with at a depth of about 16 feet. The sewer here is 30 feet deep, the trench being in sand the whole depth. From this point to the next manhole there is a fairly steep grade, sufficient to carry the water and fine sand which came with it through the sewer as it was laid to the pump sump.

It may here be said that the pulsometer did not give entire satisfaction for the work. In capacity it was found to be more than sufficient to deal with the water from the trench, and it only required to be worked intermittently. For this reason the sand which was carried by the water settled down on the valves during the periods of rest, and there was often a delay in getting the pump to start again.

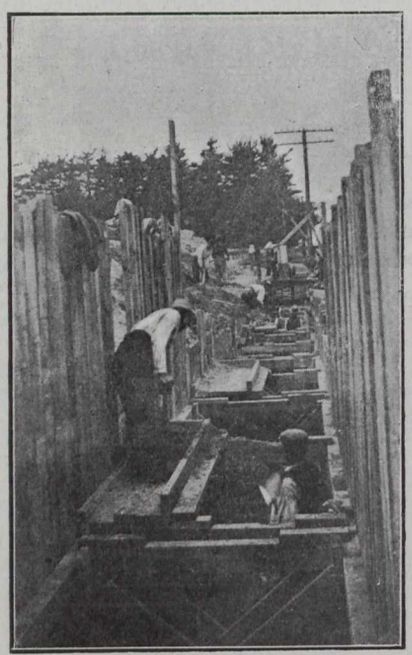

Fig. 2.—View of Trench, Showing Timbering in Position.

After passing the first manhole to the south of this point, the line of the sewer lay between a row of telephone poles and the fences of the property alongside the road, giving a width to work in of only 8 to 10 feet, which was obviously insufficient to accommodate the excavated material in addition to the trench. The use of a conveyer for hoisting and backfilling the earth was considered, but this idea was given up as being impracticable, chiefly owing to the interference of the telephone poles. The open cut and tunnel principle could not be adopted here on account of the quicksand and water, the only reasonable method apparently being the one adopted, viz., of open cutting the whole way by manual labor and removing the material from the trench by stages. The grade from this point on is 1 in 700.

The trench had necessarily to be timbered in a very substantial manner, as the sand was loose and the sides of the trench quickly fell in if unsupported. In fact, the conditions soon got so bad that it was found necessary to timber the trench with close sheeting from top to bottom. The work was carried on through the winter in order that the trunk sewer might be completed in good time, and the severe weather helped to make progress slow. Not only was there three feet of frost to break through at the top, but the excavated material froze almost solid, making the filling-in quite a large part of the work. Frost wedges and dynamite were used to break up the material for filling in the trench.

Although it was found possible to continue the laying of this sewer right through the severe weather of last winter, except for a few odd days, there is little doubt that from an economical point of view the laying of a deep sewer in ground where quicksand and water are met with had better be stopped in the winter, unless, as here, it is a case of being pressed for time. If such work must be carried on in severe frost, some kind of conveyer should, if possible, be used for backfilling the excavated material over the pipes laid as soon as it is removed from the trench, not allowing it time to freeze at the top of the ground.

Shortly after the commencement of the work on the flat grade it was found iupossible to keep the sewer free from the sand which was carried in suspension in the water, and which, being very fine, quickly settled down in the pipes and formed an obstruction. Attempts were made by means of rods and chains drawn through to keep the pipes clear, also by flushing from a hydrant. But the level of the water could not be kept down sufficiently to make good joints, and pumping in front of the pipe-layers had to be resorted to. A four horse-power vertical gasoline engine and a belt-driven centrifugal pump were provided for this purpose, the pump being set down in the trench about 10 feet above the invert of the sewer; 35 feet of flexible suction hose was attached to the pump, making it possible to lay about 70 feet of pipe before moving the pump further along the trench. The gasoline engine occasionally gave a little trouble, but the centrifugal pump proved quite satisfactory for dealing with the very sandy water, which was raised to the surface and discharged on the other side of the road.

The pipe joints were made in the usual way with cement mortar, gaskets being first put into the sockets of the pipe. Only a few pipes, about eight or ten, were laid at a stretch, the method of procedure being to excavate a length of trench, except a foot or so at the bottom, sufficient for the length of pipes to be laid; that part of the trench was then cleared of the stages, and the last level of the bottom got out while the pipes were being laid. This was necessary on account of the rapidity with which the trench silted up. The joints were cemented and covered over with sods, and the sand which was being removed from the bottom of the trench filled on to the top of the pipes shortly after. The water was not allowed to rise in the trench again or flow into the pipes until after the cement had set. Derricks were used for lowering the pipes into the trench, as well as for drawing the timbers after the pipes were laid. Two men on the derrick were able to handle the pipes with ease, and the pipes were by this means lowered and set in position in the shortest possible time. These derricks were rigged up on the job, a double purchase winch being used, fixed to a wooden frame - work with wooden mast and boom.

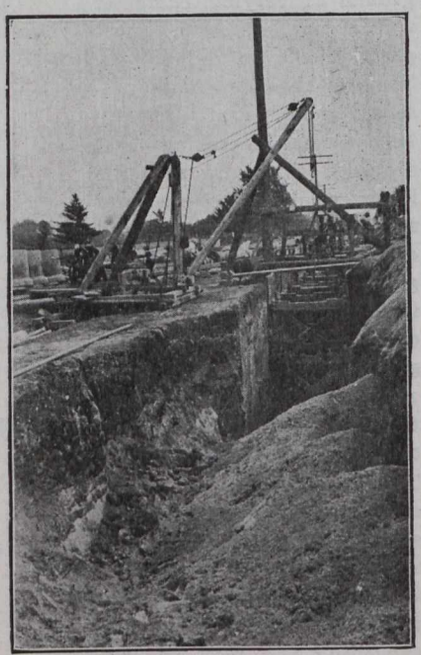

Fig. 3.—View of Trench After Removal of Timbering.

It is generally recognized to be a matter of some difficulty to make good cement joints in a wet trench, but that this can be done providing great care is taken in the jointing, and the water kept well pumped out in front of the pipe laying, is demonstrated in the present case.

Before leaving at the end of the day a stopper was put in the last pipe laid, to prevent the sand washing into the pipes at night. The sand flowed so freely into the trench that often, after standing over the week-end, it had filled the trench up to the level of the top of the pipes. The bottom