SEVENTY-FIRST YEAR

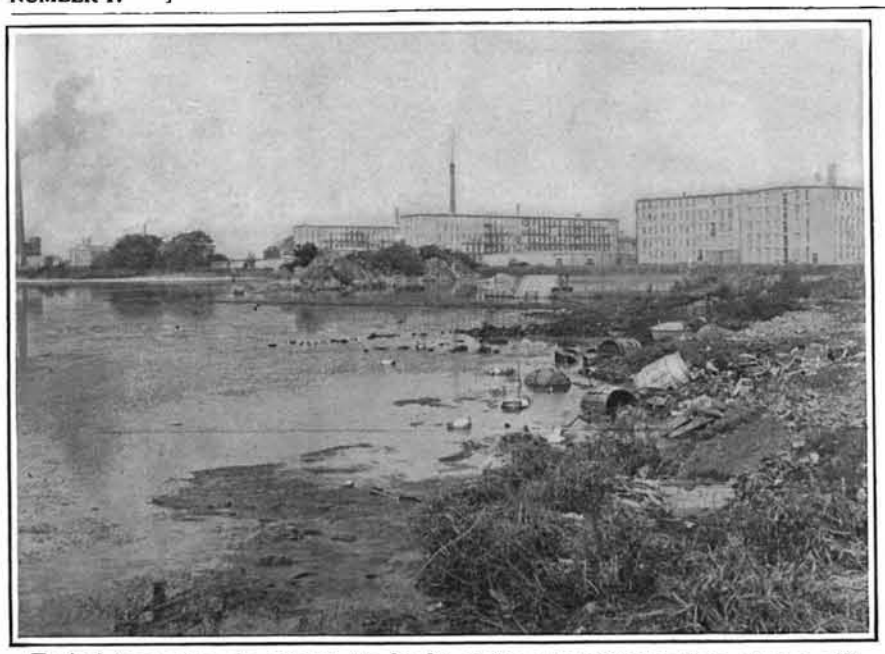
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

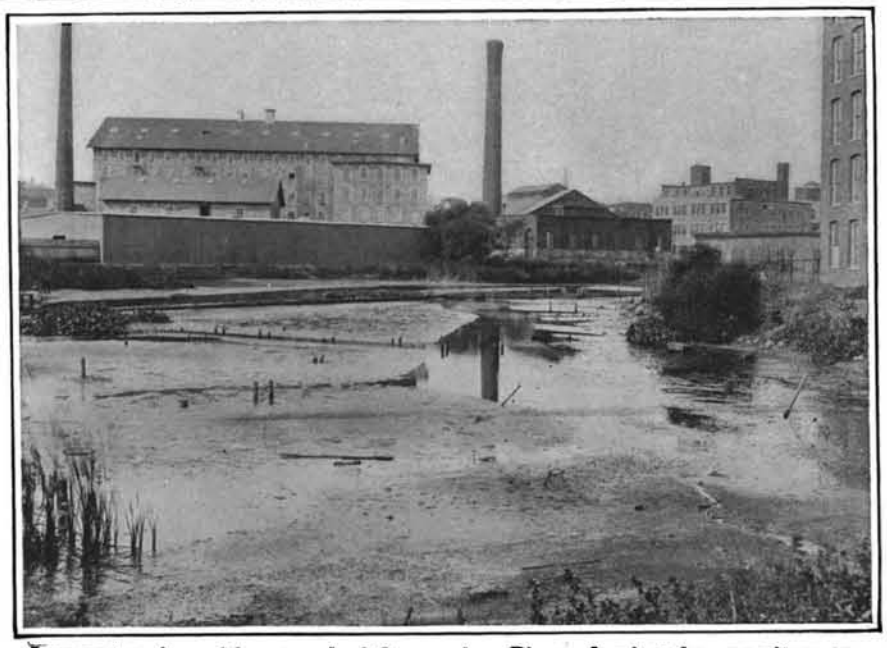
VOLUME CXIII. NUMBER 17

NEW YORK, OCTOBER 23, 1915

10 CENTS A COPY $3.00 A YEAR



Typical low water view along the banks of the upper Quequechan, strewn with refuse



Low water view of lower end of Quequechan River, showing the unsanitary exposed flats

Fall River's Proposed Water Supply System

THE highly industrial city of Fall River, Mass., is to-day confronted with a proposed plan for one of its public improvements that will involve a cost of $3,000,000. Although the plan has not yet been actually approved by the city government, the uniqueness of the project from an engineering viewpoint draws great interest to it.

The Fall River project has to do with the improvements of the Quequechan, a little stream that runs through the heart of the municipality. This stream is the outlet of a large lake and the industrial water supply to many mills; it falls more than 100 feet in its course of less than 2 miles and, from beginning to end, it is a business brook.

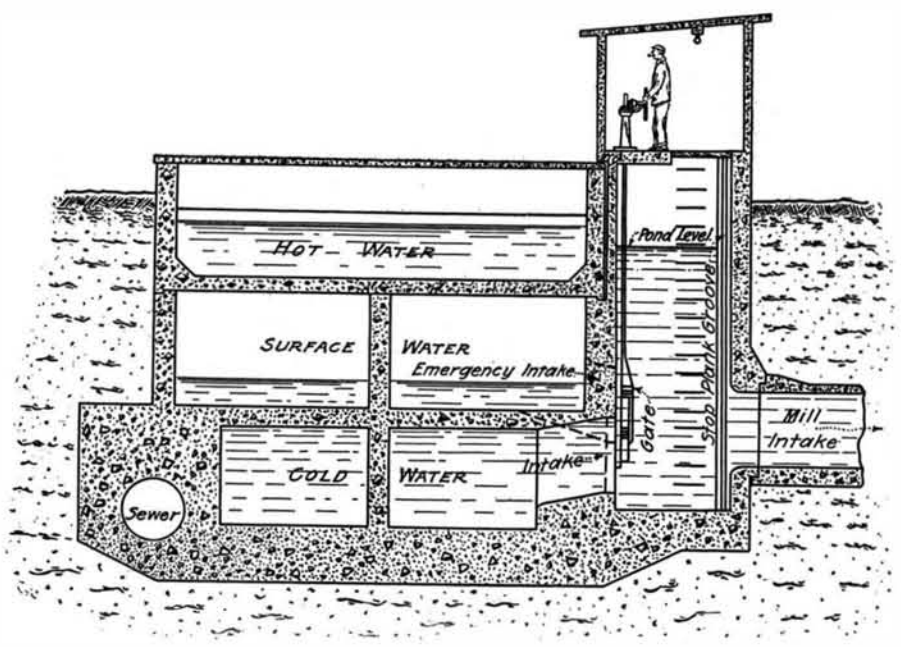
Watuppa Pond was in Indian and Colonial times the largest body of fresh water in Massachusetts. It has been divided into two parts and the city of Fall River draws its drinking water from the north pond, while the south pond furnishes industrial water for the mills along the Quequechan. Under rights which antedate the formation of the Commonwealth of Massachusetts, a private corporation controls the water in the south pond and its tributaries, the flow through the Quequechan, drainage rights on the watershed of the stream and flowage rights along the banks of the little river.

The city in using the north pond for its domestic supply does this with the limitation that the mills may not suffer for water. It is stipulated that the level of the north pond shall follow that of the south pond to within 1 inch. There is a minimum at about 4 feet below full pond level, where the north pond may be conserved. The result of this bargain is that the city is debarred from the usual and necessary conservation practices of reservoirs for domestic use. It is not permitted to reserve the excess precipitation of one season for use in a dry time, which is good common sense, for in the interim the mills have needed the water and it has been drawn off through the south pond. The city has at great expense sought to preserve the purity of its supply by reservations along the shores and spends money to divert contaminated sources from its reservoir. Yet on demand it must deliver a billion or more gallons of this precious water each year for the uses of the mills in their work.

A second bargain made nearly a century ago with the same controlling corporation affects the flowage rights along the shores of the stream. The filling of the land is under restrictions and at considerable cost to the owners, so that very little if any reclaiming of the flats of the Quequechan has been done.

The care of the Quequechan has been conspicuous generally by its absence. Along its banks are located something like fifty mill buildings belonging to about thirty companies. The mills draw water for use in the condensers of their engines—and for other industrial uses—and discharge it again into the stream, which in summer by constant use touches a temperature of 140 deg., and is consequently unfit for condensing purposes.

Many of the mills have no connections with the sewer system of the city and use cesspools, the overflow from which, at least, comes into the river. The surface drainage of the district, 2 or 3 square miles of which is the residential section for Fall River, is divided. Some of it comes into the stream without apology, while in other places it is directed into the sanitary sewers.



Cross-sectional view of the proposed Fall River triple-conduit structure

These, however, have not the capacity to care for the quick run-off of so large an area, so that they have storm-water outlets into the river. Then in one place at least, a sewer comes frankly into the stream, and then again at various points outhouses have overhung the banks, but this nuisance has in part been abated since evidence in the way of photographs presented conditions as they are. To add to the discouraging situation the flats and the stream have been used without authority for the quiet disposal of refuse, the presence and amount of which the illustrations clearly indicate.

The result of such a group of unfortunate circumstances has been a contaminated river which has attracted the attention of the State Health Department. Flats are regularly exposed in times of low water, as the illustrations show, in places with unsightly levels of black mud or covered with the rank vegetation which the "ripeness" of the soil favors. The proximity of the brook to the residential section has made it a resort for boy and men bathers, the warm water conducing to bodily comfort.

Neglect of the Quequechan has resulted in another phase of Fall River's difficulties, namely, that the silt of surface drainage and other debris has so filled the valley bottom that the bed of the stream has been elevated. The outlet from the lake is over a bar, and it is true that the actual amount of water flowing in the stream is less than it was a century ago.

It may be seen that the situation is very complicated. The State Health Department is moving towards the abatement of the nuisances of the Quequechan, and this must infallibly be done. The municipality is beginning to realize that with its growth in population continued for another five years, it will face a water famine in any subsequent dry season.

The state, further, is refusing to allow the surface drainage of the valley to enter the south pond, so that there is enforced the necessity of providing means of running if off to tide water. This drainage is eventually for an area of 5 miles of hillsides rising in one half a mile to 100 feet above the stream. With houses and streets this will mean a rapid run-off and for an ultimate quantity in a heavy storm of hundreds of millions of gallons a day.

This was and is the general situation in Fall River, and the citizens through legislation secured the appointment of the Watuppa Ponds and Quequechan River Commission, with wide scope and large powers, hoping through it to solve the problems. The Commission somewhat more than a year ago retained Fay, Spofford and Thorndike of Boston for consulting engineers, and the plans have been evolved in the comparatively short interval. The report was required by law to be in the hands of the City Council on October 1, and it was made public by consideration at the session of this body on October 4.

The features of the plan for getting rid of all the difficulties at once include for the central item a great, three-way conduit, the channels being one above another like the floors in a house. In fact, it might be described as a big factory structure of reinforced con-

(Concluded on page 366)

der and the outlet chamber; this difference of pressure—only a few ounces per square inch—being fixed by the exact weight of the moving element and the area of the piston on which the difference in pressure acts. The moving element rises until the weight is exactly supported by the difference in pressure; the pistons and rod then floating in static balance in a position corresponding exactly to the volume of air flowing, the number of holes exposed and the height of the top of the rod in the sight glass. The divisions of the scale plate are calibrated by comparison with a standardized instrument to read correctly.

The new meter is not a velocity meter which would give readings proportional to the square of the volume flowing. Instead, it is a direct volume gage with a uniform scale on which 1 cubic foot is represented by the same distance whether working at low or high capacity. The loss of pressure represented by the insertion of a meter of this kind in a pipe line is so slight that it cannot be detected by a gage. The meter is not injured by a flow in excess of its metering capacity.

Fall River's Proposed Water Supply System

(*Continued from page* 353.)

crete, without doors, windows or transverse partitions, a mile and a half long, while its width and height are approximately equal, about 25 feet. In magnitude it is equivalent to a two-track subway of equal length. From this to tide water there is planned an outlet sewer of rounded outlines about 6 feet square and three quarters of a mile in length. This it will probably be necessary to cut through the foundation granite of the city.

The three channels of the main conduit will be devoted, as the section diagram suggests, to the cold water supply for the mills, the warm water return from the condensers, and the surface drainage. As the district increases in population, the sewage can be cared for by a trunk sewer in the foundations of the conduit, and other utilities, such as gas and electric wires, can readily be placed in the walls of the conduit if it should prove expedient.

The cold water conduit is to be at the bottom of the structure, a single or divided channel with a cross section of about 110 square feet at the intake and one half that size at the lower, closed, end. It will be level, the pond pressure keeping it filled.

The warm water return, the uppermost canal, will have a gentle pitch back towards the south pond, about 2 feet to the mile, its capacity increasing as it nears the pond. The water will enter an oil-separating basin, and thence through a cooling basin which will be large enough to hold about one half the day's discharge into the south pond. The afternoon's return it is proposed to hold here through the night. The basin, which will be excavated in flats and waste shore land, will be eight acres in extent and about 6 feet deep.

The central conduit, that for surface drainage, will have a cross section of 120 square feet, and will be capable of handling the surface discharge of the area, estimated in the most violent rains to be some hundreds of millions of gallons. It will connect at the inward end with the outfall sewer, and this with its steep pitch can carry away all that the conduit will receive. The canal is level and is stopped at the pond end by a half-height partition. In cases of great emergency the surface water can here be discharged into the south pond, making of the whole construction a conduit flowing four ways at once. It will serve also as emergency outlet for floods in the pond. These, at the present time, with the Quequechan as an outlet, flood the shores with more or less injury to property. The drainage canal under such circumstances will be occupied for a few hours in caring for the storm water as it falls, the run-off to it being enormously quick, and when this has abated the pond will be beginning to feel the effects of the precipitation on its water-

shed, and this in turn can be cared for absolutely by the same channel.

The connections between the mills and the great conduit will be triple in precisely the same way. There will be narrow conduits about as high as the main one, delivering water under pressure for condenser use at the bottom, returning warm water from the condensers at the top, with storm-water drains for the mills and yards between and in addition the mill sewer for such establishments as have no present sewer connections.

The advantages of this novel construction will strike the engineer at once. There are three functions to be performed. It would be the customary method to lay conduits independently side by side, and usually in cities as separate constructions at different times, each with its own large cost figures. This planning is, however, a true evolution arising from the features of the case, and affording important economy by the triple use of the single construction.

To take better advantage of the south pond for a mill pond and to increase its storage capacity, the engineers propose to double the depth of the outlet and make it drain to 8 feet below full pond level instead of about 4 feet which it does now. Under these conditions the cold water to be distributed by gravity must be in a pipe or conduit that is low. If it were an open conduit the cold water supply would be a stream in its bottom. On the other hand, to deliver the warm water back to the south pond this conduit must be at a slight elevation above the surface of the lake. When these two conduits are placed one above the other the space between them is just where it ought to be for surface drainage, its bottom below the present levels of the stream.

The engineer will also be struck by the conservation idea of the warm water return. But for the oil and a little grit that it may pick up in doing its work, the condenser water is as good as ever for industrial purposes, and it is here possible to use it over and over again. The cutting down of the outlet will increase by about 70 per cent the storage capacity of the south pond, and taken with the return condenser water the engineers are able to assure to the mills a supply of 20,000,000 gallons a day of cold, clean water for every working day in the year, and this without the need of making any draft whatever on the north pond or drinking supply.

At the present time in the freshets, which there are no means of controlling, as much as 150,000 gallons a day have passed down the Quequechan, by far the greatest part going to waste, and on the other hand the summer flow runs as low as 5,000,000 gallons a day. Under the latter conditions the mills have been short of water, they have suffered injury through the dirty water taken in the shallow stream and have indeed been shut down for what has been asserted to be a shortage of water. And this has happened within 2 miles of a lake containing billions of gallons of water exactly suited to mill uses.

There are numerous other details in connection with the plannings, but it is not necessary to enumerate them here.

An economic advantage when the conduit shall have been built is that it will require a strip a few feet in width only in the middle of what are now extended, offensive flats. These flats constitute the nuisance that the State Health Department has decreed must be abated. It is proposed, therefore, to fill in the flats by a wholesale method that will not prove costly. The region is level land in the heart of a busy mill district and there will be gained from the unproductive flats an area of 150 acres, where land is practically sold by the foot.

Another feature that has not yet been touched upon is the better railway facilities which the filling of the flats will assure. At the present moment a railway on a trestle runs down the centre of these flats. Although its tracks all but touch the corners of 30 or 40 mills, still there are only 3 or 4 of the entire lot that have sidings or spurs. However, there will be a spur track into every factory the moment the filling is completed.