# TUNNEL.

The trionel uoder Water street is 2000 fact long; it is six feet high by 4 feet wide, and 6 inches below the sole plate of invert block, to allow for a French drain. Being the first work of its kind, a good deal of experimental work had to be entried out regarding prices and mode of construction. The work was all hand drifted. Dynamite was used. A great deal of difficulty was experienced from want of proper ventilation. The work was let in short contracts to working miners, who each worked from a shaft. There are six shafts, the greatest distance between any two being 400 feet and the average 320 feet. Ventilation was oventually effected by placing a store at the head of the shaft, and leading air pipes from the workings to ir. The men suffered a good deal from foul air and damp.

In addition to the hard and irregular formation of the rock, much trouble was met with from shattered roof rock, wet seams and loose earth.

Two surface water sewers caved in and ono water pipe burst. After battling for a considerable time with the water and pumping it, the enstern portion was abandoned and filled rapidly. This work was attended with great difficulties during construction, and is a satisfactory record to the energy, perseverance and engineering skill of the late Mr. C. Harvey.

## TRENCHING.

In digging the trenches, benching is not used. The earth is thrown up at once from the bottom of the bench, where it does not exceed 9 or 10 feet, by long handled shovels—the blade is smaller and sharper in shape than the ordinary navvy shovel.

### MATERIALS.

The City supplies all the materials required, as recommended by Mr. Harvey in bis report; the contractors are called on to ent and fill in trenches, build brick work, etc. The City employs its own pipe layers.

The bricks were purchased in Boston, as there were no home made obtainable. This year two firms have manufactured on an experimental scale; there is good clay within reasonable shipping distance. Some of the home-made bricks were first-rate, well shaped, hard-burned elinker brick, quite as good as the American article.

The sewer pipe is chiefly Doulton's make, and ranges from 9 to 24 inches. There are two qualities, the "London" and "Liverpool" Doulton. The first is a hard stoneware substance, with light yellow glaze; so far it has proved very satisfactory; it ents more easily and regularly than the other qualities. The other qualities are similar to the best grade of Ohio pipe. Scotch pipe has been used to some extent, they have not much of it in stock. All necessary fittings, such as channels, bends for manholes, half pipes, gulleys, junction blocks, are Doulton's make. The invert blocks of the same make have a largo radius; the chord is 10 to  $10\frac{1}{2}$  inches, ver. sin. 2 to  $2\frac{1}{3}$  inches, which makes a large invert. The breakage on the pipes during shipment is very great, often 50 per cent.; this adds greatly to the cost of the pipe.

The cement is of two bran ls, English and Alsen. The latter, a German brand and a slow setting cement, gives good satisfaction and makes excellent work.

Under the Board of Works a good many sewers were laid, Scotch pipe being largely use 1. In one 12 inch sower which had been laid for about 15 years, on a very steep grade, 1 in 8, it was found that no wear had taken place, the pipe was sound and hard, and almost as good as when laid. The large sized pipes, 18, 21 and 24 inches, break in the same manner as those described in Mr. Rush's paper,\* on the axis of the pipe at the crown and at the haunches.

#### \*Toronto Sewers, Vol. II, Part fL

### MANHOLES.

The manholes are circular, 4 feet diameter at the bottom, tapering to 2 feet at the top, with junctions of sewers arranged according to Riwlinson's suggestions. They are built in 8 inch brick work.