serious one facing liquid chlorine. Whereas the bulky nature of the bleaching powder plants will always militate against them.

Method of Conducting the Work.—The liquid chlorine used in this work was supplied to the city of Toronto by the Leavitt-Jackson Company, from one of their drums or carboys. A saturated solution was secured which served for making the standard solutions used in the following work. In order to ensure a fair comparison the solutions used for disinfecting the samples were prepared and titrated by the chemist at the experimental plant immediately before use.

Known quantities of water were infected with different amounts of sewage, varying the pollution to such an extent that the counts ranged from 1,000 to 30,000 bacteria per cubic centimeter. In each of the first pair of sample bottles 150 cc. of this infected water was placed, in one sufficient bleach solution was added to treat the sample at the rate of 0.2 or more parts per million of available chlorine, to the other was added an amount of liquid chlorine solution sufficient to give it an equal amount of available chlorine. These samples were analyzed for the bacterial content in duplicate after standing intervals of 20 minutes, 50 minutes and 1½ hours.

Other samples were treated with 0.4, 0.6, 0.8 and 1.0 p.p.m. of available chlorine and analyses made after the same intervals. In order to obtain as accurate results as possible a large number of analyses were made, it was also necessary to be very precise in all quantitative measurements, dilutions and shakings.

Tables of Results .- Table I shows the results obtained on treating samples of infected water with 0.2 parts per million of available chlorine from bleaching powder; the last four columns show the corresponding results obtained on treating the same samples with a similar amount of liquid chlorine. In the first column are shown counts per cubic centimeter in the untreated samples, the second column shows the counts resulting 20 minutes after the addition of the chlorine, the third and fourth columns show the counts 50 minutes and $1\frac{1}{2}$ hours, respectively, after the addition of the chlorine. Below each column is shown the average count for the whole series, and at the bottom of the 3rd, 4th, 5th, 7th, 8th and 9th columns are shown the average reductions occurring after the different intervals. The first part of the table deals with the results of the $18^{\circ}-22^{\circ}$ C. counts, then follows the 37°-40° C. counts and the colon group. On close examination it will be seen that very little difference exists in the disinfection produced by either the bleach or the liquid chlorine. Where small quantities of chlorine are used the time interval after treatment is of much greater importance than when larger quantities of chlorine are used. Summing up the action of 0.2 parts of available chlorine, whether from bleach or liquid chlorine, the reduction in the counts is not high but the reduction in the colon group is remarkable when one considers the high pollution of the water samples and the small quantity of disinfectant used. So close are the reductions by either disinfectant throughout that it would be unfair to say that the advantage lies with either.

The arrangement of the remaining tables illustrates the difference in the actions of 0.4, 0.6, 0.8 and 1.0 parts of available chlorine per million. With regard to the results, little further comment is necessary, the close similarity between the disinfecting action of the bleach and liquid chlorine is self-evident throughout the entire

work. In order to test the advisability of using a colorimetric method of testing for free chlorine, after the plating

was completed the bottles were left in a row and treated with equal quantities of Pot. Iodide solution, starch solution and acetic acid (about 2 cc. of each). The samples containing the liquid chlorine were a deeper color than those treated with bleach and the color was not nearly so well graded. In both cases the tint was very slight and uncertain in any sample which had been treated with less than 0.8 p.p.m. of available chlorine. This shows how unreliable it is to depend on the color test as a measurement of the disinfecting action.

Technique used in making the comparative analysis for bleach and liquid chlorine disinfection.

On the back of the table a row of bottles is placed, each containing 150 cc. of water sample used. In front of these are placed one or more rows of dilution bottles each containing 100 cc. of sterile water. At a noted time bottle No. 1 was treated with sufficient standard bleach solution to give it 0.2 p.p.m. of available chlorine, two minutes later bottle No. 2 was treated with sufficient to give it 0.4 p.p.m., and so on. After 10 minutes, bottle No. 6 was treated with liquid chlorine solution to give 0.2 p.p.m.; after 12 minutes No. 7 was treated with sufficient to give 0.4 p.p.m.; after 18 minutes all samples had been treated. After 20 minutes bottle No. 1 was analyzed; after 22 minutes bottle No. 2 was analyzed, etc, so that each sample was analyzed 20 minutes after adding the chlorine. In a similar manner, as will be seen from the schedule, each sample was also analyzed 50 minutes and 11/2 hours after the addition of the chlorine. This schedule was rigidly followed throughout so that there was no variation whatever in the storage periods.

A USEFUL ROAD EXPERIMENT.

The U.S. Office of Public Roads has an interesting bit of experimental work known as the Chevy Chase road. It consists of different types of pavement-bituminous macadam laid by the penetration method, surface treatments of waterbound macadam, asphaltic surfaces on concrete foundations, bituminous surfaced concrete, plain and oil cement concrete and vitrified brick, all of which are under daily observation to ascertain which of the types is best suited to the traffic and which is condemned by practical test under the same conditions of climate, soil, rainfall, heat and cold and like traffic requirements. The entire road has been laid with the utmost care and the test is one of materials, construction, durability, cost and maintenance throughout. In the stones used their specific gravity, their weight per cubic foot, their water absorption, their percentage of wear, their hardness and toughness are all determined by careful scientific tests. Patrolmen are constantly employed on this road to keep account of whatever defects in materials and construction may develop and exact data as to the cost of maintenance.

The road was so placed that all of its sections or types have been subjected to precisely the same sort of traffic year in and year out and the section or type that has not stood the strain has been as important an object lesson to roadbuilders as the section or type that has maintained itself under like strain.

According to the report of the Trespass Committee of the United States Association of Railwav Claim Agents, reports from roads representing an aggregate mileage of 231,-000, contain statistics showing upwards of 11,000 accidents to trespassers on steam railroads during 1914. The records of the Interstate Commerce Commission indicate that during the past 25 years, trespassers have comprised the bulk of deaths on railroads. in fact, to the extent of 52 per cent.