

spore-forming organisms. Chlorination operators do not usually use a dose that would eliminate all but spore-bearers and it therefore becomes essential that we should know whether the aftergrowth has any sanitary significance. Concerning the secondary development of B. Coli, the usual index of pollution, there is but very meagre information. H. E. Jordon (Eng. Rec. 1915, May 17) reported that of 201 samples, 21 gave a positive B. Coli reaction immediately after treatment, 39 after 24 hours' standing and 42 after 48 hours. These increases were confined to the warm months, the cold months actually showing a decrease. The following figures, taken from the writer's routine tests for 1913 and 1914, show a similar tendency, but an analysis of the results by months did not show that this was confined to the summer months.

The sequence of the results from left to right in the following table is in the same order as the contact period, and each percentage represents the average of approximately 290 samples.

Percentage of Samples Showing B. Coli in 10 c.cms.

| | | | | | |
|------------|------|------|------|------|------|
| | 1. | 2. | 3. | 4. | 5. |
| 1913 | 15.2 | 14.4 | 16.3 | 16.8 | 26.8 |
| 1914 | 7.0 | 5.7 | 6.0 | | 11.6 |

At station 2 the germicidal action was evidently still proceeding, but at station 5, representing an outlying section of the city, the increase is marked.

During 1915 and 1916 the writer attempted to duplicate these results under laboratory conditions and entirely failed. Usually these experiments, which were made with the same materials as were in use at the city plant, but in glass containers, were only carried to 48 hours' contact, as this would be the extreme limit found in practice; one, however, was prolonged to 5 days.

Many experiments of this nature were made with varying conditions, but as the results are all similar there is nothing to be gained by adding to those given above in tables 1, 2 and 3. In every case there is a persistent diminution in the number of B. Coli organisms found with increase of contact period. Determination of the bacterial count on nutrient agar showed in several cases that the aftergrowth had commenced and in some instances there was evidence that the second cycle was partially complete, i.e., the number had reached a maximum and then commenced to decline. The time required for the completion of the two cycles, comprising the first reduction caused by the chlorine, the increase or aftergrowth and the final reduction due to lack of suitable food material, is dependent upon various factors of which the dosage and temperature are the most important. With a small dosage the germicidal period is short and the second phase quickly

reached; with large doses the second phase is not reached within 48 hours. Low temperatures reduce the velocity of the germicidal action but extend the period over which it is effective. The higher the temperature the quicker is the action and the development of the aftergrowth. These statements refer only to the total bacteria as found by development on nutrient agar. The B. Coli did not act in this way and persistently diminished in every case. If B. Typhosus acts in a similar manner to B. Coli, the laboratory experiments show that aftergrowths are of no sanitary significance and can be safely ignored, but as the results obtained in actual practice are apparently contradictory the matter should be regarded as *sub judice* until more definite evidence is available. Perhaps the remarkable photochemical properties of chlorine are concerned in this matter.

Corrosion.—Numerous complaints regarding corrosion of piping systems in Ottawa led to the routine determination of free carbonic acid in the raw and treated waters. During a period of excessive turbidity and pollution a very heavy dose of chlorine was used and an increase in the free carbonic acid resulted. During the past 18 months the average results show a decrease, so that there could scarcely be an increased corrosive action due to carbonic acid.

If the treatment is considered according to the electrolytic theory, a slight increase in corrosion might be expected due to an increased electrical conductivity. The conductivities of various chlorinated mixtures were therefore determined with the results as shown in Diagram 3.

With the usual dosages of chlorine it is inconceivable that the increased electrical conductivity has any practical significance at ordinary temperatures. At temperatures approaching

the boiling point of water the percentage increase in conductivity would be somewhat greater and may possibly assume practical importance.

Surviving Types of B. Coli.—Several experiments were made with a view to ascertaining whether the B. Coli found after chlorination were more resistant to chlorine than the original culture. The colonies surviving after treatment with comparatively large doses were fished into lactose broth and this culture used for a second chlorination. The surviving organisms were again fished and the process repeated several times. The velocity of the chlorination reaction varied somewhat, but not always in the same direction and the variations were not greater than was found in duplicate experiments with the original culture. No evidence was obtained that the surviving organisms were in any way more resistant to chlorine than the original culture. It should be remembered, how-

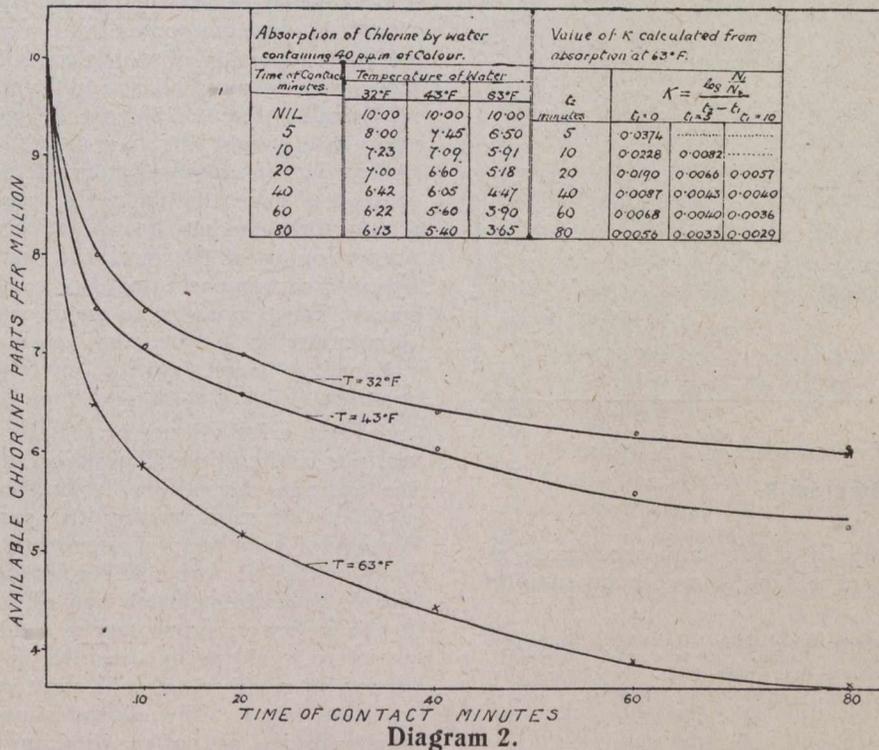


Diagram 2.