OUTFALL SEWER CONSTRUCTION.*

By James Munce, M. Inst. C.E.,
Deputy City Surveyor, Belfast, Ireland.

IN order to purify (where necessary) and dispose of sewage it must first be collected. The object of this paper is to ask engineers to take into consideration this particular section of their work, and leave for a little the chemists and bacteriologists to deal with the sewage itself which the engineers have collected for them in the place most convenient for getting rid of it, or of the effluent they leave us to dispose of.

As every portion of the country which is not a lake or marsh drains by gravitation to the sea, there is not except under very exceptional circumstances, any great genius displayed in designing a scheme entirely depending on pumps.

A town does not of necessity remove the natural watercourses, but there is no doubt the extension of buildings and streets with impervious surfaces sends the water more rapidly into the outlets, natural or artificial, provided for it. In fixing the sizes of sewers the sewage is the smallest item to be provided for, and the rainfall or surface water is the volume which needs most careful consideration.

The growth of the area within a reasonable period, and the increased use of water as the population increases, both in opulence and numbers, must not be forgotten. Many communities which a few years ago considered 25 gallons per head an ample supply now use 50 gallons. As sudden rainfalls often multiply the volume to be dealt with by 12 to 15, the positions of storm overflows and their possible effect on the streams or other outlets into which they discharge require careful study.

The problem in Belfast has been one of extreme difficulty. A large area of the city has been reclaimed from the sea, and many acres are so far below high-water level that they are only kept from daily flooding by the quay walls, which are 0.6 ft. above the highest recorded tide and 4 ft. above ordinary high water. Formerly the sewers all discharged into the harbor or into rivers which in turn discharge into it; they were protected by valves, and only discharged on the last half of the ebb tide. These have now been intercepted, and the area drained by them, and also the whole of the County Down portion of the city, 5,400 acres, form the low-level drainage area. It will be seen that as no storm overflows are available from the lower portion of this area except at and near the time of low water, storm pumps to relieve the sewers are unavoidable. The intercepting sewers extend for about 3 miles on the County Antrim side of the river, and rather more on County Down side, through lands and streets made on the reclaimed areas; they have a fall of at least 2 ft. per mile, and on the portions nearest the river are almost entirely through alluvial deposits known locally as "sleetch," or in-filling of all kinds deposited inside the reclamation embankment.

The difficulty of construction in ordinary filling was of the usual kind met with in such material, and is not further referred to. The sleetch is a remarkable material; when dry it crumbles like fine sand; with a little moisture it swells and becomes like a soapy clay; with a quantity of water it has the consistency of soft dough.

The main outlet sewer was constructed for a mile in slob lands of sleetch, which are dry at low water, but covered from 2 ft. to 6 ft. at high water. As an example of the unstable nature of this sleetch, it may be mentioned that when the author was making the surveys for the scheme in 1886 he put a man out of a boat on the apparently firm bank of a channel to fix a pole; he sank so quickly in it that he was rescued with difficulty, yet when the work was being carried out this same bank proved one of the firmest places met with and most difficult to excavate.

When the scheme was laid before Parliament it provided for four cast-iron pipes, each 4 ft. in diameter, surrounded by concrete, as the outfall sewer into the sea, one-fifth of a mile in length.

The landowners on the lough side objected to the position of the outlet and opposed the Bill. The corporation directed their consulting engineer to meet the adviser of the opponents, both very eminent in their profession, and settle the matter amicably. They agreed to omit the iron pipes, and construct instead a wooden double trough 1 mile long under the slob, with its outlet in deep water. This chute, as it was termed, is constructed of pitch-pine, which was shipped at Galveston, already cut to the scantlings required and floated from the vessel direct to the work. The method of construction was as follows: Two rows of sheet piles were driven of a length sufficient to form a half-tide dam, and constituted the permanent outer sides. The range of tide is 8 ft. in Belfast. When a length of 100 ft. or so had been driven, a cross-dam was formed, and when the tide had fallen to the level of pile heads the dam was pumped out and the excavators had about six hours' work before the tide rose over the piles again. When a length had been excavated the centre piles were driven, and the construction of the woodwork completed. When a length was finished, the pile sides forming the half-tide dam were cut off and were sufficiently long to form the centre piles for another length. In due time the chute was completed. During the past twenty-five years it has cost a great deal to repair. Many remedies were proposed for it. Hundreds of tons of old concrete were placed on its top, and strong piles fixed to keep it in its place. It is still there, but is unsatisfactory. A ferro-concrete outlet sewer is now being constructed alongside it; when this has been completed the old wooden one will be abandoned.

Lessons to be drawn from the experience gained are that compromises made between rival consulting engineers in the short time available during the progress of a Bill before a Parliamentary Committee are not always satisfactory, and that the considered design of an engineer who knows local conditions should not lightly be set aside.

This new outlet sewer through the slob lands will be in progress for more than another year, and is well worth a visit by any who can afford the time.

The present city surveyor carried out the repairs to the 5,500,000 gallons storage tanks constructed on the slob in a very ingenious way. These tanks were leaking and cracked in the bottom and sides; to rebuild them would have probably cost £40,000, besides the terrible upset to the whole outfall of the sewers. He took one tank at a time and forced cement grout into the crevices and under the floor; altogether 1,120 tons of cement were used. It was mixed with an equal quantity of sand, and was put in under air pressure varying from 7 lbs. to 15 lbs. per square inch. The reservoir is now quite water-tight.

Excavations recently made alongside it show that the grout found all the crevices in the foundation and followed them through the sleetch, even 4 ft. beyond the outer walls.

* From a paper read before the Blackpool (Eng.) Congress of the Royal Sanitary Institute.