cular deposits. Assuming money to be worth 4 per cent. per annum, then the cost of a new main at $1.00 per foot, 20 years hence, would be equivalent to 46 cents at the present time. Assuming that by proper inspection and cleaning the construction of the additional main could be delayed 10 years; the cost of a new main 30 years hence would be equivalent to 30 cents at the present time, viz.: — 46 — 30 = 16c. per foot would thus be saved, which at 4 per cent. equals 64c. per foot per year, add to this the saving in interest on $1.00 per foot for 10 years = 4c. per foot per annum, and we have

64 x 20 = 12.8
4 x 10 = 40

= 52.8 cents per foot of 6 inch main as the amount we should be justified in spending in maintenance during 30 years, in addition to present cost in repairs, which we assume to be the same, and which averages about 17 cents per foot per year for all sizes of mains. In other words, we would be justified in spending just 10 times as much for maintenance as we do at present even if all the pipes were only 6 inches, if the periods are reduced to 10 and 20 years respectively, which is more probable with heavy incrustations, then the justifiable expenditure for maintenance would be 48.4 cents per foot for 20 years, and 2.42 cents per foot per annum, which would be sufficient to clean the mains every five years.

A great deal more could be said on this subject from the economic point of view in connection with pumping and forcing water through incrusted mains. Atlantic City, N. Y., suffered for many years as a result of tubercular growths in the water mains. As a result of cleaning out the mains the pumping efficiency was increased as follows: — Before cleaning, the 10,000,000 gallon pump, which delivers the water into the reservoir, was put under a pressure of 110 pounds, and made 11 revolutions per minute, delivering 11,888,000 gallons. After cleaning, under the same pressure it made 16½ revolutions per minute, delivering 17,820,000 gallons, showing an increase in delivering capacity of 5,400,000 gallons in 24 hours, or 45.4 per cent. This enabled the department to fill the reservoir, and saved a contemplated expense of laying an additional main 30" (18,000 feet) at that time. Also, the amount saved in fuel required before, and after, the pipes were cleaned worked out at about 36 per cent.

Now supposing that a municipality contemplated putting down a water system with ample provision for control by means of hatch boxes, so that the system might be examined and scraped at any time without disturbing roads or cutting into the mains. What would be the cost? It is estimated for a population of 50,000 with 92 miles of main averaging 12 inches in diameter, the cost of distribution system amounting to $1.80 per foot of main, consumption at 60 gallons per head per day, that the cost for an ample supply of hatch boxes would add 15 cents per foot of main, or 8.3 per cent. increase to distribution system. If the supply be one of pumping, the increase on the total cost of plant amounts to about 4.7 per cent.

Experts on this question, and in fact all who have had experience in this matter, are agreed that the actual cost incurred by the installation of hatch boxes, intelligently spaced out, is more than balanced by the benefits obtained.

Mechanical Filtration.

There is a rapidly growing opinion that all surface collected waters, especially those drawn from rivers, should undergo some purification process before being delivered for consumption, as apart from the direct discharge of sewage into water courses there are many other sources of contamination. We have seen that many of the biological growths occuring in water mains are directly due to organic impurities in surface water. The removal of these impurities ensures longer life to the mains, more constant pressures, and a water free from mal-odours, bad tastes, and less contained nutriment on which pathogenic bacteria can be maintained.

Water purification may be effected by (a) filtration; (b) direct sterilisation.

Filtration may be divided into two processes, 1st, Slow sand filtration, and 2nd, Rapid mechanical filtration.

1. Slow sand filtration necessitates large areas of filter beds, and very fine grained sand is used. The purifying powers of these filters is primarily due to the formation of a sediment blanket on the surface of the filter. At first very little bacterial purification results, but as the sediment scum forms, the percentage removal increases up to very high rate efficiencies, gradually as the scum or blanket thickens, the rate of filtration is lowered until it is necessary to remove the scum by scraping; until the scum blanket forms, the water passing through the filter is passed to waste. The filter beds are generally about 1 acre in area, the rate of filtration being about 2,000,000 gallons per acre per day. This system has been adopted largely in Europe in connection with river waters. Its introduction has invariably been followed by a marked reduction in the typhoid fever rate. Several Cities in the American States have also adopted the system. Toronto is at present putting down a large plant to treat 30,000,000 gallons per day. The system, as compared with others, is very expensive, both in first charges and in maintenance, and it is doubtful whether it would be possible to work it under the severe frost conditions of this Province.

2. Mechanical or rapid filtration occupies a much smaller area. The sand used is coarser than in the case of slow sand filtration. The rate of filtration is about 120,000,000 gallons, per acre per day, or 60 times the rate of slow sand filtration. With municipal plants the size of a single filter is equal to about a hundreth part of an acre. Very high purification efficiencies are obtained by this method. Efficiency depends not so much upon the filter, however, as upon the use of a coagulant, and general attention and care to proper working. At Harrisburg, Pa., the average bacterial removal for the year 1908 was 99.62 per cent. Similiar high efficiencies were obtained elsewhere. The filter is constructed more to a view of obtaining an efficient sand washing apparatus, while purification is obtained by the proper use of a coagulant, combined of course with the filter action.

This system is peculiarly adapted for our Province, as the whole plant can be housed in a small building and thereby worked independently of severe frost. Its power of removing turbidity is very great, and we are all well aware how turbid our rivers are in the early months of the year. I saw this for myself last July in visiting Saskatoon and Prince Albert, where, although small sedimentation basins were provided, the finer particles of the suspended matter remained in the water.

With reference to the use of a coagulant, I will quote from a report of the "Joint Special Committee to examine and report relative to the pollution of water supply, and the best method of filtration." City Document No. 15 of the City of Providence, R. I., as follows:—

"If the diameter of matter floating about in water is much less than that of the interstices between the grains of sand composing the filter-bed, such matter, except as