

By this method a bacterium was made use of, discovered in colliery waters, termed "M7," which had the property of precipitating hydrated oxide of iron from solutions containing salts of iron, together with organic matter.

Sewage from which the grosser solids had been removed by sedimentation was treated with a small quantity of iron salt and inoculated with the organism referred to, and aerated for several hours. Perfect clarification took place, and a deposit containing a very high percentage of nitrogen (as much as 10 per cent.) was formed.

The effluent from this process could be nitrified at very high rates on percolating filters.

Inasmuch as preliminary settlement of the sewage was called for by this process, with production of ordinary sludge, and as the effluent still required final treatment on filters for complete oxidation, the method, although having many advantages, did not completely realize the object of the researches.

In the development of the field experiments in connection with this process, valuable practical experience on the economical application of air was, however, gained. Contemporaneously with this work, experiments were being carried on at Davyhulme, at the writer's suggestion, on the continuous aeration of successive quantities of sewage, as in the Massachusetts work, and these experiments ultimated in the activated sludge process described in the various papers of Messrs. Ardern and Lockett.

It is now possible to correlate the various results which have been obtained and to get some steps nearer to a proper understanding of the nature of the process. The writer's present idea is that it can be referred entirely to bacterial activity. It was distinctly stated, in the first paper by Messrs. Ardern and Lockett that their sludge did not contain any algal growths; the process thus differs essentially from that which was in operation at Lawrence at the time of the author's visit and which was subsequently described in the annual report of the Massachusetts State Board of Health for 1913, p. 289 and seq.

It would appear, therefore, that the activated sludge process consists broadly of three operations: a clotting or clarifying action, a rapid carbon oxidation process, and finally, nitrification. It is probable that the first process is, to some extent, the result of the activity similar in character to "M7" organisms which was definitely shown to depend on enzymic action whereby traces of iron appeared to start the flocculation of the whole sewage. The "M7" bacillus is probably fairly ubiquitous, as it has been found that sewage containing iron and a certain amount of partially activated sludge but in which clarification has not been effected, can be made to clarify almost at once by the addition of a small quantity of properly activated sludge. Simultaneously with clarification, the organic matters in solution follow the usual course of oxidation, which takes place rapidly owing to the enormously extended area of bacterial activity. In the writer's opinion, the outstanding advantage of the process lies in the fact that the sewage is really clarified and the process of clarification results in the precipitation of the emulsified nitrogenous matter in the sewage. This has hitherto not been arrested in any process of tank treatment, with the possible exception of certain precipitation processes which involve the addition of large quantities of costly and inert chemicals. Experiment has shown that bacterially precipitated sludge is quite extraordinarily active as a manure and there seems every reason to believe that an important step has been taken in the ultimate aim of economic sewage disposal, *viz.*, the return of nitrogen to the land.

A great deal of research remains to be done on the conditions of activity of the sludge, both as an agent in

sewage purification and as a manure, but advance is only possible by patient and exact biochemical investigation, and it is of the utmost importance that unfounded assumptions and short-cuts of all kinds, which have been responsible for so much waste of public money on sewage treatment plants in the past, should be avoided.

It cannot be too strongly emphasized that the proper treatment of sewage is a matter, in the first place, for the scientific specialist; when he has worked out the governing facts of the situation, it remains for the engineer economically to construct the plant which fulfils these conditions.

In the present case, the engineering problem is a comparatively simple one; it is merely to keep the activated sludge uniformly mixed with the sewage in presence of the necessary air. A large amount of work has been done in this country and also by Mr. Chalkley Hatton at Milwaukee and Dr. Bartow at the University of Illinois in collaboration with the writer, and the experimental plants of various dimensions capable of dealing with quantities varying from 60,000 gallons to as much as 2,000,000 gallons per day are in course of operation or construction.

In all comparisons of cost between one process and another it is essential that result should be compared with result. Unfortunately, this rule is not always adhered to and a given process, *e.g.*, is said to be cheaper when on examination it gives much less satisfactory results. Where strict comparison is made the advantages of the activated sludge process are, in the majority of cases, beyond question, and the writer considers that any further large expenditure on works of the conventional type is—in view of the results already obtained—seriously to be deprecated.

## HYDRO-ELECTRIC POWER IN EASTERN ONTARIO.

Representatives of Eastern Ontario municipalities have recently taken up with Sir Adam Beck, chairman of the Hydro-Electric Power Commission, the question of supplying them with power and radial lines. There has been but little activity as regards the development and transmission of hydro-electric power by other than private companies in Eastern Ontario in recent years, during which time the western peninsula has been experiencing phenomenal rural and urban improvements as a result of the supply of power and equipment furnished by the Commission. This delay in Eastern Ontario has been largely due to difficulties of a technical nature existing between the Federal and Provincial Governments as regards the water power development in the Trent Valley. In this connection Sir Adam made an important announcement to a delegation which waited upon him on February 1st. He stated that the existing difficulties had been practically removed, subject to the approval of the two parliaments, and, if these bodies corroborated the proposed agreement, the province would have control of the future development of water powers within its boundaries. When the necessary legislation giving effect to this understanding has been enacted, the municipalities in Eastern Ontario may expect a betterment of the situation.

The Winnipeg office of The Canadian Engineer has been moved from Room 1008 to Room 1208, McArthur Building. The new telephone number is Main 2663. Mr. G. W. Goodall remains in charge of the office.