still lower cost. Five parts per million probably represents the maximum amount of chlorine required for the treatment of trickling filter effluents of poorer quality."

Phelps is careful to point out that the above results do not amount to sterilization, but may be reasonably called "pratical disinfection." Considerable extra cost is required to obtain, but a slight improvement.

Crude sewage, if disinfected to the same efficiency standard as above, reqires from five to ten parts of available chlorine at a cost of from $1.50 to $3 per million gallons.

Septic sewage requires the application of from 10 to 15 parts of chlorine, costing from $3.50 to $5 per million gallons.

Phelps is also careful to explain that the above data has only general application and that sewages vary so much in character and stability that no hard and fast figures can be given.

We have shown that the results obtained are much more favorable than those of the German, or in fact of any results elsewhere. We see no reason, however, to doubt the accuracy of the conclusions. The "hall mark" of absolute fairness stamps every paragraph of the report. There is no straining to obtain preconceived results, and the whole of the experimental work has evidently been accomplished with strict observance to detail and general efficiency.

It must not be concluded that the results are such as to warrant sewage being directly termed drinking water. Further dilution, however, will easily effect a reduction of bacteria so as to bring the total count within the standard of drinking water required of slow sand filtration.

A 98 to 99 per cent. reduction of intestinal bacteria means 98 to 99 per cent. less chance of typhoid, and surely that is something gained.

But the main crux of the whole question is. Is it cheaper to apply sand filtration as a supplementary process to sewage disposal in order to reduce the number of bacteria, or is it cheaper to use chlorine at the cost rates of from $1 to $1.50 per million gallons for non-putrescible effluents.

Again is it cheaper to pay from $1.50 to $3 for the disinfection of crude sewage, where a non-putrescible effluent is not demanded, rather than go through the several processes of sewage disposal. This applies only to cases of discharges into tidal basins or large bodies of water.

The question of disinfecting a septic effluent, we think, may be left out of consideration, as impracticable because of cost and little or no consideration gained.

We will suppose the case of a city discharging its settled crude sewage into Lake Ontario, and that the city draws its water from the same lake which is thus subject to contamination. Now if it was desired to reduce the chance of disease infection from sewage pollution, two courses would be open to that city: (a) The further treatment of sewage by filtration until a bacterial removal of from 98 to 99 per cent. was gained; or (b) the immediate disinfection of the settled crude sewage by an expenditure of from $1.50 to $3 per each 1,000,000 gallons of sewage discharged.

Assuming the daily discharge to be 30,000,000 or 10,950,000,000 gallons per annum, then we would require for disinfection an annual expenditure of from $16,200 to $32,400 depending on the strength of the sewage. The average annual cost being $24,000. This sum capitalized at 5 per cent. would represent an immediate expenditure of $480,000.

It is safe to estimate that a sewage filtration plant giving equal bacterial removal efficiency, could not be installed under a capital expenditure of $1,000,000, and 5 per cent. of this amount capitalized must be added as an annual payment for operating expenses and depreciation fund.

It therefore would appear that in the above case, when the sewage enters a sufficiently large body of water capable of effecting chemical purification by dilution, a city may save even $500,000 in obtaining an effluent practically biological harmless to a water supply drawn from the same source by the adoption of methods of disinfecting crude settled sewage in lieu of supplementary sand filtration, applied to the effluents from percolating filters.

In the case of small towns discharging sewage into small inland streams, the production of a non-putrescible effluent will in almost every case be demanded, apart from the question of disinfection or otherwise. As previously pointed out, disinfection will not prevent but only retard putrefaction. This process, if allowed to take place in streams, forms the chief cause of nuisance, depleting the water of its available oxygen, destroying fish life, and gradually converting a stream into an open sewer.

In producing a non-putrescible effluent no greater reduction than 80 per cent. of bacteria can reasonably be expected by the use of percolating filters. Circumstances, therefore, arise when it is necessary to treat such an effluent for a further bacterial removal.

Assuming, for the sake of illustration, a small town of say 2,000 inhabitants, with a per capita water consumption of 60 gallons per day, producing 120,000 gallons of sewage per day or 43,800,000 gallons of sewage per annum. The number of bacteria in sewage varies considerably, depending on dilution and other factors, but for purposes of illustration we may assume a bacterial count of say 1,000,000 bacteria per c.c. in the above case.

The sewage discharges into a small stream eventually used for drinking purposes, the proportion between sewage and stream discharge being as 1 to 100. It is assumed that a bacterial purity of effluent is required which will not increase the total number in the stream by more than 100 per c.c. The stream being 100 times greater in volume than the sewage discharge the sewage effluent should, therefore, present less than 10,000 bacteria per c.c., or an equivalent bacterial reduction from the number in the crude sewage of 99 per cent.

If tankage for the removal of solids be adopted, followed by percolating filters, we may assume a total bacterial reduction of 80 per cent., representing the removal of 800,000 bacteria from the original 1,000,000, and leaving 200,000 per c.c. to be yet dealt with.

In order to satisfy the above assumed standard of not more than 10,000 bacteria per c.c. in the effluent we require a further percentage reduction of something like 96 per cent. In fact a 96 per cent. further reduction would just leave 8,000 bacteria per c.c. in the effluent, adding 80 per c.c. to the stream water after dilution.

This further reduction may be obtained by either sand filtration or disinfection. The question again is, which is the cheaper and most practical method for a small municipality of the above population?

In order to treat 120,000 gallons of percolating filter effluent per day by sand filtration to obtain a reduction of 96 per cent. of bacteria, the rate of filtration should not exceed 1,000,000 gallons per acre with medium coarse sand. A filter 75 by 75 feet would therefore be required, and such should be in duplicate to allow of surface removal of sand and cleaning from time to time. The filters, operated by a head pressure, as in ordinary slow sand filtration, built complete at three feet deep with under drains, concrete walls foundations, and frost protection cover would cost approximately $5,000 (the average cost of sand filtration in the U.S. approximates $30,000 per acre for open filters). The operating expense would add about $500 per annum to the cost of the primary works. The