strength are the main objects, but owing to the thickness and rapid corrosion of wrought iron and steel pipes the author thinks cast iron will be hard to displace for general use, as they are cheaper and more easily made Their greater thickness allows for corrosion, which overcomes to a certain extent one of the main difficulties in the upkeep and maintenance of water mains.

Pipe Jointing.—Cost and local ground conditions play an important point in settling the type of joint to be used, but the local custom of selecting spigot and socket joints in all horizontal positions (except for very high pressure pipes) and flanged joints where pipes are fixed vertically are so universally adopted that any description is not necessary. The author has used with success the turn and bored joint and can safely recommend same in bad situations, providing the pipes are laid in a straight line and an ordinary spigot and socket lead joint inserted every ninth or tenth pipe to allow for expansion in variable temperatures.

The laying of distributing pipes and mains presents very little difficulty, requiring engineering skill, especially in open ground. The only occasion where the work becomes intricate is in handling and laying large pipes in the centre of cities having their usual network of underground mains which have to be considered. On all pipe lines washout chambers should be built within reason, and especially at every depression, so that scouring out process may be easily accomplished, and an air valve placed at every high point to allow the imprisoned air to escape. Pipes should be laid true to line, grade, and on a good solid foundation, with particular care and attention paid for sufficient collar holes to facilitate and ensure the proper caulking of the joints. The mains, after being laid, should be subjected to proper tests and every length, when completed, should be closed by means of a blank socket, drilled and tapped to receive the connection pipe from the pressure pump, and a water pressure gauge showing the pressure registered in feet of water and lbs. per sq. in., with valves for safety, and lowering the pressure. An economical arrangement for testing the pipes is to commence laying, wherever practicable, from the source of supply, say reservoir, to the site of distribution.

All defects can be easily detected in the trench by careful observation and close attention to the indicator or pressure gauge, especially when pumping ceases. The most familiar defects are from weeping joints, split or cracked pipes and pinholes. The position of defect was marked on pipe, the pressure lowered, leakage made good, and the section re-tested. Weeping joints are generally easily put right by re-caulking. A split or cracked pipe requires more labor and attention, and in most cases its removal and replacement is the only satisfactory remedy. This can be accomplished in one of the following ways: (1) Burning out lead; (2) cutting out lead joint; 3) splitting off the socket; (4) replacing the whole pipe; (5) cutting the pipe, providing the defect is not too serious, the cracked portion taken out and a short piece cut to the required length inserted and jointed up by thimbles or sleeves. Pinholes in otherwise sound pipes may be drilled, tapped and plugged with brass or gun metal plugs.

Corrosion or rusting of pipes conveying water, both externally and internally, are serious items in the life of pipes supplying water as, although when properly coated with patent solution, corrosion is greatly reduced. But in time, unless properly inspected and removed, it takes effect, and although the danger of weakening the pipes is small, the real trouble lies in the contraction of the bore of the pipes, which diminishes their discharging capacity and reduces the working head.

Fire Service and Meters.—In conclusion the author would like to mention in connection with water supply for cities and towns—especially those in Canada—the absolute necessity of providing in all waterworks schemes an abundant supply to meet all the demands when called upon to save the destruction of lives and valuable property. This can only be successfully accomplished by the engineer making ample provision in the preparation of the scheme he is called upon to design; and by remedying the shocking waste of water in our cities through careless consumers who do not value or realize the expense a proper waterworks system entails to properly maintain out of the city's funds.

The advantage of having a powerful stream of water to be easily put into requisition to retard or prevent conflagration of buildings can be readily understood.

A little extra cost, if necessary arrangements are provided, in the original design of the waterworks, but may, as afterthoughts, prove an expensive addition.

The writer strongly recommends for use in case of fire, a surplus storage capacity over and above that required for general purposes, such storage to be of sufficient elevation to allow water being forced above the tops of the highest buildings in the cities, and also the arrangement and dimensions of the mains and distributing pipes to be capable of permitting the maximum fire supply when the demand for water for other purposes is at its greatest. In order to render a fire service efficient, hydrants should be placed at the most convenient and important points on the system to ensure a maximum efficiency. They should be in sufficient number and, above all, easily accessible, but not in danger of frost.

The available head at any given point on the system is calculated by deducting the loss of head due to friction in the pipes from the statical head at that point. It can plainly be seen that such results only hold good on a thoroughly watertight system, and it is imperative for hydrant purposes to maintain pressure. The laying and testing of mains should have the strictest attention of the engineer.

With reference to the prevention of waste, this important point must sooner or later be taken up seriously by Canadian cities, especially where pumping is the means of supply. The author strongly favors the insertion of water meters on the distribution services as an excellent prevention against extravagance and thoughtless excess in consumption. There are certainly advantages and disadvantages, the latter applying especially to the cheaper class of dwellings, for such a step might mean reversing the conditions as they exist at present and economy being substituted for undue extravagance at the expense of cleanliness and health. On sanitary grounds this would be a great objection, but at any rate the writer strongly advocates the adoption of meters for trade and manufacturing purposes, and also the serious consideration of meters on residential property with modifications to offset the disadvantage mentioned above. There are two types of meters, the "positive" and the "inferential." The former records by clock mechanism on similar principle to that of a cylinder and side valve of a high-pressure steam engine, water alternately filling and emptying a vessel of known capacity. The latter mechanically registers the flow by recording the revolutions made by a wheel with vanes or discs attached, on the principle of the water-wheel or turbine in a small chamber. The engineer should select the one which combines accurate results with varied flows, simple and easy repairing, and does not interfere with loss of head in supply pipe.