each fire hydrant. This amount is included in the receipts in the following statement:

	Expenditures.			Receipts.
	Construction.	Interest.	Maintenance.	
1878	$7,033.42	$3,430.94	$1,209.17	$1,616.45
1879	5,204.68	4,117.17	1,338.53	5,408.70
1880	2,832.40	4,440.00	1,494.81	6,831.80

The superintendent of the water-works, Timothy Woodruff, reports to the water committee of the Common Council.

CLXXI.—ROCKFORD.

Rockford, Illinois, in lat. 40° 18′ N., long. 89° 10′ W., is on both sides of Rock River, which at this point is crossed by a dam 6 ft. high furnishing a water power used for manufacturing.

Settled in 1834 it was incorporated as a city in 1852. Water-works were built by the city in 1875 after plans furnished by the Holly Manufacturing Co., taking water from the river and pumping it directly into the main by Holly engine and four double-acting piston pumps of 9 in. diameter and 24-in. stroke. In the inlet pipe from the river there is a filter 25 ft. in diameter, filled with sand and charcoal, which passes 800,000 gallons of water per day, but does not work satisfactorily. A well 50 ft. in diameter and 45 ft. deep was also sunk in water-bearing gravel, which is said to be capable of yielding 1,500,000 gallons per day. Distribution is by cast-iron pipe of which 27 miles are in use, of from 20-in. to 2-in. diameter, with 190 fire hydrants and 1,000 taps. Wrought-iron pipe and lead pipe are used for service pipe. The mains on the opposite sides of the river are connected by 680 ft. of submerged 12-in. pipe, with 18 flexible joints

The population in 1880 was 13,136, and the daily consumption 900,000 gallons. The ordinary pressure maintained is 57½ lbs. and the fire pressure from 95 to 110 lbs.

The cost of the works has been $280,070.44. The expenditures in 1880 were $5,791.76 and the receipts $7,273.78.

The works have been managed since their construction by S. P. Crawford, Chairman of the Water Committee of the Common Council. John A. Ferguson is the Chief Engineer.

CLXXII.—NEWPORT, R. I.

Newport, Rhode Island, in lat. 41° 29′ N., long. 71° 19′ W., on Narragansett Bay, is on the summit and slopes of a hill on the south part of the island of Rhode Island.

Settled in 1639, it was incorporated as a city in 1784. Water-works were built in 1875 by George H. Norman, and were owned by him alone until June, 1881, when a company was organized. Water is taken from Easton's Pond, formed by impounding the water of 4½ sq. miles watershed, by two dams of sand, one 2,800 ft. long, 15 ft. high and 12 ft. wide at top, with the water-slope covered with rip-rap stone; the other 2,000 ft. long, 4 ft. high and 6 ft. wide on top. The area of the pond is 160 acres. From the pond the water is lifted 160 ft. into a reservoir of 10,000,000 gallons capacity, built in excavation and embankment, with its flow-line 60 ft. above the highest point in the city. There are two steam pumps, a "Knowles" of 19½-in. water cylinder and 36-in. stroke, and a "Carr-Selden" of 12-in. water cylinder and 24-in. stroke.

Distribution is by cast-iron pipe and some wrought-iron and cement pipe. About 30 miles are in use of from 18-in. to 4-in. diameter, with 157 fire hydrants, 113 gates, 1,160 taps and 27 meters. The city pays for the use of water for fire hydrants. The service pipes are of wrought iron, cement lined. The population in 1880 was 15,693. The daily consumption in 1881 was about 500,000 gallons. The capital stock of the company is $500,000. Statistics of cost and revenue are not furnished. Charles B. Weaver is the superintendent and treasurer, and G. Cole Stevens the clerk.

CLXXIII.—NORRISTOWN.

Norristown, Pennsylvania, in lat. 40° 7′ N., long. 75° 15′ W., is on the Schuylkill River, 16 miles above Philadelphia. The topography is hilly. Settled in 1778, it was incorporated as a borough in 1812.

Water-works were built by a private company in 1847, after the plans of William E. Morris, C.E., taking the supply from the river, which opposite the town is divided by an island a mile long, and from the further channel a conduit 20-in. diameter and 1,450 ft. long conveys the water to the pumping station, where it is lifted by three steam pumps, one of 7⅜ in. bore and 60-in. stroke, a double-acting piston pump, one a Worthington duplex pump, of 1,000,000 gallons capacity, and the third a double-acting piston pump, of 16-in bore and 16-in. stroke, built by R. S. Newbold & Son, into two reservoirs, one 194 ft. above the river, and of 10,000,000 gallons capacity, the other 132 ft. above the river, and of 750,000 gallons capacity. Both are in excavation and embankment, in two divisions, and with the inner slopes lined with brick pavement on clay puddle.

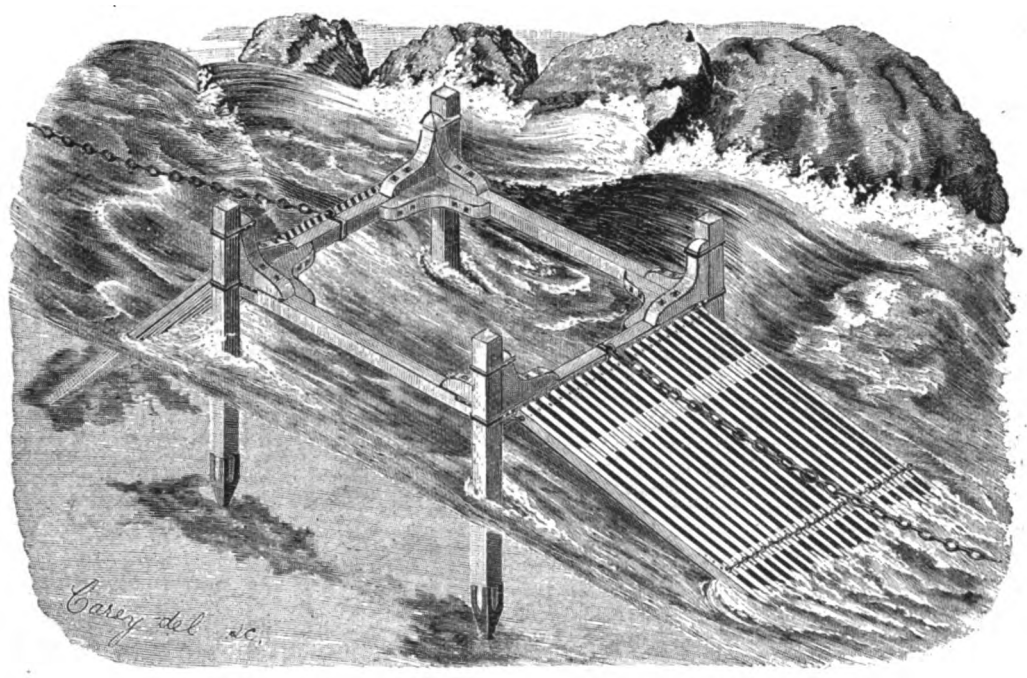
Distribution is by cast-iron pipe of 16 in. to 3-in. diameter. The pumping main is 1⅞ miles long, of 24-in. diameter; 27 miles of pipe are in use, with 85 fire hydrants, 125 gates and 2,500 taps. The town does not pay for use of hydrants. The population in 1880 was 13,863 and the daily consumption 800,000 gallons. The capital stock of the company is $150,000. The works have cost $275,000. The bonded debt is $90,000, at 5 per cent. interest. H. S. Sechler is Secretary of the company and John Slingluff the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks: From Timothy Woodruff, Superintendent, reports of Bridgeton (N. J.) water-works for 1878, '79, '80. From the Water Commissioners, report of Erie (Pa.) water-works from May 1, 1879, to Dec. 31, 1880. From Geo. P. Wescott, Superintendent, history of the Portland (Me.) Water Company. From John A. Ferguson, Chief Engineer, statistics of Rockford (Ill.) water-works. From John Slingluff, Superintendent, statistics and water rates of Norristown (Pa.) water-works. From G. Cole Stevens, Clerk, statistics of Newport (R. I.) water-works.

SYLVESTER'S TIDE AND CURRENT BREAKERS.

The attention of our readers is called to the above engraving which represents a tide and current breaker that has been used during the past six months in the channel of the Piscataqua River.



SYLVESTER'S TIDE AND CURRENT BREAKER.

Portsmouth, N. H., for retarding the current while removing rock.

The velocity of the current in this river at this locality, whether at ebb or flood tide, is from four to six miles per hour, and the time of slack tide is so brief that it became a doubt whether the ledge known as Gangway Rock, which was in the channel and covered with twenty-two feet of water at high tide, could ever be removed.

The work is now being successfully done by the use of "Sylvester's Tide and Current Breakers," which retard the current to such extent as to make comparatively still water under the lee of the breakers, and a submarine diver is enabled to perform in safety any required work at all times.

The tide and current breakers, or the direct agent that retards the current, consists of a series of timbers that rise and fall at each end of the frame, according to the direction of the current. These timbers are uniformly spaced so that a sufficient quantity of water may pass through them, and the water that has been rendered turbid by the disturbance of the soft material on the bed of the channel is made perfectly clear.

In whatever direction the currents may be, the breakers on the end from which the current is running will be forced down until they rest on the bed of the channel, and the breakers on the opposite end will float on the surface of the water, as seen in the engraving.

In currents of very swift velocity the frame with the breakers may be anchored, though under ordinary circumstances this is not necessary, as its weight keeps it in position.

Our readers will see the utility of this invention in any swift current where work without it would be impossible; not only for removing rock, but for building and repairing dams, removing obstructions and other work where the hours of labor are limited by the current or changes of the tide.

This invention was patented August 23, 1881, and parties wishing particulars in regard to any of its details, or general information, may address Isaac A. Sylvester, Newton Centre, Mass.

SAND FILTRATION AT BERLIN.

BY PROF. WILLIAM RIPLEY NICHOLS.

[From the Journal of the Franklin Institute.]

Up to the present time there has been very little done in this country in the way of systematic filtration of water supplies, partly, perhaps, from indifference and lack of information, but mainly on account of the expense. The numerous complaints which arise in the case of almost every city and town supplied with surface water render the question of filtration an important one for the immediate future, and any engineer who has to do with the planning of water-works is liable to be called upon to estimate the cost of filtration and to state how far it may be expected to overcome anticipated or existing evils. For this reason, details of the practice in well-managed works, where the conditions are similar to those which obtain with us, are of peculiar interest. Such details are given in a pamphlet recently published by the superintending engineer (Betriebs-Ingenieur) of the Berlin filtration works. The pamphlet also contains the results of observations on "natural filtration" in the neighborhood and elsewhere.

A very considerable portion of the city of Berlin is still supplied with water from the dirty and sluggish Spree after it has been subjected to a very thorough filtration. The water is taken from the river directly on to the filter-beds, and although the sluggishness of the flow would allow the deposition of much suspended matter, the very considerable water traffic between Berlin and Köpenik, past the water-works, keeps the water in a roily condition. Furthermore, the Spree receives, above the point from which the supply is taken, the waste-water of a number of factories, among which are dye and print-works, it also receives the effluent of a sewage farm, mixed, in some cases, with sewage itself. Besides being thus contaminated, the water, especially in time of flood, possesses a deep brownish-yellow color and, at times, a peculiar *pondy* taste, due to vegetable extractive matter. Moreover, from spring until fall, a more or less copious growth of *algæ* adds to the disagreeable character of the water.

The filtration works now supply daily about 40,000 cubic meters (in round numbers 10½ million U. S. gallons) of filtered water—in summer often a larger quantity. There are eleven filter-beds—three covered and eight uncovered—having a total area of 37,000 square meters (about 400,000 square feet). The beds are constructed on the English model, fine sand at the top and coarser material below. With the large area at disposal it is possible to carry on the filtration at a very slow rate. The water is used, of course, in varying quantities from hour to hour, and, on account of the small size of the clear water reservoir, a constant rate of filtration is impossible; the maximum rate is, however, not over 4 inches downward per hour.