

stallation, afterwards completed for dealing with the whole sewage of Exeter and extending over 2½ acres, is now overseen by two men, the principal duties of whom are confined to the simple care of ensuring working order in the automatic gear controlling the various discharge valves, etc.

It should be stated that the comparative absence of putrefactive decomposition at the filter beds prevents the creation of a nuisance. The experimental works at Exeter, and the subsequent larger installation, are situated in a bit of low ground bordering the river Exe, and immediately below a residential district. No complaint arises of nuisance to neighboring residents, and, as the author can personally testify, little that is unpleasant can be detected, either at these works themselves, or at the many other installations of the same type with which he is more or less familiar.

The gas generated in the hermetically sealed tank sometimes exists under a certain pressure, which is, however, very variable; a typical analysis of gases thus present may be quoted as follows:—C O₂, 0.30%; C H₄, 20.3%; H₂, 18.2%; N₂, 61.2%; its composition is, of course, very variable, but the large percentages of methane (marsh gas), and free hydrogen, indicate high inflammability, and it is a most interesting fact that, by means of an incandescent mantle, these gases, of heat producing but feeble illuminating power, have been used at Exeter (and probably elsewhere), for lighting the works at night. Some idea of the degree of purification that may be expected may be obtained from quotations of the most significant features of analysis, made of both tank effluent and filtrate, respectively, at one or two installations now in operation.

FROM AN INSTALLATION AT BARHEAD,
SCOTLAND.

	Parts in 100,000		
	Crude Sewage.	Tank Effluent.	Filtrate.
Organic and volatile matter in solution	10.86	11.35	2,740
Albuminoid ammonia	0.30	0.34	0.051
Total ammonia	2.93	2.95	0.866
Nitrogen as nitrates and nitrites	nil	nil	0.918
Oxygen absorbed by organic matter	2.83	3.06	0.670
Color (Loch Katrine water=10)	25	20	7

Total purification shown in filtrate as compared with tank effluent, judged by albuminoid ammonia = 84.7%; or judged by oxygen absorbed, 78%.

Analysis at experimental test installations at Manchester and Leeds show 85% to 87% albuminous purification, and 89% to 93% purification as judged by oxygen absorbed, with a purification of tank effluent over crude sewage rising to over 60%.

Analysis of results from an installation at Yeovil (a town producing, through its particular industries, a sewage of unusual foulness and complexity), give averages about as follows:—

Tank effluent, as compared with

crude sewage, 64.8% purification.

Filtrate effluent, as compared with crude sewage, 87% purification.

The Exeter filtrates were stated, in a report by Mr. Dibdin, to be in a condition rendering them fit for discharge into a stream or river of relatively small volume; and as showing no signs of putrefaction or offensive secondary decomposition on keeping.

Analysis of the results of the process are embodied in reports by many of the foremost chemists in the kingdom; Mr. Dibdin, Dr. Rideal, Mr. G. J. Fowler, chemist to The Rivers Committee of The Manchester Corporation, and others; from some of which the above figures have been selected; they all indicate the production, in the filtrate, of a highly nitrified effluent, rich in dissolved oxygen (the nitrates often exceeding one part per 100,000)—these characteristics prove permanence in the purification effected, and absence of liability to the putrefaction which may follow mere temporary sterilization.

In a nitrified effluent, oxidation of any organic matter present will be continued even after contact with the filters may have ceased; indeed, it has been proved at Manchester that the filtrate improves the state of the water in the Manchester ship canal into which it is discharged, and that the addition of it, in equal parts, is sufficient to arrest a putrefaction in the latter, which takes place when it is kept without any such admixture.

Even in the tank effluent we have a purification comparable with that effected by any chemical or precipitation processes, without the accompanying difficulties due to the "Sewage sludge."

The scope of the present paper does not admit of the discussion of minor variations in method of treatment, dictated by variations in character of sewage, and in climatic influences;—a very wide experience, during the past ten years, has certainly proved that the septic tank and the contact beds are together equal to dealing with sewage of the worst types, and their efficacy has been tested under the greatest variations in climate.

The author has had, perhaps, some special opportunities of following the development of the process from its incipency, through a personal acquaintance with Mr. Cameron and some of those associated with him, and he has been able to visit a number of works in operation; it is his belief that in its application will lie the means of dealing with the sewage disposal difficulties, yearly becoming more acute in so many Canadian towns and villages, especially those of the lake districts, where contamination of water supply is becoming increasingly serious in its consequences. In this connection it may be added that experiments conducted

some time ago by Dr. Ransom Pickard, F.R.C.S., aiming at comparisons of percentages of typhoid bacilli present after the addition of typhoid bacillus cultures to crude sewage untreated, and to sewage afterwards submitted to the septic tank and contact beds process, admitted of the preparation of the following table, taken from Dr. Pickard's report upon the subject.

Results of addition of Cultures of Typhoid Bacilli to Crude Sewage taken from the Exeter Installation:

On the elapse of	% Typhoid Bacilli present
0 hours	100.
24 "	76.14
48 "	60.55
7 days	8.16
14 "	0.73

The application, to the same infected sewage, of the septic tank and biological filter process, as carried out in Dr. Pickard's laboratory, indicated a speedy removal, by tank and filter, of a fair 90% of the bacilli; with the result, moreover, that of the bacilli passing from the biological filter, in successive periodic filtrations, subsequent to the first contamination of the crude sewage, the second filtration showed but 1.41%, and the third is given as 0.491%.

A doubt would naturally arise respecting the maintenance of efficient action of contact beds in the face of the extreme cold of a Canadian winter. As before stated, it is but comparatively lately that information on this point has been forthcoming. Respecting some of the experiences gained on this continent, the writer can speak personally.

Towards the end of the very severe winter of 1903-4, he received an invitation from the American Cameron Septic Tank Company to visit certain of their installations in Northern Illinois and Iowa, for the purpose of making enquiry respecting their operation during that season! amongst other visits, one was paid to a plant in the neighborhood of Davenport, Iowa. The winter had been phenomenally severe, and at Davenport, at the time of the visit, ice was reported upon adjacent parts of the Mississippi river exceeding 30 inches in thickness. The mean temperature at the place, for January and February, was not as high as 17° F, the mean of minimum temperatures for the same period was barely 9° F, yet the author was assured by the attendant that no ice formed upon the contact beds which was not immediately dissipated by the next charge of sewage, and that the heat of the sewage itself proved quite sufficient to prevent any failure in the action of the alternating valve gear, which, in installations exposed to a severe winter, it is the custom of this company so to place as to receive the effect of radiant heat from the comparatively high temperature sewage. The author, on the occasion of his visit, collected some of the filtrate as it was dis-