The Detroit Water Works.

A Short History Compiled and Written by Clarence W. Hubbell, Assoc. M. Am. Soc. C. E., and Civil Engineer to the Board of Water Commissioners.

The soil underlying the city is an impervious blue clay containing occasional striated granite boulders and enclosing isolated pockets of sand, sometimes of considerable extent. Close-grained limestone is found at a depth of 70 to 120 feet below the river surface. In this soil there are no springs, and the small streams which originally flowed through the site of the city were never suitable for water supply. Shallow wells fill with surface water during the wet season and go dry in summer, making them not only satisfactory but also unsanitary; while deep wells, reaching to or penetrating rock, are either dry or furnish an unpalatable water. These unfavorable conditions forced the settlers led by Le Mothe Cadillac in 1701, and the early French "habitans" as well as their successors down to the present generation, to turn to the Detroit River, which has ever proved an unfailing and satisfactory source of supply. In pioneer days every man, with water cart or shoulder yoke, supplied his domestic need; and it is safe to say that, under this system, domestic waste, that ever fruitful source of debate, was at a minimum. An early ordinance provided for fire protection by compelling each citizen to keep on his premises a cask of given size, filled with water and furnished with pole handles, ready for immediate use in case of need.

Founded in 1701, the settlement at Detroit remained under French rule for nearly sixty years. Fort Pontchartrain, located on the then river bank near the present intersection of Jefferson Avenue and Shelby Street, was surrendered to the English on November 29, 1760. During the Revolutionary War, the English condemned the old fort as indefensible, and built a new one which was named Fort Lernoult. The site was on higher ground farther back from the river, and is marked by the present postoffice building, which stands at the northwest corner of the old fort. This fort was first occupied by American soldiers in 1796. It was ignominiously surrendered to the English by General Hull, August 16, 1812, and re-occupied by the American forces under General McArthur, September 29, 1813, nineteen days after Perry "met the enemy" on Lake Erie. The name was changed at this time from Lernoult to Fort Shelby. Although an important post, the population was unstable, and fluctuated between a few thousand and a few hundred during more than a century of international jealousy and savage intrigue. However, dating from the restoration of confidence after the War of 1812, the growth and prosperity of the city has been uninterrupted.

The inception of the system of water supply dates back as far as 1820, when the Trustees of the city invited proposals for the exclusive privilege of erecting works. Nothing came of the invitation, however, only one proposal being received, and that not satisfactory. Detroit's need became well known, and in 1824 Bethuel Farrand and Rufus Wells, of Aurelius, Cayuga County, New York, determined to obtain the right to furnish the city with water. Mr. Farrand obtained the desired privilege from the Common Council February 21, 1825. He was certainly deserving of success, for, in order to meet the Council, he made the trip from his home to Detroit on foot and in the midst of winter, coming by way of the south shore of Lake Erie and returning through Canada. The plant erected under this grant consisted of two pumps of 5-inch bore, driven by horse power. The pumps were located at the foot of Randolph Street, and lifted water into a 40-gallon cask, from which it flowed by gravity through 4½-inch bore tamarack logs into a white-oak reservoir 16 feet square and 6 feet deep, which was located where the water office now stands. The distribution system consisted of a few lines of tamarack logs which Mr. Farrand and Mr. Wells cut on the Clinton River and rafted to Detroit. At this time the population had reached about 1,500.

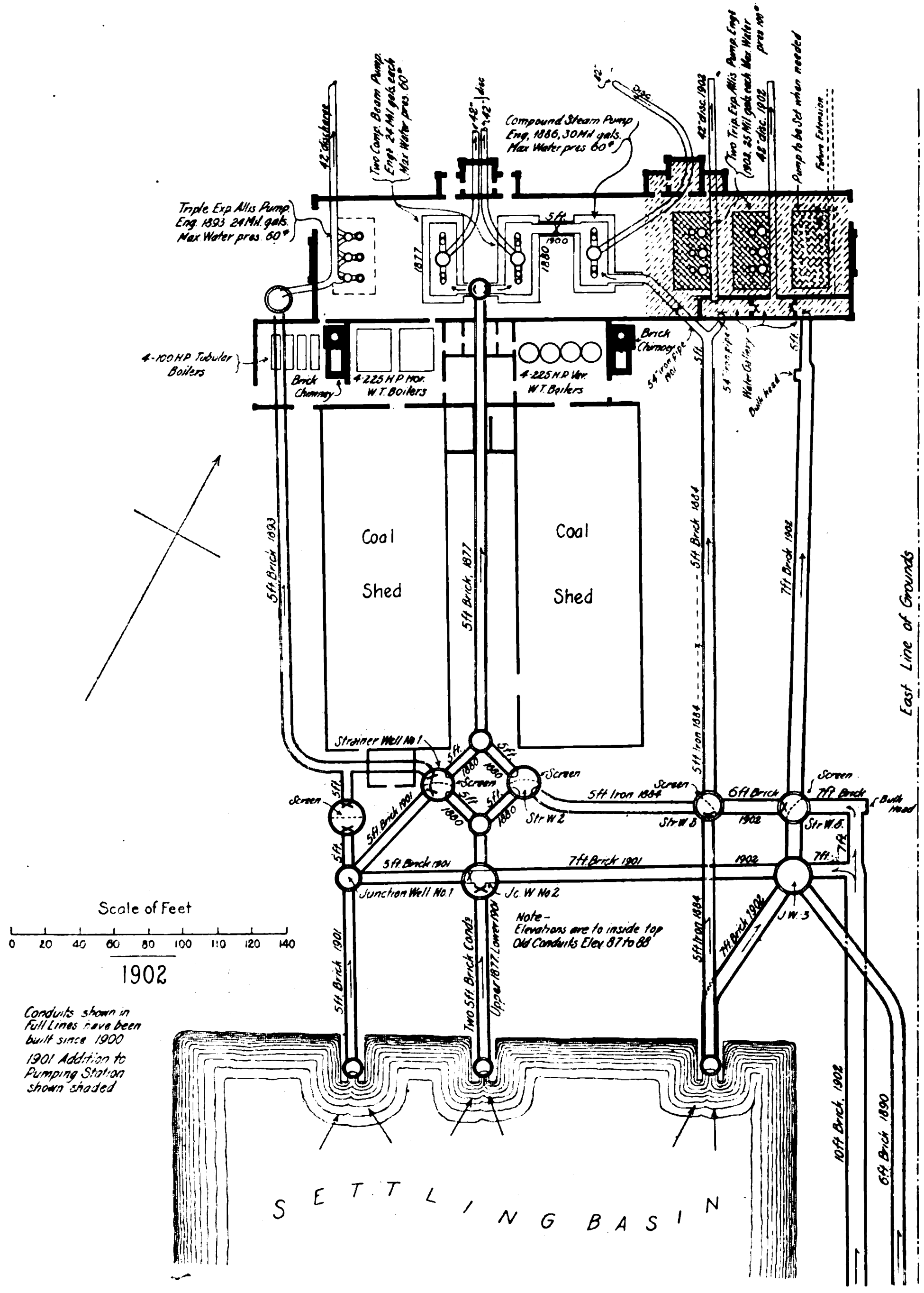


Diagram Showing Location of Pumping Station, Conduits and Settling Basin.

From this primitive beginning, the works have passed through many transformations. The first steam pump was installed in 1830, and was of the rotary type driven by a 10-horse-power engine, the delivery main being 3-inch iron pipe. The original horse power pump used by Mr. Wells in 1827 and a section of the 3-inch pipe laid in 1830 are now in the possession of the Board and may be seen at the pumping station. The works were purchased by the city June 1, 1836, at a cost of $20,500, the population being between 5,000 and 6,000. In 1840, contracts were made for the completion of the new works which were under way at the foot of Orleans Street. The contract included the laying of 9 miles of tamarack logs and 4½ miles of cast-iron pipe.

The present management rests in the Board of Water Commissioners, created by special act of the state legislature on February 14, 1853. The Board consists of five men who serve without salary. The term of office is five years, one man being appointed each year by the Mayor and approved by the Council. A better system could scarcely be devised for securing an uncorruptible public service, and the results have been uniformly good. In 1857, a reservoir, having a capacity of 10,000,000 U. S. gallons, was completed at a total cost of about $116,000. The surface of the water in the reservoir when filled was about 77 feet above the river level. The cast-iron supply main was 24 inches in diameter.

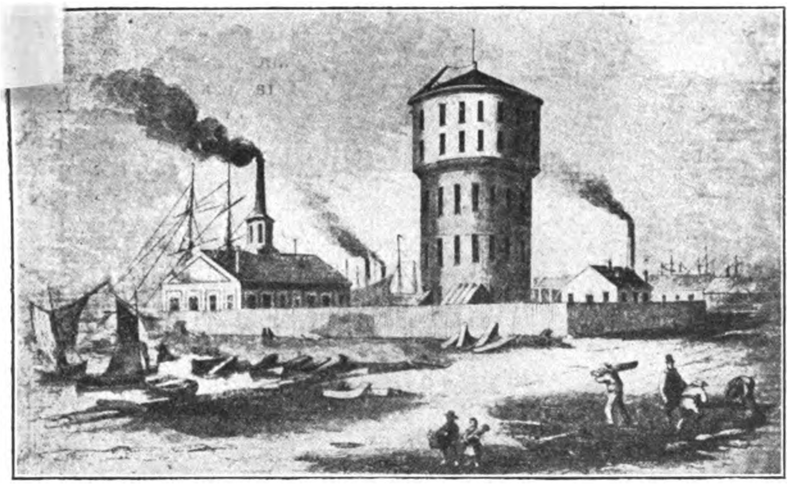
The present pumping plant, and we may also say the present system, dates only from 1874, when the site now occupied was purchased. In 1886 the use of the reservoir, which was completed in 1857, was dispensed with, and in 1895, a stand-pipe, which still ornaments the grounds, was disconnected from the mains, since which time the city has been supplied through a direct pressure system, absolutely without reservoir, stand-pipe, or other reserve, and is dependent for its pressure upon the continuous action of the pumps. Taking this fact into consideration, together with the size of the plant, which supplies at the present time 325,000 persons, the management is proud to say that, for a period of nearly twenty-five years the supply has never once been entirely cut off, although accidents to force mains and difficulties with anchor ice have occasionally caused pressures to be somewhat reduced for periods of a few hours. It is believed that few cities can make so good a showing, although protected from accidents by large reserves in he form of reservoirs. The entire system is ipplied by one station, which so far as known as the largest capacity of any single station ι the world. It contains six large pumping ıgines, and has foundations laid for a seventh. Engine No. 1 is a 24,000,000-gallon compound ndensing beam engine, built by the Detroit ›comotive Works in 1874, having steam cylin-·rs of 42 and 84 inches in diameter, with 72-:h stroke, the pumps being the double-acting .ton type, directly connected, and 40¼ inches diameter. Engine No. 2 was built in 1880 Samuel F. Hodge & Company's Riverside ›n Works, of Detroit, and is similar in type, ıstruction and capacity, but has a high-press-ure cylinder 46 inches, and pump cylinders 41 inches, in diameter. Engine No. 3 was built by the Riverside Iron Works in 1884, and is of the same general type. It is one of the largest pressure pumping engines in America, and although rated at 30,000,000 gallons, is frequently speeded to 35,000,000 gallons per 24 hours. In 1897 its high-pressure cylinder was reduced from 46 inches to 35 inches in order to admit of the use of higher-pressure steam and improve its duty, which was thereby raised from about 96,000,000 foot-pounds to 107,000,000 per 100 pounds of coal or 1,000 pounds of dry steam.

Engine No. 4 is of the well-known Reynolds-Corliss triple-expansion type, built by the Edward P. Allis Company, of Milwaukee, in 1893. Its rated capacity is 24,000,000 gallons per 24 hours, and the duty developed upon official trial was 142,000,000 foot-pounds per 1,000 pounds of steam. Engines Nos. 5 and 6 are in duplicate, and are vertical, triple-expansion, crank and fly-wheel, three-plunger, condensing, self-contained engines, having a rated capacity of 25,000,000 U. S. gallons per 24 hours, and a guaranteed duty of 140,000,000 foot-pounds per 1,000,000 heat units consumed. The length of stroke is 72 inches, and the pumps are designed for a water pressure of 80 pounds, with steam at 135 pounds. These engines weigh 900 tons each, and will be ready for service within a few weeks. The Allis-Chalmers Company, of Milwaukee, have the contract to build both engines for $276,000.

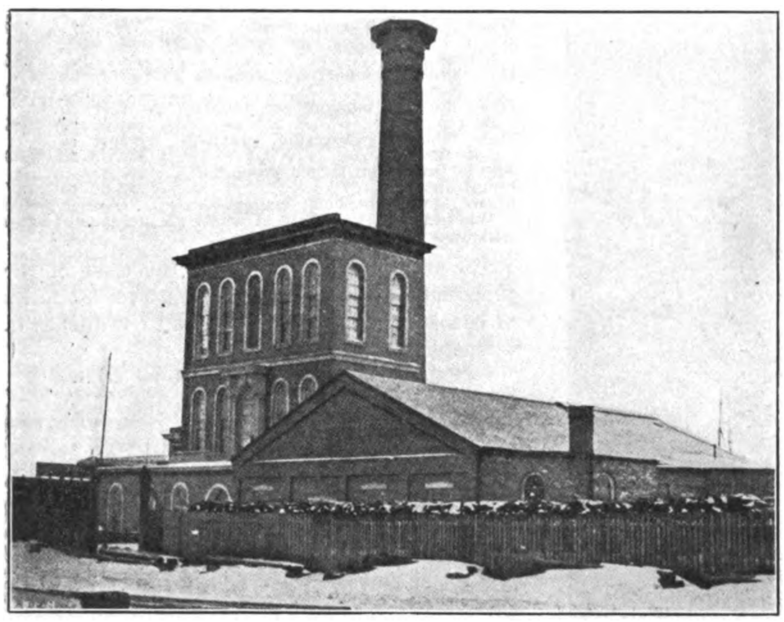
The pumping station, exclusive of boiler house and coal sheds, is 314 feet long by about 70 feet wide, and is provided with a 20-ton hand crane which travels the entire length of the building. The boiler plant consists of four 100-horse-power tubular boilers, four 225-horse-power horizontal water-tube boilers, and four 225-horse-power vertical water-tube boilers. The best quality of mine-run bituminous coal is used, and it is brought by boat, costing on an average about $3.25 per ton laid down. The brick coal sheds, in the rear of the boiler house, have a storage capacity of 10,000 tons. The total pumping expenses, including fuel, maintenance and operation, but exclusive of fixed charges, such as interest on investment, was $51,505.43 for the year ending June 30, 1902, or an average of $2.80 per million gallons pumped against a mean head of 50.32 pounds.

For many years cordwood was cheap, costing about 75 cents per cord for soft wood and $1.25 for hard. It was used exclusively in early years, coal being purchased for the first time in 1860. The wood was still used in a diminishing ratio for nearly twenty years, the last entry being a small purchase made in 1879 at $2.58 per cord. The excessive cost of hard coal, which was used to avoid smoke nuisance, led the Board to experiment with natural gas, which was first used for fuel December 8, 1890; but, although satisfactory, it was discontinued in September, 1892, on account of failing supply, crude oil being substituted therefor. This fuel likewise gave good satisfaction; but, owing to the ever-increasing cost of oil it was discontinued in April, 1896, when the use of anthracite coal was resumed, followed by the introduction of bituminous coal in October of the same year. The latter change, accompanied by the equipment of the boilers with mechanical stokers to abate the smoke nuisance, reduced the bills for fuel about 50 per cent.; and no changes have been made since.

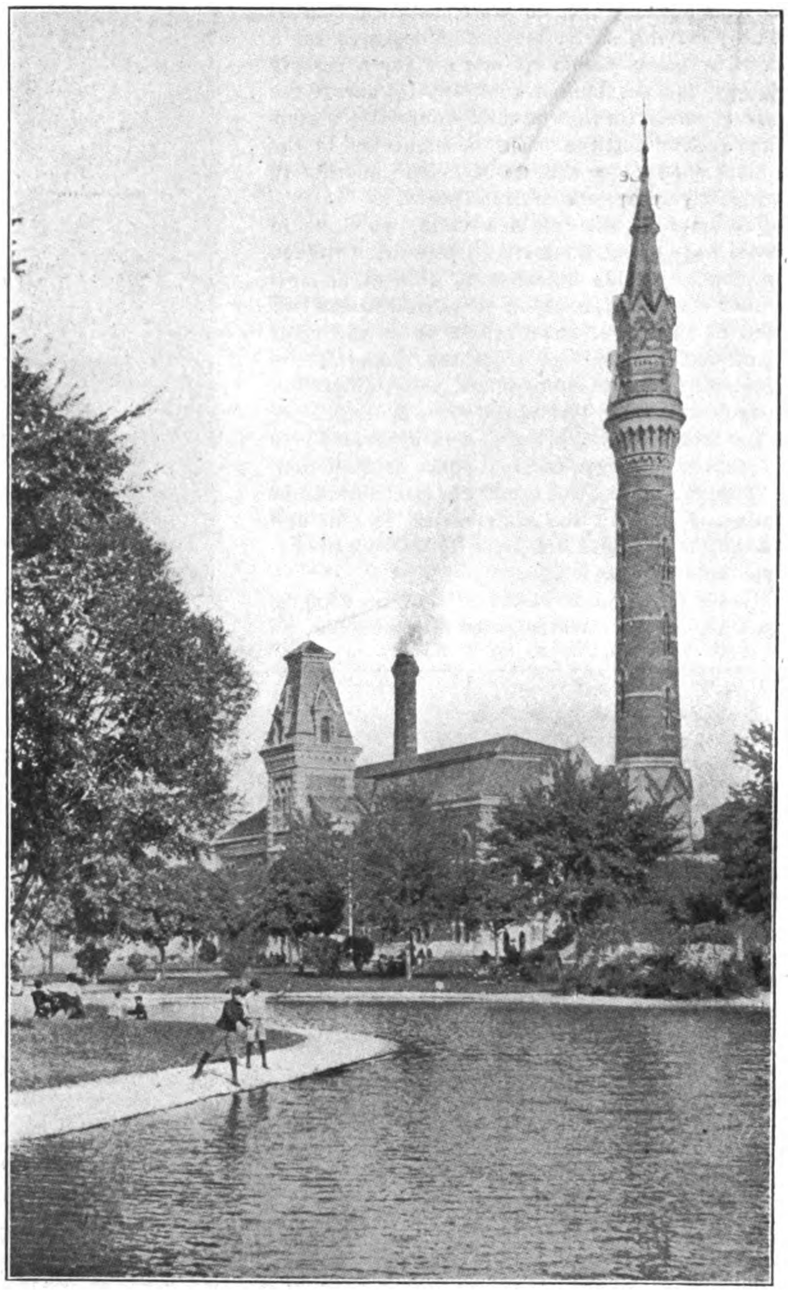
Views Showing Development of Detroit Water Works in a Quarter Century.



The Detroit Water-Works, 1848-1858.



The Detroit Water-Works, 1858-1874.



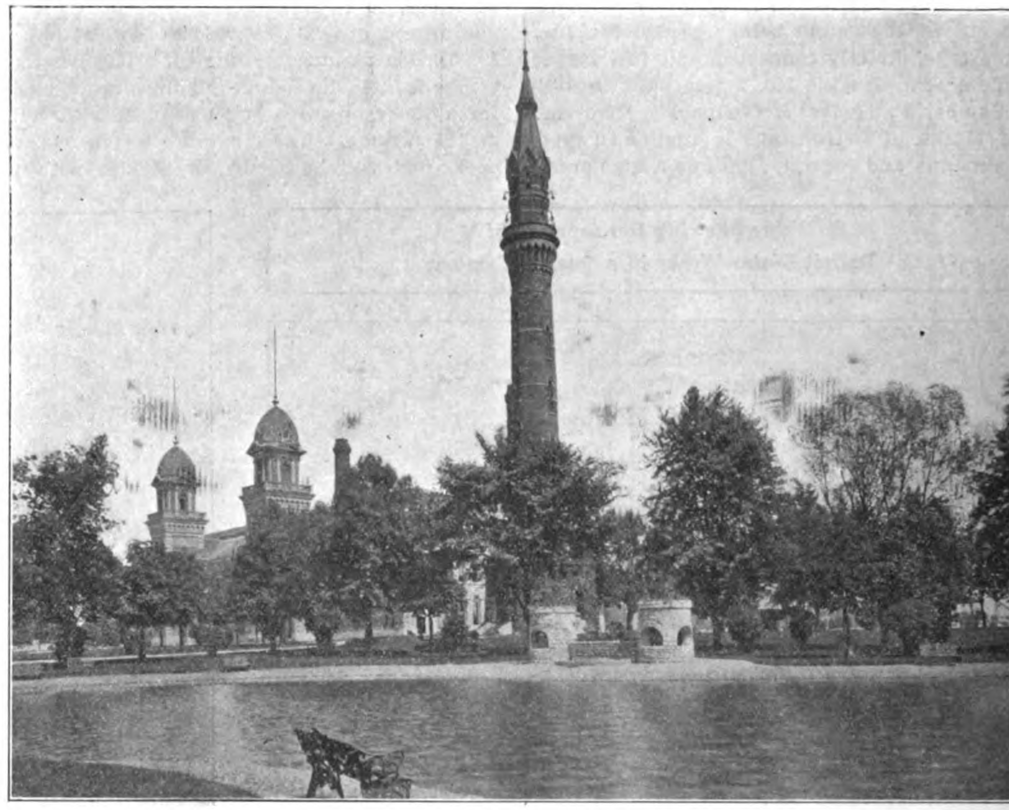
The Detroit Water-Works, 1874.

The water supply is taken from the American channel of the Detroit River opposite the head of Belle Isle. The three intake cribs lie in about 28 feet of water, are of the submerged type, and have vertical white-oak strainer bars, between which the clear opening is about 1¾ inches. The average depth over the tops of the cribs is 20 feet, and water is taken in through side openings only. Water flows by gravity from the intake cribs to a receiving basin 365 feet wide, 775 feet long by about 16 feet deep, through three boiler-plate intake pipes, two of which are 6 feet in diameter and one 5 feet, having lengths of 1,030, 1,505 and 1,505 feet, respectively. The intake cribs are frequently blocked up by anchor ice in winter, and several mechanically operated emergency devices are employed to overcome the difficulty. The receiving basin, originally designed for a settling basin, serves as storage for a reserve supply for the pumps sufficient to carry the works safely through several hours of ice stoppage. The settling basin is connected to the pump wells by a system of brick conduits in which strainer wells are interposed.

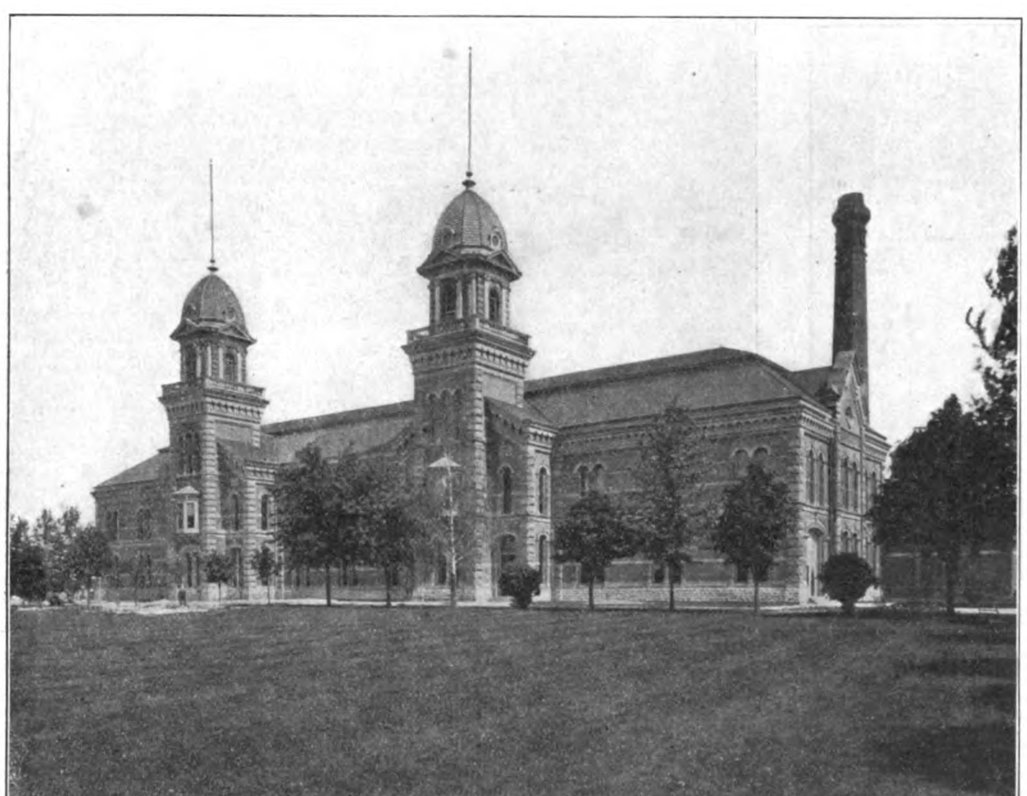
To improve the intake system, which is in some ways unsatisfactory, a 4-ring brick tunnel, having an inside diameter of 10 feet, is now under construction, being completed to the bottom of the shore shaft which is at the river bank about 1,360 feet from the pumping station. From the shore shaft, the tunnel will extend under the bed of the river a distance of 3,160 feet, and will terminate in a surface crib of timber, concrete and cut-stone construction.

The population, consumption, and number of miles of pipe in the distribution system and valuation of works are given in an accompanying table by decades.

Bonds outstanding at the present time aggregate $1,029,000. Water rates are very low, as shown in the following schedule, adopted July



The Detroit Water-Works Park, 1903.



The Detroit Water-Works Pumping Station, 1903.

Meter Rates—Payable Quarterly.

	Quarterly.
First 30,000 gals.	$1.75
All in excess of 30,000 gals.	2¼ cts. per M.
Minimum rate	1.75

Assessment Rates.

	Per annum.
For family, household purposes	$2.60
Additional families to first, in same house supplied through same faucet, each family	1.40
Greenhouses—Special rates.	
Private stable, for each horse	1.20
Livery stables, for each horse	1.20
Dray and team horses, each	1.60
Cows, each	.60
Stores and offices, from	$1.00 to 12.00
Bakeries, average daily use for each barrel of flour	2.00
Groceries and provision stores, from	$3.00 to 50.00
Saloons, from	6.00 to 50.00
Bar, with faucet, from	8.00 to 50.00
Fish houses, from	6.00 to 50.00
Beer Pump	2.00
Barber shops, each chair	2.00
Slaughter houses—Special rates.	
Hotels and Taverns, in addition to family rate, each room	.60
Boarding schools, from	$4.00 to 50.00
Printing offices—Special rates.	
Butcher stalls, each not less than	3.00
Workshops, for 10 persons or under	3.00
Workshops, for each additional 10 persons	1.00
Boarding Houses, in addition to family rate, each boarder or roomer	.40
Estimated quantities of water each 1,000 gals.	.07
Building purposes, each 1 M. brick	.03
Building purposes, each 100 yards plastering	.05
Building purposes, each perch stone	.01
Building purposes, minimum	.50

Fixtures.

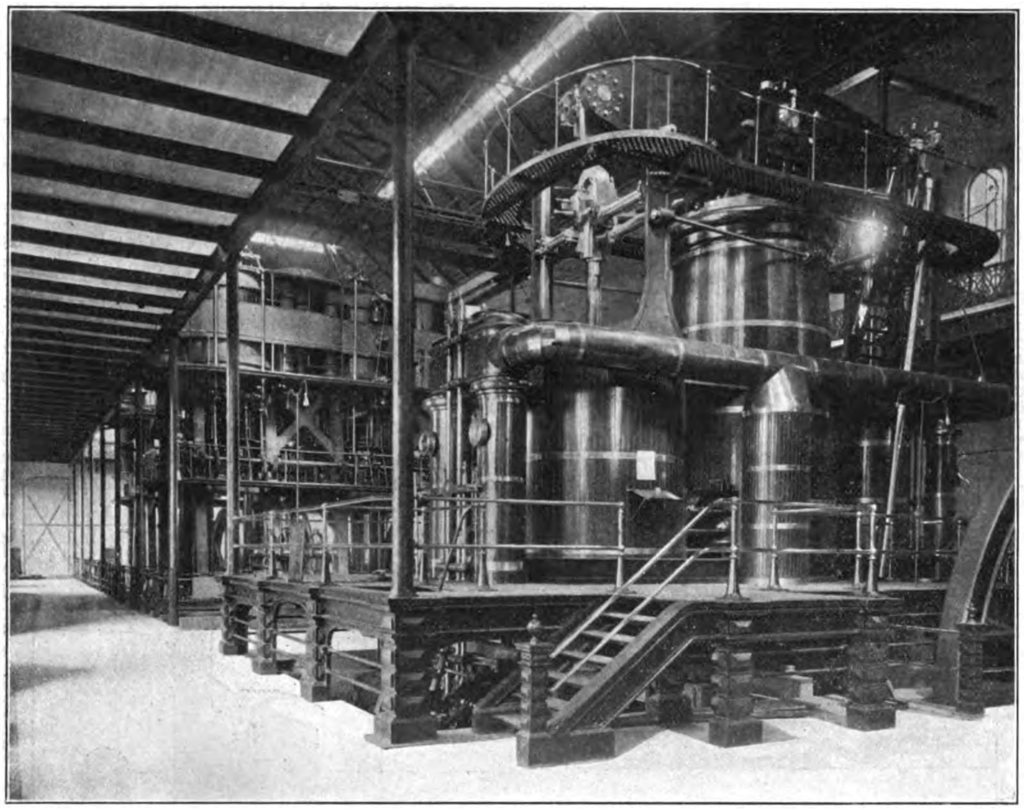
Bath tub, for families, 1st tub	$1.00
Bath tub, each additional tub	.60
Bath tub, public, each tub	4.00
Automatic water closets, for family, 1st closet	1.60
Automatic water closets, each additional	.60
Automatic water closets, for hotels, stores, factories, etc., for 10 persons	2.00
Automatic water closets, each additional person	.20
Rod water closets, not less than	6.00
Urinals, not less than	2.00
Wash hand basins, for family, each	.50
Wash hand basins, for other purposes, each person	.15
Hose bibb or connection, premises 30 feet front or less	.60
Hose bibb or connection, premises 30 feet to 60 feet	.80
Hose bibb or connection, premises, 60 feet to 100 feet	1.60
Special rates for larger grounds.	
Fountains	$5.00 to 20.00
Street sprinklers, each wagon	50.00

Where there is a waste of water an increase of rates will be made.

The distribution system, at the close of the year ending June 30, 1902, comprised 581 miles of cast-iron pipe in sizes from 3 to 42 inches in diameter, as follows:

Size of pipe, inches.	Total length in feet, to July, 1902.
42	73,379
36	3,602
30	54,494
24	84,587
20	393
18	87
16	53,829
12	37,562
10	163,655
8	324,716
6	1,395,798
4	810,633
3	63,221

The pumping station is not centrally located with reference to the distribution system, lying at the extreme easterly side of the city; and as the supply mains extend nearly 12 miles north and west, the friction losses to the points most distant from the station is considerable. The ground rises gradually, reaching an elevation of about 70 feet above the surface of the river at the extreme north end of the city, in which portion the available pressure for use is very low, not more than 14 to 18 pounds after deducting friction and elevation. For many years, residents in this portion of the city were able to draw water only on the first floor, and in some instances even this was not possible except at certain hours of the night. About 1890 it was the custom to throttle gates in order to restrict the area supplied and thus reduce the velocity in the mains supplying the upper district, thereby gaining a few feet head, due to the reduced frictional loss, the maximum pressure available at the pumps being 60 pounds only. The system of throttling gates to prevent the flow of water from high to lower territory was elaborated by Mr. Gardner S. Wil-



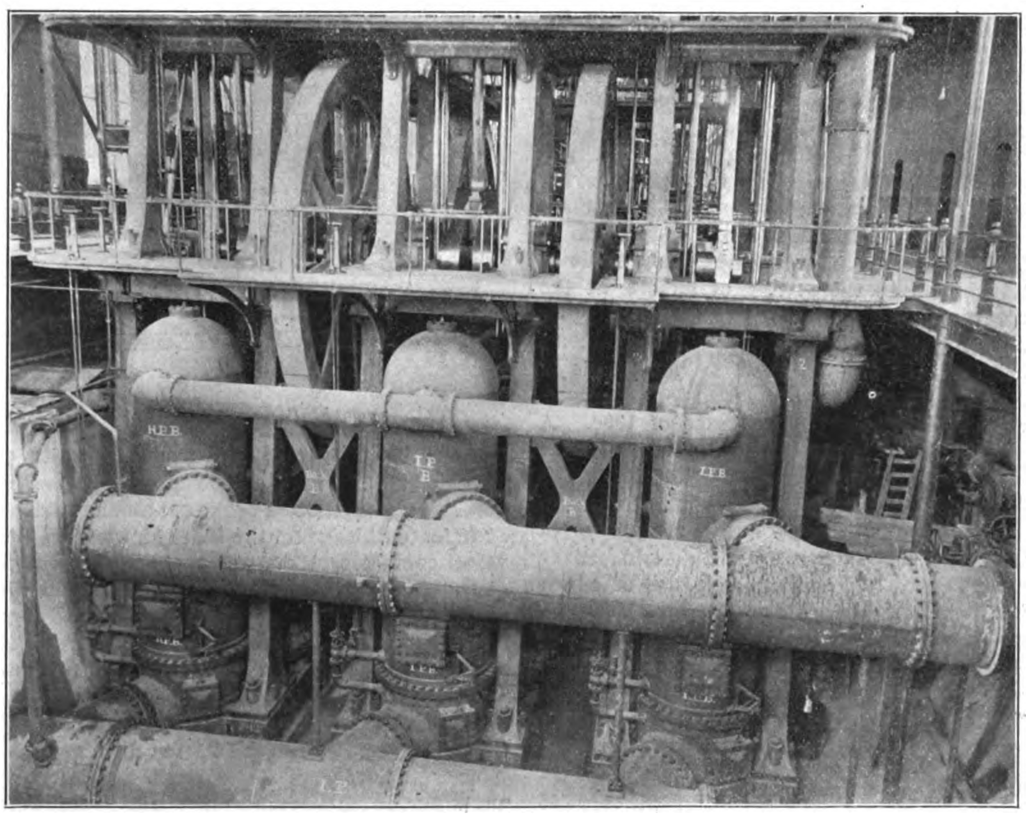
Interior of Detroit Pumping Station Showing Some of the Large Engines.

liams, M. Am. Soc. C. E., civil engineer to the Board from 1893 to 1898.

In 1898 it was decided to divide the city into two systems, each to be supplied by its own pumps and mains. The division was made on a contour line approximately 50 feet above the river level. A new line of 42-inch pipe was laid to supply the upper district; and the two 25,-000,000-gallon pumps now nearing completion, belong to the upper or high-pressure system. The lower system, along the river front, is supplied through three 42-inch cast-iron force mains, and the pressure of 60 pounds obtainable from the old pumps is sufficient for all purposes except fire. All buildings above five stories have their own pumping plants.

In order to determine the frictional loss at various points in the system, thirty Crosby pressure gauges are located in the various fire department engine houses throughout the city, and are read hourly by the watchmen in charge, throughout the entire twenty-four hours. The records of these gauges are reported weekly to the civil engineer and furnish data upon which to base the extensions required from time to time. They prove very useful, also, in showing, as they do, the maximum and minimum pressures to be expected during the year in the case of proposed high buildings or use of power for pumps, elevators, and small turbines. Self-recording gauges have been used to some extent, but on the whole have proven of little benefit, partially on account of the constant pulsation which is felt to the farthest extremity of the system at every stroke of the pump. No one thing adds more to the efficiency of the engineering department than the records obtained from the pressure gauges, which are carefully tested from time to time, and their readings averaged and kept ready for immediate use.

The pressure maintained by the engineers at the pumps is regulated by a gauge 4 miles away, in the water office near the center of the city, where a constant pressure of 27 to 28 pounds is maintained. The pressure at the pumps varies according to the amount of water used and the consequent intervening friction in the mains, the range being from 40 to 60 pounds, according to the time of day and the season of the year. The maximum hours occur in the summer when lawn-sprinkling is done, at which time the friction is greatest; but the maximum days usually occur in winter when many taps are left running full to prevent freezing during the entire twenty-four hours.



Water End of One of the Allis Triple-Expansion Pumping Engines.

The Detroit system furnishes an unusually good opportunity to study the phenomena of consumption, there being no reservoir to complicate results, and only one station supplying the entire system. The pumps being of the piston and plunger type, give an accurate record of the amount of water used, and this is recorded for each hour of the twenty-four. The hourly records extend over a period of about ten years, previous to which time daily records only were kept. The consumption recorded at the minimum hour, between 2:00 and 3:00 A. M., during the periods of minimum consumption, which occur twice a year, in the spring and fall show a consumption rate of 88 to 90 gallons per person supplied. Careful experiments, made in districts where the pipe was new and tested before covering so that it was known to be absolutely tight, indicate that the necessary consumption at this hour, both in resident and manufacturing districts, is at the rate of 13 to 16 gallons per capita daily. These results are also substantiated by Deacon meter readings taken some years ago in an old portion of the city. Making allowances for all legitimate use of water, it is safe to say that at least 70 gallons daily per person serves no useful purpose; and, as the present average consumption is 162 gallons per person, the waste amounts to 43 per cent. of the total quantity of water pumped. The rate of consumption during maximum hours occasionally reaches 300 gallons per person, for which the works must be designed. The 70 gallons wasted therefore necessitates an excess capacity in the works of about 23 per cent.

This question of waste is no new problem, neither in Detroit nor other cities. As far back as 1836 bitter complaint was made that the pumps were required to deliver 19 gallons daily per person, most of which, it is alleged, escaped through the leaky joints in the lines of wooden pipe.

A few meters were introduced in 1854 and 1857. It was not, however, until 1888, when the consumption had reached an average of 215 gallons per person supplied that the subject of meters received any serious consideration. At that time a crusade was established to reduce

STATISTICS OF DETROIT WATER WORKS.

Year.	Population.	Miles of pipe.	Million gallons pumped.	Million gallons metered.	Total rates collected.	Value of works.
1810	770	....	....	....	......	......
1820	1,442	....	....	....	......	......
1830	2,222	Few logs	....	....	......	......
1840	9,192	No record	....	....	......	‡$20,500
1850	21,019	No record	....	....	......	......
1860	45,619	Wood 27, Iron 39	870	....	49,434.90	690,000
1870	79,577	Wood 67, Iron 52	1,866	....	127,143.61	1,030,372
1880	116,342	Wood 84, Iron 125	5,553	*40	227,452.73	2,751,000
1890	205,876	Wood 10, Iron 351	12,121	626	387,877.73	3,712,000
1900	292,462	571	17,077	3,283	†309,385.22	6,221,000
1903*	330,000	620	....	....	......	7,000,000

* Estimated. †Rates reduced in 1896 and 1898. ‡ Purchase price in 1836.

the consumption, in which Mr. Leverette N. Case, then secretary of the Board, now manager of the water and gas works at Duluth, took an active part. A corps of inspectors was organized, excessive waste at the pumps was cut off, and the installation of meters begun. The waste at the pumps was considerable, owing to the fact that they were allowed to run full capacity even during hours of minimum consumption, the excess being returned through waste gates into the pump wells. The reduction in per capita consumption from 215 gallons, 1888, to an average of about 130 gallons, 1898, can be credited approximately as follows:

	Per consumer daily.
Saving due to meters, about	45 gal.
Economy at the pumps, about	30 gal.
Work of inspectors, about	10 gal.
Total reduction	85 gal.

The meter system was gradually extended to cover all manufacturing and business consumption; and, in 1894, about 1,000 private houses were metered. They demonstrated that a considerable saving could be effected; but the extension of the meter system to cover all domestic consumption, could not be defended upon financial grounds, owing to the exceedingly low cost of furnishing the water—in fact, it would be difficult to find a city where the financial benefit of the meter system would be less than in Detroit, owing to the unlimited supply, comparatively low pressure, and economical pumping machinery. The policy of metering all manufacturing, business, and public supplies, is still continued, and all villages lying outside the corporation limits are supplied by meter, paying double rates for water consumed. The increase in per capita consumption from 130 gallons in 1898 to 162 in 1902 is not believed to be due to retrenchment in the setting of meters, as the percentage of metered water within the city has constantly increased; but may be in part accounted for by the reduction in rates made in 1897-8 and in part by corrected population returns based on the U. S. Census of 1900. A 42-inch Venturi meter has been placed in the force main supplying the upper district. The village of Highland Park is supplied through a 12-inch Venturi meter; and the villages of Hamtramck, Woodmere, Delray and River Rouge are supplied through batteries of 4-inch and 6-inch Thomson meters. On June 30, 1902, there were 59,225 service connections in use, of which 5,738 were metered. About 2,200 services are added yearly. The total water pumped last year was 18,333,104,700 U. S. gallons, distributed in the following manner:

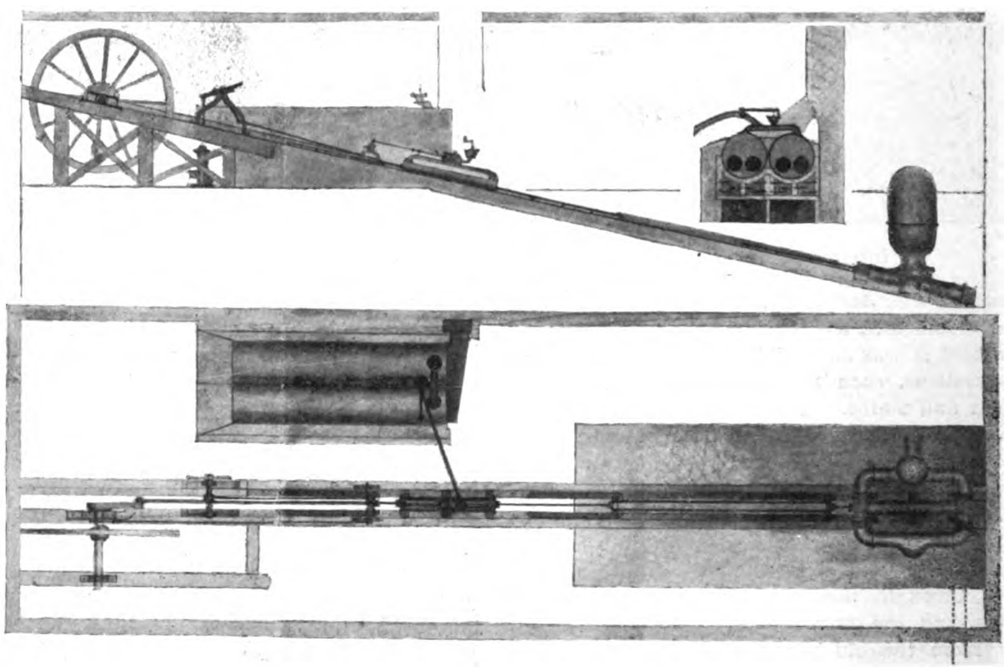
	Per cent.
Unmetered city consumption	76.14
Metered city consumption	23.02
Supplied to villages by meter	.83

The present valuation of the works is approximately $7,000,000; the pumping station and real estate, $2,600,000; distribution system, $4,280,000; meters, $100,000; tools and materials on hand, $120,000.

Although unfiltered, the quality of water supplied is the very best, and the typhoid death-rate lower than in most cities which have purification works. The death-rate from this disease averages only 16 per 100,000, while the death-rates in Chicago and Cleveland are about 80 per 100,000. The following table shows maximum and minimum results of chemical and bacterial examinations extending over a period of one year:

Description.	Parts per million. Minimum.	Maximum.
Appearance	Clear	Slightly turbid
Total solids	103.0	118.2
Volatile matter	34.8	44.4
Non-volatile matter	58.6	79.6
Free ammonia	.006	.028
Albuminoid ammonia	.074	.126
Nitrogen as nitrates	.082	.230
Nitrogen as nitrites	.000	.000
Chlorine	2.50	3.15
Oxygen absorbed in 15 min.	.28	.48
Oxygen absorbed in 4 hours.	.72	.96
Bacteria per cubic centimeter	26.	398.
Growth in .2 per cent. carbolic-acid gelatin	None	None

Notwithstanding the purity of supply, Detroit has not been entirely free from epidemics of those diseases which are considered as waterborn. In 1832, cholera broke out among soldiers en route to Chicago for the Black Hawk War. The vessel containing them was anchored for a time at Belle Isle, and many diseased soldiers finally landed at Mt. Clemens, 25 miles from the city, some of them finding their way to Detroit. In addition to the soldiers who died, the epidemic resulted in the death of ninety-six citizens. Two years later, cholera again broke out and seven per cent. of the population died within a month. There were also outbreaks in 1849 and 1854, during the heights of which there were thirty-five to forty deaths per day. It is doubtful whether these epidemics could be traced directly to the water supply. There has never been a serious epidemic of typhoid fever, although certain cases have been clearly traced to pollution coming from cities above Detroit, and especially to the dredging out of Black River at Port Huron, 60 miles away.



Reproduction of Old Drawing of Pump and Boiler Used in 1831.

The water is suitable for industrial purposes, causing slight though not excessive scale. The following table gives the mineral analysis in grains per U. S. gallon:

Sodium chloride ($NaCl$)	0.288
Sodium carbonate (Na_2CO_3)	0.069
Potassium chloride (KCl)	Trace
Calcium sulphate ($CaSO_4$)	0.639
Calcium carbonate ($CaCO_3$)	3.122
Magnesium carbonate ($MgCO_3$)	1.506
Silica (SiO_2)	0.093
Alumina (Al_2O_3)	0.198
Ferrous carbonate ($FeCO_3$)	Trace
Total mineral matter	5.906
Organic and volatile matter	2.123

The structural records of the Board are kept by the engineering department organized by Mr. Gardner S. Williams in 1893, prior to which time much reliance was placed in the memory of certain foremen who, unfortunately, had a habit of dying at inopportune times; the records could not, therefore, be said to be of a permanent nature. There is now a detailed drawing of every street intersection, some 5,000 in all, showing the location of the water mains and all other construction, such as conduits, sewers, drains, gas pipes and works of private companies. Sketches are made of all underground work exposed from time to time, and the information posted on the drawings as rapidly as possible. These records are therefore becoming more complete and valuable year by year, it being the policy of the department to record only such construction as is absolutely known to exist—on the principle that it is better not to know so much than to know so much that isn't so. The system of records is supplemented by a complete card index; and it is believed that few systems, outside of the Metropolitan Water Board, are so well organized in their engineering departments.

The fire department of the city is managed by a separate board; but although it has an auxiliary supply consisting of a system of steel pipe lines to which powerful fire boats may be attached at various points along the river front, its main supply is obtained from the water-works system. At the close of the last fiscal year there were in service 3,613 fire hydrants and 561 reservoirs. Fire engines are used and a record is kept of the quantity of water used at each fire; although considerable, amounting to about 16,000,000 gallons per year, it is a small amount compared with the normal consumption. All the water used to put out fires in a year is less than one-tenth of one per cent. and could be pumped in sixteen hours by our smallest pump.

This sketch would not be complete without some mention of the water-works park. The grounds, some 70 acres in extent, surrounding the pumping station, are maintained as a public park, the finest in the city. The handsome and much used Hurlbut Branch of the public library, which forms an attractive feature of the park, is remodeled from the old oil tank formerly used for the storage of fuel oil. There is a pear tree in the park which measures 9 feet 4 inches in circumference 3 feet above the ground. Tradition says that the Jesuit priests who visited the Indians some 200 years ago brought pear seeds from France, which they planted along the shores of Detroit River, always placing eleven in a cluster and one by itself a little to one side to represent Judas; when the grounds were purchased it was necessary to remove all that remained of the cluster, and now "Old Judas" keeps his lonely watch, the last of the twelve.

In the history and development of the works, no one man has exercised so great an influence as Chauncey Hurlbut. He was connected with the business interests of Detroit when it was a mere village, having a population not exceeding 3,000; and it was his privilege to witness the development from small beginnings to a city of 170,000. Having sustained loss by fire in 1831, he was active in the formation of the first fire department, and organized the Hurlbut Hose Company No. 1, June 6, 1837. He was chief engineer of the fire department from 1837 to 1842, at a salary of $100 per year. A letter written by him at that time well illustrates the public spirit and high ideals of the man:

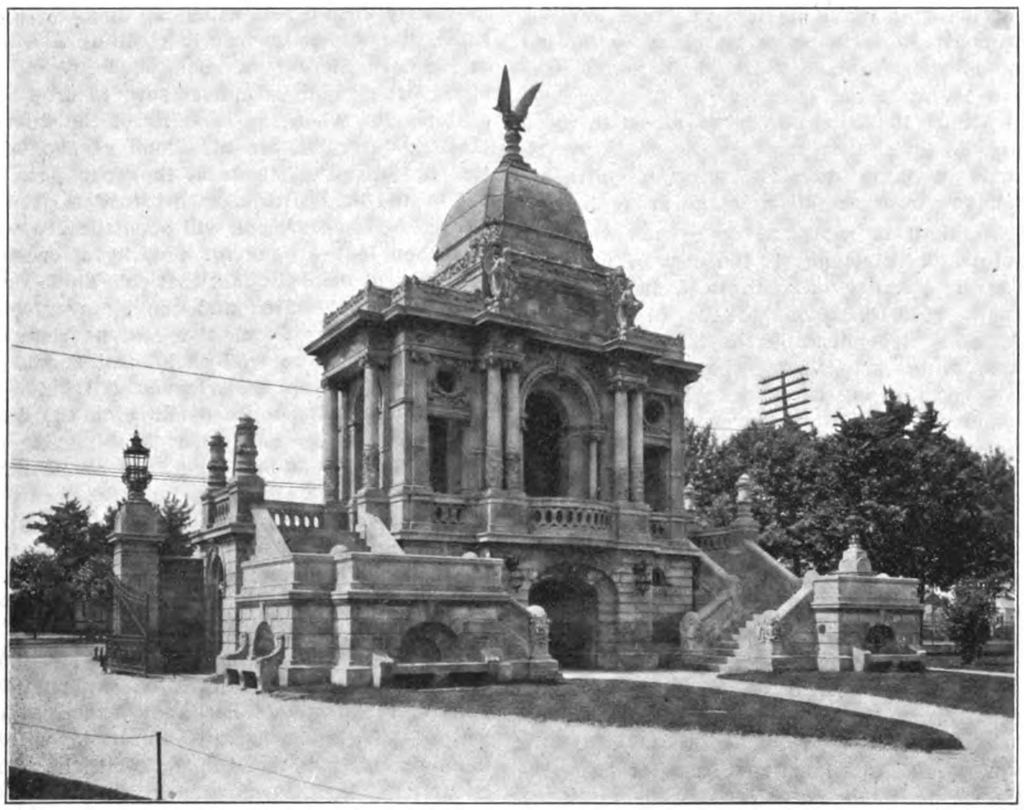
"Detroit, March 3, 1841.

"Jno. Owen, Esq., Pres. Fire Department of the City of Detroit.

Dear Sir:—Enclosed you will find a warrant on the City Treasurer for $100 which I received for services as Chief Engineer. Being a believer in Franklin's doctrine that no man should grow rich by emoluments of office, I remit the warrant to you for the benefit of the Fire Department.

"Very respectfully yours, CHAUNCEY HURLBUT."

He served as president of the fire department in 1843. He was secretary of the Detroit Mechanics' Society in 1835, and the library of the Society was still given a place over his store on Woodward Avenue in 1873. He was one of the first directors of the Merchants' Exchange and Board of Trade organized in 1847, also of the Second National Bank opened in 1863. He served several terms as alderman from the second ward of the city, and was appointed on the Detroit Sewer Commission in 1857 for one year. His greatest public service, however, was connected with the development of the water works. His connection with that enterprise, although not continuous, dates from March 1, 1840, when he was appointed to serve on a committee on "new hydraulic works." He was a member of the Board of Water Commissioners from 1861 to 1863, was again appointed in 1868, and was made president in 1873, which position he retained until his death in 1885 at the age of eighty-two years. He was especially interested in the plans for enlargement when that ever-recurring subject came up for consideration in 1870; and it was largely due to his energy and foresight that the present location of the pumping station was selected, and that the plans adopted at that time were laid out on a scale which admitted of extension to meet the requirements of a growing city. His confidence in the prosperity of Detroit was absolute, and his policy accordingly broad in its conception. Having acquired a comfortable fortune, he practically gave up his own business, and devoted his entire time and the experience of his ripest years to the development of what he considered Detroit's greatest need. In the face of bitter opposition, he carried his plans to successful issue by sheer force of will; and in later years the correctness of his judgment was acknowledged even by his enemies. A man of large ideas, he did not forget details, and applied to the management of the works those principles which had made his own business a success, reducing the operating expenses to the lowest possible amount. His fortune was left in trust for the permanent maintenance of the water-works park and a public library in connection therewith. The Hurlbut memorial gateway was erected by the Board at a cost of $30,000 in appreciation of his services.



The Hurlbut Memorial Gate of the Detroit Water Works.

Management of Pumping Stations.

By Kenneth Torrance, M. Am. Soc. M. E., Chief Engineer, Ridgewood Pumping Station, Brooklyn.

In the management of pumping stations on which the supply of water for large or small communities depends, the principal object to be sought must be the uninterrupted supply of water. When one stops to think of the consequences which would follow to a city of any size should the water supply suddenly fail, it is readily seen that water is the most essential of all the various articles required for daily life. In some fortunate cities they always have considerable water supply in reserve by being supplied from large storage reservoirs, but most of our largest cities have to depend on the continuous operation of pumping stations.

Large bodies move slowly, and this is especially so in regard to large water works plants. Usually, no matter how large the plant is when planned and work started, it is just about equal to the demand when completed and it must then be operated to its maximum capacity while new and larger plants are designed and built.

In keeping up a continuous supply, the most important thing is eternal vigilance, and second to that is system. Every detail should be watched, and, as far as possible, the spare engines or boilers must be in such condition that should an accident occur to those in operation, others can be started at once. If the plant contains spare machinery, it is best to run the engines and boilers in turn for certain periods at a time, all the most important repairs, etc., being done at once on shutting down, so as to be prepared for emergency.

In this way a smaller force can be used, the work being done to the best advantage. If we could only plan out the work ahead, shutting down each engine or boiler at certain intervals, sweeping tubes, washing, cleaning and testing boilers, examining feed and air pumps, overhauling water plungers and valves, packing, etc., all these and other matters being taken up on regular days in turn, it would simplify matters immensely, but it is the unexpected that always happens and no sooner does the system get in fair order than something is sure to occur and several cogs are slipped before things are moving smoothly again. Most pumping stations, save in very small cities, run continuously day and night. The most satisfactory system is where there are storage reservoirs large enough so that the pumps can be operated at constant speed and not be dependent on the consumption, for in the latter case engines must be shut down and boilers banked during the small hours of the night and then started up again when the large consumption of early morning comes. The present trend of the times is certainly toward an eight-hour working day, and this division works very nicely in the continuous running of stations as it gives three watches in each day. This usually divides as follows: The morning watch, 6:00 A. M. to 2:00 P. M.; the afternoon watch, from 2:00 P. M. to 10:00 P. M.; and the night watch, from 10:00 P. M. to 6:00 A. M. These three watches are devoted to those who are immediately connected with the running of the machinery, engineers, oilers, firemen, etc. Then there is the regular day watch of from 8:00 A. M. to 5:00 P. M. for those about the station engaged in repairs, cleaning, etc., and duties which can only be done effectively in the day.

Anyone who has had much night work to do will appreciate how unpleasant and wearisome the turning of night into day becomes, and, in the Brooklyn Water-Works, our watches are arranged so as to have each set of men one