

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

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(Continued from page 381.)

CCCCII.—OWEGO.

Owego, New York, in lat. 42° 15' N., long. 76° 20' W., is on the Susquehanna River in a hilly region.

Water-works were built in 1879 by S. L. Wiley for a private company, taking the supply by gravity from Barnes Creek, a mountain stream of about 3 square miles water-shed. An earth dam 60 ft. high, with slopes of 2½ to 1 on the inside and 2 to 1 on the outside, forms a reservoir on the stream, 2½ miles distant from and 235 ft. above the town. The water is filtered through sand and gravel and conveyed through 12-in. cast-iron pipe to a small reservoir in excavation, with paved slopes, on a hill near the town. When the supply from this source is deficient in extreme drought, it is supplemented by pumping from a well in the upper part of the town by a compound Deane steam pump of 500,000 gallons daily capacity.

Distribution is by 10½ miles of pipe, of from 12 to 2 in. diameter. Pipes of 4 in. and greater diameter are of cast iron. Those under 4 in. are of wrought iron, coated with asphalt. There are 51 fire hydrants, 25 gates and 248 taps. The town pays \$50 per year for each hydrant. Service-pipes are of wrought iron, coated with asphalt, and of lead.

The population in 1880 was 6,087 and the daily consumption is 200,000 gallons.

The capital stock of the company is \$100,000. No further financial statistics are given.

S. L. Wiley is the general manager and H. W. Moore the Superintendent.

CCCCIII.—KINGSTON, CAN.

Kingston, Ontario, in Canada, in lat. 44° 8' N., long. 76° 41' W., on Lake Ontario, is on ground sloping up from the lake to an elevation of 80 ft. It was founded in 1784 on the site of the old French fort Frontenac, which was built about 1675.

Water-works were built by a private company in 1849, after plans of R. L. Innes, taking the supply from Lake Ontario. A wooden crib, divided into compartments filled with coarse stone, gravel and sand, is submerged in the lake. From the bottom of this filter, which is said to be able to pass 3,000,000 gallons per day, the cast-iron suction pipe of the pumps is led. The water is lifted 80 ft. by a steam engine (beam) with double-acting vertical plunger pumps of 8-in. bore and 54-in. stroke, into a reservoir holding 600,000 gallons. An 8-in. stand-pipe, used to give fire pressure in the mains, rises 15 ft. above the reservoir. Distribution is by 10 miles of cast-iron pipes of from 8 to 3-in. diameter, with 42 fire hydrants, 45 gates and 816 taps. There are 20 meters. The city pays \$275 per year for fire hydrant service. Service pipes are of lead.

The population in 1880 was 15,000. The daily consumption is 750,000 gallons.

The capital stock of the company is \$120,000. The works have cost \$160,000. There is no debt. The expenses in 1881 were \$8,325 and the receipts \$19,000.

R. L. Innes was Superintendent to 1854 and James Wilson has held the position since that year.

CCCCIV.—RENOVO.

Renovo, Pennsylvania, in lat. 41° 15' N., long. 77° 45' W., is on the West Branch of the Susquehanna River, in a mountainous region.

Settled in 1863, it was incorporated as a city in 1867.

Water-works were built in 1872 by the city after plans of E. H. Walsh, taking the supply from a mountain stream, a dam across which forms a reservoir holding 20,000 gallons, 150 ft. above the city and three-quarters of a mile from it. A cast iron main conveys the water to the tank. Distribution is by 15 miles of wrought iron and cement pipe of from 10 in. to 18 in. in diameter, with 29 fire hydrants, 29 gates and 265 taps. Service pipes are of lead and of wrought iron.

The population in 1880 was 3,014. The daily consumption is not known.

The works have cost \$65,000. The bonded debt is \$45,000. The expenses are not given. The receipts in 1881 were \$2,200.

The works are managed by the City Council. James H. Ferguson is the Superintendent.

CCCCV.—FREDERICKSBURG.

Fredericksburg, Virginia, in lat. 38° 20' N., long. 77° 25' W., on the Rappahannock River, is on a plain slightly elevated above the river and surrounded by hills.

Settled in 1727, it was incorporated as a village in 1727, as a borough in 1781, and as a city in 1870. Water-works were built by a private company in 1832, after plans of Alexander Henderson, taking the supply from Poplar Springs, half a mile from the town. It is distributed through 4 miles of cast-iron pipe, with 225 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,000. The daily consumption is not known. The water is only used for culinary purposes. The citizens generally use water from wells provided by the city government. The capital stock of the company is \$17,000. The works have cost \$25,000. No further financial statistics are given.

J. W. Sever has been the Superintendent for 25 years.

CCCCVI.—LEWISTON, ME.

Lewiston, Maine, in lat. 44° N., long. 70° W., on the Androscoggin River, is on undulating ground, rising from the river to hills 350 ft. high. There is a fall of 70 ft. in the river opposite the city, which is utilized for water-power for manufacturing purposes. The source of the Androscoggin is a chain of mountain lakes with 80 square miles water-shed, about 100 miles above Lewiston. The town was incorporated in 1795 and chartered as a city in 1863.

Water-works were built by the city in 1878 after plans and under superintendence of M. M. Tidd, C. E., taking the supply from the river above the falls and pumping it by two Worthington duplex pumps, of 3,000,000 gallons daily capacity each, driven by two Ridsen turbines. A brick conduit conveys the water from the pond to the pump-well. In 1890 a filter of 400 square ft. area, with 32 in. of sand and sea gravel, was constructed in the conduit. The water passes up through the gravel and falls over a weir to the well.

The pumps lift the water 250 ft. through 10,450 ft. of 24-in. pipe to a reservoir 15 ft. deep, built in side hill excavation and embankment, the inner slopes paved with cobble-stones, and holding 15,000,000 gallons, at 220 ft. above the general level of the city. The pressure in the mains is from 70 to 120 pounds, according to location.

Distribution is by 23 miles of cast-iron pipe of from 24 to 4-in. diameter, with 148 fire hydrants, 175 gates and 1,800 taps. There are 25 meters in use. The city contributes \$40 per year for each fire hydrant. Tared wrought-iron service pipes are generally used, and some of galvanized iron.

The population in 1880 was 19,083. The daily consumption in 1881 was 1,016,260 gallons, with 1,518 taps.

The works have cost \$500,000, including \$200,000 paid for water-power and privileges. The receipts have been \$61,332.88. The bonded debt is \$474,000 at 5 per cent.

The expenses in 1881 for maintenance and repairs were \$14,711.32, and the receipts \$25,837.88.

The works are managed by a board of seven commissioners, one being elected by the City Council each year. James Dempsey is President of the board; John Read, Clerk and Registrar, and John F. Nash, Superintendent.

F. F. Forbes, Superintendent of the Brookline (Massachusetts) Water-works, and Edward S. Philbrick, C. E., having noted some inaccuracies in the description of those works on p. 251, ENGINEERING NEWS, of July 22, 1882, have furnished more complete data and a full set of the reports, which enable the following description to be prepared. It is to be substituted for the one previously printed:

CCCLX.—BROOKLINE.

Brookline, Massachusetts, in lat. 42° 40' N., long. 71° 10' W., on the Charles River and a small, tidal estuary called Muddy River, is bounded on three sides by the city of Boston. It comprises about 200 acres of salt marsh, 500 acres of a plain of river gravel rising to about 100 ft. above tide, and hills of glacial drift rising from 300 to 500 ft. above tide. Settled in 1634, it was incorporated in 1705.

Water-works were built by the town in 1875, after the plans and under the superintendence of Edward S. Philbrick, C. E., taking the supply from the ground water on Cow Island, a ridge of gravel surrounded by marshes, alongside of the Charles River, about 6 miles from the heart of the town.

A collecting gallery was excavated from 100 to 300 ft. from the river, in clean, coarse sand and gravel. Its bottom is 6 ft. below the lowest stage of the river. It is 4 ft. wide, with vertical side walls 2 ft. high, of uncemented rubble stone, and covered by a semi-circular brick arch 8 in. thick. At first, two sections, respectively 491 and 271 ft. long, were built, connected by 389 ft. of 24-in. stone-ware pipe with cemented joints, laid through a peat bog, from which it was not deemed advisable to take water. From the filter gallery, a conduit of 24-in. stone-ware pipe was laid on a timber foundation in saturated gravel and sand 6½ to 10 ft. below the surface of the swamp for 3,074 ft. to the pump well and engine house. This was completed in November, 1874. In July, 1875, it was found that 10 per cent. of the pipes were broken by the weight of the superincumbent gravel. They were removed and replaced by a flume of 3-in. white pine plank, 2 ft. square inside, and with tongued and grooved joints.

In 1878 there were complaints of impurity of the water, and it was found that the wooden conduit had shrunk, admitting swamp water and sand through the joints. The gallery which, when first

constructed in September, 1875, had yielded 1,602,000 gallons per day on a 36-hour test, with the water in the pump-well 2.75 ft. above the gallery floor, yielded in July, 1878, 1,160,000 gallons per day with the water 2.30 ft. above gallery floor. The average daily consumption had increased from 200,000 gallons in 1875 to 465,000 gallons in 1878. The pumping station was removed to near the gallery, a 16-in. cast-iron force main substituted for the wooden conduit, and an additional gallery, 160½ ft. long, 6 ft. wide and 6 ft. high in the center, built from the pump-well to the old gallery. Weirs are so arranged that the water can be drawn from the new gallery at 7 ft., and from the old gallery at 6 ft. below low water in the river. This work was done after plans of Shedd & Sawyer, civil engineers. In examining the other old gallery, after the new arrangements had rendered it practicable to draw down the water, it was found that 460 ft. of its length was rendered useless by about 18 ft. of the arch having fallen in, evidently as soon as it was built, as the space had been filled with debris of brick, broken stone-ware pipes, brush, lumber and gravel. This was repaired and the whole length of galleries, 923 ft., made available. In June, 1880, the yield of the galleries was 1,000,000 gallons per day, and the daily consumption 1,200,000 gallons. On the recommendation of Gen. George S. Greene, C. E., a canal was dug along the bank of the river, parallel to and 30 to 50 ft. distant from the gallery for 150 ft. The bottom of the canal is 3 ft. below the river level and it is connected with the river. The admission of water from the river to this canal increased the yield of the galleries about 300,000 gallons daily.

The first pumping engine was a Worthington duplex compound condensing engine, with steam cylinders of 21¼ and 43½ in. and water cylinders of 16 in. diameter, all of 24 in. stroke, pumping through 9,070 ft. of 14-in. cast-iron pipe to a brick well 4 ft. in diameter and 17 ft. deep on Walnut Hill. The bottom of the well is at the same level as the water surface in the reservoir, 160 ft. above low water in the river. The 14-in. force main enters this well or stand-pipe at the bottom, and a 16-in. supply main leaves it also at the bottom and leads 13,000 ft. to the reservoir, with a branch at 6,000 ft. from the stand-pipe, leading directly to the city distribution. While the engines are running, the water is pumped directly into the mains, only the surplus reaching the reservoir.

Another Worthington engine of 1,000,000 gallons daily capacity was erected at the new pumping station in 1879, and the first engine then moved to the same place.

The reservoir is in a natural basin on Fisher's Hill. It is in excavation and embankment, with the bottom covered with 12 in. and the slopes with 18 in. of clay puddle. The bottom was then covered with 4 in. of gravel concrete, and the slopes with 12 in. of broken stone, on which was laid a dry slope wall of stone 15 in. deep. During construction, springs in the gravel banks gave trouble by softening the puddle. This was obviated by making pockets of broken stone and leading the water through the puddle by gas pipe. On the completion of the work the pipes were plugged.

Distribution is by 28.5 miles of cast-iron pipe, of from 16 to 2 in. diameter, with 164 fire hydrants, 150 gates and 1,013 taps (February, 1882). The town pays \$25 per year for each fire hydrant. Service pipes are now exclusively lead. Wrought-iron pipes enameled, cement lined and tarred have been used with unsatisfactory results.

The population in 1880 was 8,100. The number of taps in use at the end of each year and the daily consumption for the year have been as follows:

Year	Daily consumption	
	Taps	Gallons.
1876	587	336,452
1877	702	352,042
1878	755	462,867
1879	857	489,009
1880	930	570,738
1881	1,013	477,113

The reduced consumption in 1881 is due to inspection of fittings and cutting off waste.

In 1881 the consumption varied from 407,481 gallons in March to 588,607 gallons in August.

The total cost of construction has been \$621,530.88 to Jan. 31, 1882.

The bonded debt is \$593,000 at 4½ to 7 per cent. interest.

The expenses of maintenance in 1881 were \$7,999.94 and the receipts, \$14,199.04. The town contributes in addition, for water used for public buildings, \$6,497.50.

The works are managed by three Water Commissioners. F. F. Forbes is the Superintendent.

(TO BE CONTINUED.)

CORRECTIONS AND ADDITIONS.—Carroll E. Gray, Jr., reports that there are no water-works in Alliance, Ohio; Corsicana, Texas; Danville, Ill., and Sherman, Texas. July 15, 1882, p. 239, *Canon City, Colorado*. The works were planned by J. W. Peabody. There are 3½ miles of pipe and 21 gates,