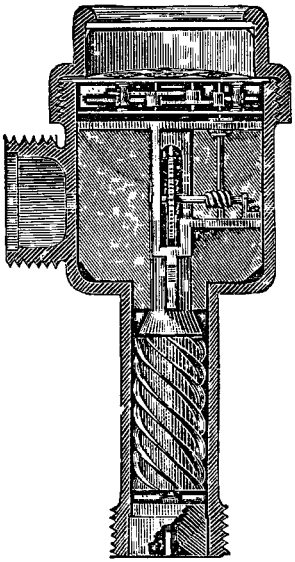


FIG. 2.

Figure 3 shows a sectional view of the wing piece containing the main-wheels for moving the index-hands, and will be readily understood.

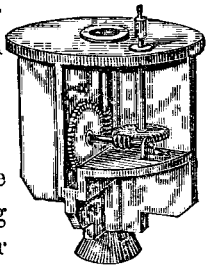


FIG. 3.

*DIRECTIONS FOR SETTING.—The meter should be set plumb, and NO RED LEAD SHOULD BE USED UNDER ANY CIRCUMSTANCES, when setting. Plain or screw connections furnished as may be preferred for all sizes up to 2 inches. As a rule, the outlet should never be below the inlet of the meter, unless a bend is made to bring up the discharge pipe on a line with the supply; the purpose is to keep the meter full of water at all times, when it may be drawn as low as desired.

GEM METER CASH PRICE LIST.

FOR WATER DEPARTMENTS ONLY.

Size.	*Weight.*	*Price.*	*Size.*	*Weight.*	*Price.*
½-Inch,	5 pounds,	$17.50	2-Inch,	15 pounds,	$85.00
¾ "	6 "	22.50	3 "	40 "	150.00
1 "	7 "	30.00	4 "	80 "	275.00
1½ "	11 "	55.00	6 "	125 "	600.00

Boxing Extra.

☞ *These prices include connections for setting.*

Larger sizes, 8-inch, 10-inch, 12-inch, 16-inch, 20-inch, and upwards, will be made to order.

A ½-inch GEM METER will discharge 2 cubic feet of water per minute; a ¾-inch, 6 feet per minute; a 1-inch, 8 feet per minute; a 1½-inch, 18 feet per minute; a 2-inch, 32 feet per minute; a 3-inch, 96 feet per minute; a 4-inch, 128 feet per minute; and a 6-inch, 288 feet per minute. These figures give results under 60 pounds pressure, but the discharge increases with the pressure, and a 1-inch meter has delivered 16 cubic feet per minute under a very heavy pressure. All sizes will deliver in the same ratio, under the same circumstances.

☞ When it is remembered that they are no obstruction to the flow of water, but will, without hindrance, pass all the water the service-pipe will supply, it will be seen that the GEM METER, when estimated by its capacity for work, *will be about* 300 *per cent. cheaper* than the most popular and best known piston meter.

For the purpose of comparison, a Price List, at which the piston meter referred to is sold, is here given:

PISTON METER PRICE LIST.

(*Not made, sold, or recommended by the National Meter Co.*)

Size.	*Greatest proper quantity per Minute.*	*Price.*	*Boxing.*
⅝ inch pipe....	1 cubic foot, or.... 7½ gallons.	$26.....	$2.00
1 " "	4 " " .... 30 "	.. 55.....	3.00
1½ " "	6 " " .... 45 "	.. 70.....	3.50
2 " "	8 " " .... 60 "	.. 85.....	4.00
3 " "	18 " " .... 130 "	..175.....	5.50
4 " "	60 " " .... 450 "	..550.....	

The prices named do not include connections, which are an additional expense. It will also be seen that its capacity for dis-

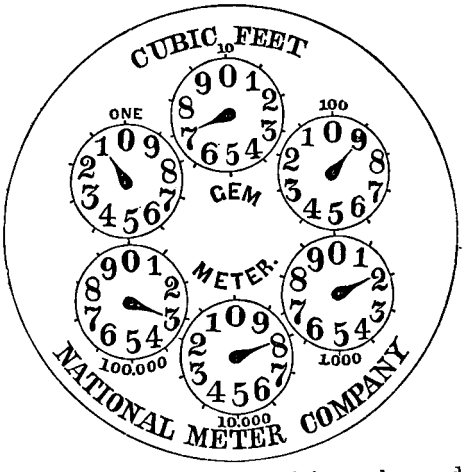
charging water is quite limited, and that a 1-inch GEM METER and connections, costing $30, will deliver 8 cubic feet per minute, while it will take a 2-inch piston meter and connections, costing $90, or three times as much money, to deliver the same amount of water. In other words, the GEM METER costs Water Departments *only one third* the amount that must be paid for a piston meter to do the same work. It should be borne in mind, that this is the showing when the piston meter is made of iron; but if made of composition or brass, as the GEM METER is, it will cost at least 25 per cent. more than it now does of iron.

TWENTY REASONS

WHY THE GEM METER SHOULD BE USED.

1. It will prevent the waste of water.
2. It will make consumers self-interested guardians of the water-works.
3. It will save trouble to Water Departments, and insure justice to all.
4. It will render water-works more efficient.
5. It will save the main conduit from danger.
6. It will render the extension of water-works unnecessary.
7. It will cheapen the price of water for manufacturers.
8. It will regulate the price of water to meet its cost.
9. It will facilitate the changing of rates.
10. It will increase the revenue, without increasing the rates charged.
11. It will increase the force of the head of water in the pipes.
12. It will insure sufficient water in the reservoir for use at fires, etc.
13. It will insure enough water for public fountains.
14. It is the most simple meter in construction.
15. It is the most accurate and efficient meter.
16. It is the most durable, because it has less wearing surface.
17. It has greater capacity than any other meter.
18. It will cost less for repair than any other meter.
19. It is of lighter weight than others.
20. IT IS THE CHEAPEST AND BEST METER IN MARKET.

GEM METER INDEX.



This engraving shows the Counter of the GEM METER. It registers cubic feet—one cubic foot being $7\frac{4\,8}{1\,0\,0}$ U. S. gallons, and is read in the same way as the counters of gas meters. The following example and directions may be of service to those unacquainted with the method:

If a pointer be between two figures, the *smallest* one must always be taken. When the pointer is so near a figure that it seems to indicate that figure exactly, look at the dial next below it in number, and if the pointer there has passed 0, then the count should be read for that figure. Let it be supposed that the pointers stand as in the above engraving; they then read $28,187\frac{1}{1\,0}$ cubic feet. From dial marked "ONE," we get $\frac{1}{1\,0}$; from the next, marked 10, we get 7; from the next, marked 100, we get the figure 8; from the next, marked 1,000, the figure 1; from the next, marked 10,000, the figure 8; and from the next, marked 100,000, the figure 2.

Although the exact reading of the Counter, as shown by the engraving, as here given, it is never so taken by Water Departments, but is allowed to go on until it has registered more cubic feet. It is recommended that the reading be never taken for less than 100 feet, except it be for a final settlement.

The Counter is well protected by a covering of thick glass, strong enough to stand any pressure that may be brought to bear on the meter. It would be well for the Water Departments to attach a seal to the counter cup, so that it (the seal) will be broken if there be any attempt to alter the register.

Directions for Setting the Gem Meter.

When setting a meter, either for testing or actual use, care should be taken that it be PLUMB and properly secured to keep it so. It is also absolutely necessary, when set, that it be *always full of water*. This may be attained by bringing the outlet pipe on a level with the inlet. It may be done by bending the outlet pipe for the purpose, and the meter then being full of water, as soon as any is drawn, the stream moves the propeller, and the counter indexes the quantity passed. *It is indispensable that the meter be always full of water*, and this will be the case, if water is never drawn below the supply pipe.

In actual use the supply pipe is never reduced, and a "test" should in no manner differ from everyday use, no matter what the pressure may be. If it be desired to test the meter's capacity for discharging water, care should be taken that the pipe be fully equal in size to the inlet and outlet connections of the meter.

Instructions for Taking the Meter Apart.

In all cases and in all sizes, the lower bearing, which holds the lower center piece or step, should be carefully withdrawn when the meter is on its end or side, which being done, will allow the propeller to drop out. Remove the cap, which in sizes up to two-inch is screwed down. It can be easily removed by holding the meter in a vise, at a point not lower than inlet, and using wrench furnished. Then drive the wing-piece out at top, by using a round stick of wood, almost as large as the opening. In the larger sizes the cap is held in place by screws. Take out Counter or Index by removing two small screws; when you have done this, remove the two large screws that are countersunk, and the wing-piece, (see fig. 3, page 29,) will drop out through the bottom.

TESTS OF DURABILITY.

OFFICE OF THE WATER WORKS, CITY HALL,
MONTREAL, 24TH DECEMBER, 1873.

JOHN C. KELLEY, ESQ., President of National Meter Co., New York :

DEAR SIR—The Gem Water Meter manufactured by your Company has been in use in the Montreal Water Works for some time, and has so far given entire satisfaction. One of them has been on for a period of two years, being alternately at rest and at work, by periods of two or three months at a time, showing, after a rest of two or three months, its readiness to record any water which could be drawn from the supply pipe on which it was. This I consider one of the great advantages required in a Water Meter. There are at present from twenty to thirty at work, amongst them 3 four-inch, and yet not one has failed. I have made experiments with the 4-inch Meter, in order to test its accuracy in measuring small quantities of water. The result has been quite satisfactory.

I remain, yours truly,

LOUIS LESAGE,
Superintendent of Water Works.

The following letter from JOHN H. RHODES, Esq., who has been connected with the Brooklyn Water Department for some fifteen years, serves to show the *durability* and *accuracy* of our new GEM METER. After two years' actual use, it shows that 7,500 gallons per day, or 750 gallons per hour, had passed through the meter every working day during that time. It has never had or required repair or attention of any kind, and has been put back to work without any of its parts being either renewed or repaired. We feel fully convinced it will not require attention for at least five years.

DEPARTMENT OF CITY WORKS, WATER PURVEYOR'S OFFICE,
BROOKLYN, January 28, 1874.

JOHN C. KELLEY, ESQ.,
President National Meter Co.

SIR—The Department placed one of your one-inch meters on a service, to supply water for Mr. Spire Pitou's Dyeing Establishment, January 5th, 1872. It was taken out, tested, and examined on the 10th day of January, 1874, after furnishing 4,597,696 gallons. Upon trial it was found to run upon a small stream with loss of about one-and-a-half per cent., and upon a medium about one-half per cent. I believe this running to be as close as may be expected or desired for a water meter. Upon examination of the working parts, I could discover no wear that would affect it, except in the counter-gear, which was not more worn than might be expected for the service performed.

Yours respectfully,

JOHN H. RHODES, Water Purveyor.

Gem Meter Testimonials.

OFFICE OF THE WATER-WORKS, CITY HALL,
MONTREAL, Sept. 7, 1870.

DEAR SIR—I have received the Water Meter you sent me by express, and have had it under trial ever since. So far it has given satisfaction. I have tried it under every head of the column of water. I am therefore satisfied as to its accuracy. Yours, etc.

LOUIS LESAGE,
Supt. of Water Works.

MR. J. C. KELLEY, Pres't, etc.:

MONTREAL, Nov. 29, 1872.

All I can say at present is, that I had the four-inch Meter tested under various heads, and that it gave good satisfaction. I hope to order some of the six-inch that you are now making.

I remain, yours truly,
LOUIS LESAGE,
Supt. of Water Works.

WATER WORKS OFFICE, HAMILTON (Canada),
August 15, 1870.

DEAR SIR—As to our trial of your one-inch Meter. We have in our shop a water-tight box of thirty cubic feet, supplied by a half-inch pipe, under a pressure of sixty pounds to the square inch. We coupled your Meter on one side, and a three-quarter-inch piston Meter on the other side. Your Meter registered a full stream *exactly*, and half stream about twenty-nine and three-quarter feet. It does not seem to be any obstruction to the free passage of the water. The piston meter registered (*under similar circumstances*) on two trials, twenty-six feet instead of thirty; and two of the meters not before used, we could not get to start at all.

If all your Meters are as perfect as the one sent us, I consider them valuable instruments, which should be patronized by all the works on this continent. Yours, &c.,

WM. HASKINS,
Superintendent of Water Works.

JOHN C. KELLEY, ESQ.,
President National Meter Co., New York.

OFFICE OF THE NEW HAVEN WATER COMPANY,
NEW HAVEN, CONN., August 26th, 1871.

JOHN C. KELLEY, Esq.:

Dear Sir—It gives me pleasure in stating that the "Gem Meters" we have in use here are giving general satisfaction. In my opinion their light weight, correctness, cost, and facility of attachment should give them the preference over any other Water Meter that has been brought to my notice. Yours truly,

D. GOFFE PHIPPS,
Secretary New Haven Water Company.

Gem Meter Testimonials.

OFFICE OF THE BOARD OF WATER COMMISSIONERS,
NEW LONDON, Conn., November 8, 1873.

MR. JOHN C. KELLEY, President National Meter Co.:

SIR—Since you were here, I have examined nearly all the Meters we have in the city, and find them to be in good order and registering correctly. We have comparatively few Meters; but every day demonstrates how much labor and expense in inspection and keeping accounts would be saved in selling water by Meter measurement. The Water Commissioners here have adopted the rule to furnish a Meter to any consumer who wishes one, charging him 10 per cent. on the first cost of the Meter, in addition to the Water rate. This seems to be an impartial rule and profitable to both parties.

In my opinion Water Departments mistake in not using a Meter for every service. I can see no reason why Water Meters should not be as universally used as Gas Meters. If Water Departments should adopt the rule on start-works, to sell water by meter measurement only, millions of gallons of water now wasted would be saved and, the necessity of constantly increasing the supply obviated. As the custom now is, of supplying families at from $5 to $8 each, per year, with bath-tubs, water-closets, etc. extra, some families use much more water than others, yet have to pay the same rent.

One objection raised against Meters is their liability to get out of order. With the Gem Meter, this must be of rare occurrence; even if the Meter stops working the supply still continues, and the defect is soon discovered and remedied. The stoppage of a Meter would cause a slight loss of water; but the loss would be trifling compared with the amount wasted without a Meter. In a word, the Gem Meter, with its cheapness, durability and compactness, seems to be just the Meter to use for a general system of Meter measurement. Yours truly,

W. H. RICHARDS,
Engineer and Superintendent.

From THOMAS HANSON, Esq., *Hydraulic Engineer.*

No. 291 PEARL STREET, NEW YORK, Nov. 28th, 1871.

NATIONAL METER COMPANY:

GENTLEMEN—After a trial of your Gem Water Meter for nearly ten months, I took it apart to ascertain if there were any signs of wear on it, but to my great surprise I found it just as good as it was when first put in, and during that time it registered over 47,000 cubic feet of water. Unlike other Water Meters, it takes off no power to work it; therefore, I can freely recommend it to those that require Water Meters, as being the best in the market. Yours truly,

THOMAS HANSON.

NASSAU WATER DEPARTMENT (Engineer's Office),
BROOKLYN, March 1st, 1871.

JOHN C. KELLEY, National Meter Co., 95 John St., N. Y.:

SIR—I take sincere pleasure in stating that we have between forty and fifty of different sizes of your "Gem Meter" in use—including 1-inch, 2-inch, and 4-inch—under my immediate supervision more than two years. I have tested them under all circumstances, and have no hesitation in saying that they are accurate, simple, light, and durable, and that they have given satisfaction both to the consumer and to the Department.

Yours respectfully,

WILLIAM P. RHODES,
Clerk and Superintendent Pipe Yard.

Gem Meter Testimonials.

CONCORD WATER WORKS, CHIEF ENGINEER'S OFFICE,
CONCORD, N. H., January 1, 1874.

JOHN C. KELLEY, ESQ., President National Meter Co. :

DEAR SIR—Your favor of the 29th ult., in relation to the Gem Meters in use by the Concord Water Works, is before me. When it was fully decided to place meters upon the main pipe, to measure the entire water supply for the city, a committee of the Board investigated critically the various kinds of apparatus in use, and adopted the Gem Meter as the best for their purpose, all things considered. Accordingly, three six-inch meters have been placed upon the main pipe, and are put in operation this day. I look with confidence for a satisfactory result. The smaller meters, which have been in use since last summer, have given entire satisfaction.

Yours truly,

JAMES A. WESTON,
Chief Engineer.

CONCORD WATER WORKS,
CONCORD, N. H., Jan. 22, 1874.

Mr. JOHN C. KELLEY, President of National Meter Co.:

DEAR SIR—We send you the following statement of the working of your Meters: The three 6-inch meters upon our main supply pipe show our average use to be about 375,000 gallons per day. The lowest any day being 344,000, and the highest, 401,000. Our other meters, of smaller size, are working satisfactorily, and appear to give correct results. We cheerfully recommend your Meters to the public.

V. C. HASTINGS,
Superintendent.

WATER REGISTER'S OFFICE (District of Columbia),
WASHINGTON, February 24th, 1873.

JOHN C. KELLEY, Esq., President National Meter Company, New York:

DEAR SIR—We have some thirty of your Gem Meters in use in this Department, some of them nearly two years—including half, three-quarter, one, two, and four-inch—all of which have given excellent satisfaction. They never cause any trouble, nor require any repairs or extra attention. The other meters that we tried were of the piston pattern, most of which broke down and had to be taken out as unfit to use.

I do not hesitate to say that I consider your Gem Meter the cheapest, the most simple, and best Water Meter made.

Yours truly,

HENRY LARMAN,
Inspector of Water Mains.

OFFICE MONONGAHELA WATER COMPANY,
BIRMINGHAM, PA., Sept. 25th, 1871.

JOHN C. KELLEY, Esq., Pres't National Meter Co., of New York:

DEAR SIR—We began using your "Gem Meter" in April last, by introducing a 4-inch Meter at a rolling-mill and a 3-4 inch Meter at a large dwelling. The house Meter was tested first by filling a small fish pond with hydrant water, and was found to register the exact quantity. Next I instituted a test with the 4-inch Meter, by ascertaining the contents of and filling a large tank. The tank contained 1107 cubic feet, and the Meter accorded 1100 cubic feet. Since then we inserted three additional 4-inch Meters at rolling-mills. In conclusion, I will say that the force of the water is not perceptibly lessened by its passage through your Meter.

Yours, very truly,

G. STENGEL,
Engineer and Superintendent.

TABLE

Showing the Value of Water.

Value of one million gallons at prices per thousand gallons as named in the left hand column, and also the value of one million gallons per day, per year of 365 days.	Price per 1000 gallons.	Value of one million gall's.	Value of one million gallons per day for one year of 365 days.
	5 cents.	$50 00	$18,250
	10 "	100 00	36,500
	15 "	150 00	54,750
	20 "	200 00	73,000
	25 "	250 00	91,250
	30 "	300 00	109,500
	40 "	400 00	146,000

TABLE

Showing the number of gallons of water, at fixed rates, which a consumer is entitled to per day, for one year, for each dollar paid per 1000 *gallons.*

Rate paid Per annum.	5 cents per 1000 gallons.	10 cents per 1000 gallons.	15 cents per 1000 gallons.	20 cents per 1000 gallons.	25 cents per 1000 gallons.	30 cents per 1000 gallons.	40 cents per 1000 gallons.	50 cents per 1000 gallons.
$1	54.8	27.4	18.2	13.7	10.9	9.1	6.8	5.5
2	109.6	54.8	36.5	27.4	21.9	18 2	13.7	10.9
3	164.4	82.2	54.7	41.1	32.8	27.4	20.5	16.4
4	219.2	109.6	73.0	54.8	43.8	36.5	27.4	21.9
5	274.0	137.0	91.3	68.5	54.8	45.6	34.2	27.4
6	328.8	164.4	109.6	82.2	65.7	54.8	41.1	32.8
7	383.6	191.8	127.8	95.9	76.7	63.9	47.9	38.3
8	438.4	219.2	146.1	109.6	87.6	73.0	54.8	43.8
9	493.1	246 6	164.4	123.3	98.6	82.2	61.6	49.3
10	547.9	273.9	182.6	136.9	109.6	91.3	68.4	54.8
20	1096.	548	365.	274	219	182.	137	109.6
30	1644.	822	548.	411	329.	274.	205.	164.4
40	2192.	1096	730.	548	438.	365.	274.	219.2
50	2740.	1370	913.	685	548	456	342	274.0
60	3288.	1644.	1096.	822	657	548	411	328.7
70	3836.	1918.	1278.	959.	767	639	479	383.5
80	4383.	2191.	1461.	1095.	876	730	549	438.3
90	4931.	2465.	1643.	1232.	986	821	616	493.1
100	5479.	2739.	1826.	1369.	1095	913	684	547.9
200	10.959	5479	3653	2739	2191	1826	1369	1095.8
300	16.438	8219	5479	4109	3287	2739	2054	1643.8
400	21.918	10.959	7306	5479	4383	3653	2739	2191.7
500	27.397	13.698	9132	6849	5479	4566	3424	2739.7
600	32 876	16.438	10.958	8219	6575	5479	4109	3287.6
700	38.356	19 178	12.785	9.589	7671	6397	4794	3835.6
800	43.835	21.967	14.611	10.983	8767	7305	5491	4383.5
900	49.315	24.657	16.438	12.328	9863	8219	6164	4931.5
1000	54.794	27.397	18.264	13.698	10.959	9132	6849	5479.4

TABLE

Showing the Pressure of Water in Pipes.

Diam. Pipe in inches.	Circum. in inches, 1 pound per inch.	5 lbs. pressure per sq. in. 11 1-2 feet Head.	10 lbs. pressure per square in. 23.1 ft. Head.	20 lbs. pressure per square in. 46.1 ft. Head.	30 lbs. pressure per square in. 69.3 ft. Head.	40 lbs. pressure per square in. 92.5 ft. Head.	50 lbs. pressure per sq. in. 155 ft. Head.	100 lbs. pressure per square in. 231 feet Head.	150 lbs. pressure per square in. 346 feet Head.	200 lbs. pressure per square in. 472 feet Head.	250 lbs. pressure per square in. 579 feet Head.	300 lbs. pressure per square in. 693 feet Head.
2	6.28	31.4	62,8	125.6	188.4	251.2	314	628	942	1,256	1,570	1,884
3	9.42	47.1	94.2	188.8	282.6	377.6	471	942	1,413	1,888	2,355	2,826
4	12.56	62.8	125.6	251.2	376.8	502.4	628	1,256	1,884	2,512	3,140	3,768
6	18.84	94.2	188.4	376.8	565.2	753.7	942	1.884	2,826	3,768	4,710	5,652
8	25.13	125.6	251.3	502.6	753.9	1005.2	1256	2,513	3,768	5,026	7.280	7,539
10	31.41	157.0	314.1	628.2	942.3	1256.4	1570	3,141	4,710	6,282	7,880	9,423
12	37.69	188.4	376.9	753.8	1130.7	1507.6	1884	3,769	5,652	7,538	9,420	11,307
16	50.26	251.3	502.6	1005.2	1507.8	2010.4	2513	5,026	7,539	10,052	12,565	15,078
18	56.54	282.7	565.4	1130.8	1696.2	2261.6	2827	5,654	8,481	11,308	14,135	16,962
20	62.83	314.1	628.3	1256.6	1884.9	2513.2	3141	6,282	9,423	12,566	15,705	18,849
24	75.39	376.9	753.9	1507.8	2261.7	3015.6	3769	7,539	11,307	15,078	18,846	22,617
30	94.24	471.2	942.4	1884.8	2827.2	3769.6	4712	9,424	14,136	18,848	23,560	28,372
36	113.09	565.4	1130.9	2261.8	3392.7	4523.6	5654	11,309	16,962	22,618	28,270	33,927
42	131.94	659.7	1319.4	2638.8	3958.2	5277.6	6597	13,194	19,791	26,388	32,985	39,582
48	150.79	753.9	1507.9	3015.8	4523.7	6031.6	7539	15,079	22,617	30,158	37,695	44,237

TABLE

Showing Total Quantity of Water pumped for Chicago, together with Annual and Daily Increase.

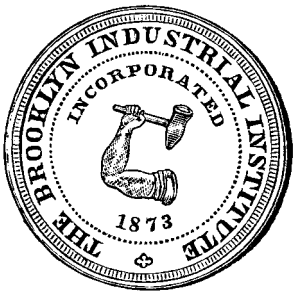
YEARS.	Total Quantity Pumped. GALLONS.	Annual Increase. GALLONS.	Average Daily Quantity Pumped. GALLONS.	Average Daily Increase. GALLONS.
1858	1,091,865,459		2,991,413	
1859	1,415,147,910	323,282,453	3,877,119	885,706
1860	1,716,786,552	301,338,642	4,703,525	826,406
1861	1,767,154,689	50,368,137	4.841,520	137,995
1862	2,217,279,739	450,125,050	6,074,739	1,233,219
1863	2,336,108,454	118,128,715	6,400,298	325,559
1864	2,523,339,218	187,230,764	6,913,259	512,961
1865	2,777,817,349	254,478,131	7,610,459	97,200
1866	3,168,760,609	390,943,260	8,681,536	1,071,077
1867	4,231,791,659	1,063,031,050	11,562,273	2,880,737
1868	5,374,624,576	1,142,832,917	14,724,999	3,162,726
1869	6,801,146,720	1,426,522,144	18,633,278	3,908,279
1870	7,944,684,840	1,143,538,120	21,766,260	3,133,082
1871	8,423,890,966	479,206,486	23,464,877	1,698,617
1872	10,050,939,189	1,627,048,223	27,536,819	4,071,942
Average for 15 years	4,122,755,862	597,204,939	11,318,825	1,636,367

TABLE

Showing the pressure of water in pounds per square inch for every foot in height, up to three hundred feet.

Feet Head.	Pressure per square inch.	Feet Head.	Pressure per square inch.	Feet Head.	Pressure per square inch.	Feet Head.	Pressure per square inch.	Feet Head.	Pressure per square inch.
1	0.43	65	28·15	129	55.87	193	83.60	257	111.32
2	0.86	66	28.58	130	56.31	194	84.03	258	111.75
3	1.29	67	29.02	131	56.74	195	84.46	259	112.19
4	1.73	68	29.45	132	57.18	196	84.90	260	112.62
5	2.16	69	29.88	133	57.61	197	85.33	261	113.06
6	2.59	70	30.32	134	58.04	198	85.76	262	113.49
7	3.03	71	30.75	135	58.48	199	86.20	263	113.92
8	3.46	72	31.18	136	58.91	200	86.63	264	114.36
9	3.89	73	31.62	137	59.34	201	87.07	265	114.79
10	4.33	74	32.05	138	59.77	202	87.50	266	115.22
11	4.76	75	32.48	139	60.21	203	87.93	267	115.66
12	5.19	76	32.92	140	60.64	204	88.36	268	116.09
13	5.63	77	33.35	141	61.07	205	88.80	269	116.52
14	6.06	78	33.78	142	61.51	206	89.23	270	116.96
15	6.49	79	34.21	143	61.94	207	89.66	271	117.39
16	6.92	80	34.65	144	62.37	208	90.10	272	117.82
17	7.36	81	35.08	145	62.81	209	90.53	273	118.26
18	7.79	82	35.52	146	63.24	210	90.96	274	118.69
19	8.22	83	35.95	147	63.67	211	91.39	275	119.12
20	8.66	84	36.38	148	64.10	212	91.83	276	119.55
21	9.09	85	36.82	149	64.54	213	92.26	277	119.99
22	9.52	86	37.25	150	64.97	214	92.69	278	120.42
23	9.96	87	37.68	151	65.40	215	93.13	279	120.85
24	10.39	88	38.11	152	65.84	216	93.56	280	121.29
25	10.82	89	38.55	153	66.27	217	93.99	281	121.72
26	11.26	90	38.98	154	66.70	218	94.43	282	122.15
27	11.69	91	39.42	155	67.14	219	94.86	283	122.58
28	12.12	92	39.85	156	67.57	220	95.30	284	123.01
29	12.55	93	40.28	157	68.00	221	95.73	285	123.45
30	12.99	94	40.71	158	68.43	222	96.16	286	123.88
31	13.42	95	41.15	159	68.87	223	96.59	287	124.31
32	13.86	96	41.58	160	69.31	224	97.03	288	124.75
33	14.29	97	42.01	161	69.74	225	97.46	289	125.18
34	14.72	98	42.45	162	70.17	226	97.89	290	125.62
35	15.16	99	42.88	163	70.60	227	98.33	291	126.05
36	15.59	100	43.31	164	71.04	228	98.76	292	126.48
37	16.02	101	43.75	165	71.47	229	99.19	293	126.91
38	16.45	102	44.18	166	71.90	230	99.63	294	127.35
39	16.89	103	44.61	167	72.34	231	100.06	295	127.78
40	17.32	104	45.05	168	72.77	232	100.49	296	128.21
41	17.75	105	45.48	169	73.20	233	100.92	297	128.65
42	18.19	106	45.91	170	73.64	234	101.36	298	129.08
43	18.62	107	46.34	171	74.07	235	101.79	299	129.51
44	19.05	108	46.78	172	74.50	236	102.22	300	129.95
45	19.49	109	47.21	173	74.93	237	102.66	310	134.28
46	19.92	110	47.64	174	75.37	238	103.09	320	138.62
47	20.35	111	48.08	175	75.80	239	103.52	330	142.95
48	20.79	112	48.51	176	76.23	240	103.96	340	147.28
49	21.22	113	48.94	177	76.67	241	104.39	350	151.61
50	21.65	114	49.38	178	77.10	242	104.83	360	155.94
51	22.09	115	49.81	179	77.53	243	105.26	370	160.27
52	22.52	116	50.24	180	77.97	244	105.69	380	164.61
53	22.95	117	50.68	181	78.40	245	106.13	390	168.94
54	23.39	118	51.11	182	78.84	246	106.56	400	173.27
55	23.82	119	51.54	183	79.27	247	106.99	500	216.59
56	24.25	120	51.98	184	79.70	248	107.42	600	259.91
57	24.69	121	52.41	185	80.13	249	107.86	700	303.23
58	25.12	122	52.84	186	80.57	250	108.29	800	346.55
59	25.55	123	53.28	187	81.00	251	108.72	900	389.87
60	25.99	124	53.71	188	81.43	252	109.16	1000	433.18
61	26.42	125	54.14	189	81.87	253	109.59		
62	26.85	126	54.58	190	82.30	254	110.02		
63	27.29	127	55.01	191	82.73	255	110.46		
64	27.72	128	55.44	192	83.17	256	110.89		

FAC SIMILE



OF

SILVER MEDAL.

TABLE

Showing the Waste of Water in Six Cities.

Water Works at	Rate of Report.	Gallons of water furnished per day.	Reported income from the sale of water.	Rate pr. 1000 gallons at which metered water is sold.	Income estimated at rate for which metered water is sold, deducting 10 per ct. for necessary waste.	Income received from each 1000 gallons furnished.
Boston,	1869	15,070,400	629,551.48	30 cents.	1,485,188.00	11c. 4 m.
Cambridge,	1869	1,617,481	76,149.30	30 "	157,602.00	12c. 8 "
Charlestown,	1869	2,354,974	102,878.09	30 "	232,082.74	11c. 8 "
Brooklyn,	1869	17,630,400	578,451.15	20 "	1,158,317.28	8c. 9 "
						5c. 6 "
Philadelphia,	1869	34,040,409	702,469.29	20* "		
New York,	1872	88,000,000	1,239,233.67	16⅔ "	4,815,445.00	4c. 3 "

* Commenced using the Gem Meter in 1872, when they were adopted by the City Council.

For any information not contained in this pamphlet, address

JOHN C. KELLEY, President,

95 John Street, New York.