Sewage Effluents in Relation to Standards," by Gilbert John Fowler, D.Sc., F.I.C. Mr. Fowler is superintendent and chemist of the Manchester Corporation Sewage Works. He gave much valuable evidence before the British Royal Commission on Sewage Disposal, and is recognized all the world over as an eminent authority on sewage disposal matters.

## THE QUALITY OF EFFLUENTS IN RELATION TO STANDARDS.\*

## By Cilbert John Fowler, D.Sc., F.I.C.

At the outset it will be well to define the scope and point of view of the present paper, so as to limit the discussion within reasonable bounds. In the first place, it is assumed that rigid and universally applicable standards are impracticable. In the writer's opinion it is of the greatest importance, in view of the large sums of money which authorities must spend on works of sanitary improvement in many directions, that every effort should be made accurately to ascertain the conditions surrounding any effluent discharge in any given instance. It may be that unnecessary expenditure in the endeavor to reach an uncalled-for standard of purity may cripple the resources available for more needed reform in other directions. In saving this, one is, of course, well aware that many authorities fall far short of adopting reasonable and practicable means for the purification of their sewage. On the other hand, the natural zeal of those responsible for the treatment of the sewage may cause large sums to be lavished on the attainment of results which are more than the situation really calls for.

In this connection the following paragraph 30 of the original Interim Report of the Royal Commission, issued in 1901, may usefully be quoted :---

"We consider it of the utmost importance that the simplest possible means should be provided for adequately protecting all our rivers, and we are further of opinion that it will be desirable, probably for some time to come, that scientific experiments should be carried on in order to ascertain all the real dangers of pollution, against which they should be protected.

"In the present state of knowledge, and especially of bacteriology, it is difficult to estimate these dangers with any accuracy, and it seems quite possible that they should be either exaggerated or undervalued according to the predisposition of those who have to deal with them. An authority, guided by medical considerations, might not unnaturally be inclined to insist on a degree of purity which may ultimately prove in certain cases to be uncalled for, while another authority, with its mind fixed upon economy, might shrink from taking essential precautions."

In the second place, the present paper is' not concerned to consider the rival claims of well-known methods of sewage treatment. Any suggestions which may arise are confined to dealing with the effluent as it leaves the filtration works and before it reaches the stream. The subject for discussion, therefore, falls under two heads:—

1. The actual chemical significance of the various chemical tests at present made use of by various rivers authorities for estimating the quality of effluents, with a special reference to the tests suggested by the Royal Commission.

\* Extracted from paper read before the Royal Sanitary Institute.

2. The effect which certain effluents, which may comply with some, at any rate, of these standards, may have upon the streams into which they flow.

Taking these subjects, then, in order :--

## 1. The Chemical Meaning of Various Standard Tests.

The chemical tests which are used in estimating the purity or otherwise of an effluent are, speaking generally. The amount of oxygen absorbed from permanganate; the incubation test; albuminoid ammonia; nitrates; suspended solids; and the rate of absorption of dissolved oxygen.

One of the first questions which arise in judging of the meaning of analytical figures is whether a sewage is weak or strong; thus, for example, an 80 per cent reduction of impurity, measured by albuminoid ammonia, with a sewage of original strength of I part of albuminoid ammonia per 100,000, would give an effluent with an albuminoid ammonia of 0.2 parts per 100,000. If the original figure for the sewage was 0.5, the effluent would be 0.1, which would be, for instance, within the limits of the Mersey and Irwell Joint Committee. Assuming that the sewages differed only in strength, it may be taken that the character of the organic matter remaining in the effluent is the same in both cases, and thus is of equal effect from a pollution point of view, although superficially one effluent is twice as bad as the other. It has, indeed, been argued by Dunbar and Thummy on the Continent that after a certain percentage purification has been attained the residual organic matter is so altered in character as to be inoffensive.

On the other hand, it has been pointed out to me by a responsible chief inspector that the effect of the two effluents on the stream is not identical, owing to the greater volume of diluting water carried by the weaker sewage. This is a point which deserves discussion, especially in relation to the development of growths, which is the chief subject matter of the later part of this paper.

The question of suspended matter raises several points of importance. As Mr. Thompson pointed out at Leeds, much depends upon the length of time elapsing between the taking of the sample and its actual analysis. Many effluents, especially those containing iron salts, while free from visible suspended solids at the time of sampling, are capable of yielding considerable deposits on standing. The "clarification test," which was described by the present writer in a paper before the Society of Chemical Industry, 1908, affords a means of approximately estimating the character and amount of this potential deposit. It may vary very much in different classes of sewage, and in the same sewage on different days of the week. Thus, for example, the sewage of Wakefield, which has recently been submitted to thorough investigation, contains the greater part of its organic matter in the colloidal state, owing to the amount of wool-washing refuse present. The precise reverse is characteristic of Manchester sewage. Again, those who are familiar with small sewage works will have noticed the greater opalescence of the effluent on washing days; in fact, there is evidence to show that the colloidal matter in an effluent consists largely of metallic soaps.

The trade effluents in the sewage naturally greatly affect the meaning to be attached to the different analytical figures. Mention has already been made of Wakefield. Even after the removal of the grease, the residual organic matter from the wool contains a high proportion of organic nitrogen, which there is reason to believe oxidizes much more slowly than the nitrogenous organic matter of ordinary sewage.

What has been said with regard to Wakefield sewage applies even more noticeably to the sewage of Bradford. It