

construction or unforeseen expense. If such a scheme is actually adopted the ultimate outlay is found to be greatly in excess of the preliminary estimate, and the engineer, and his profession generally, is blamed for the result. It is not uncommon for local authorities and private individuals to complain of the futility of engaging consulting experts to advise them on engineering matters, and for this unsatisfactory state of affairs the engineers themselves are alone to blame. It would therefore seem advisable for engineers to set themselves a high ideal in the matter of competitions and preliminary estimates, and, in the author's opinion, it would lead to greater confidence being placed in consulting engineers if all were to refrain absolutely from taking part in competitions of any kind, and from giving preliminary estimates which are not based upon ample prices and do not cover every contingency that can possibly be foreseen.

#### **Preliminary Considerations.**

In preparing a scheme of sewage disposal there are many points which need careful study before the actual works can be considered. In the first place the question of site must be settled. The ideal site is one which is sufficiently removed from the neighbourhood of dwellings to prevent any possibilities of nuisance arising. It should also be situated so that all the sewage may be delivered at the works by gravitation, and the nature of the subsoil should be such that it can be utilized, if not for land treatment alone, at any rate for the final stage after treatment in tanks and filters. Conditions such as these are undoubtedly a counsel of perfection and are seldom available, but every effort should be made to secure them. There is, as a rule, no difficulty in complying with the conditions as to distance from dwellings, but if all the sewage cannot be delivered by gravitation, only that portion of the sewage which is below the level of the outfall should be pumped, and the remainder should be allowed to gravitate. It is true that the extra initial cost of pumping plant capable of raising the whole of the sewage is in some cases not much in excess of that for the volume which must of necessity be raised, but the continuous annual charge for operating the pumping plant is a most important consideration, and should be reduced to a minimum. Even when a pumping scheme has been decided upon it is frequently not possible to secure a site where the character of the subsoil is suitable for the purpose of irrigation. In these circumstances it is useless to recommend the purchase of any greater area than will suffice for the actual works required, with due provision for probable future extensions. Although it is a difficult matter, the question of the cost of the land should receive careful consideration, especially where two or more suitable sites are available.

Having chosen the site, the next problem to be considered is what method or combination of methods should be adopted to secure the desired result at the lowest cost both for construction and maintenance. This is probably the most important and the most difficult part of the engineer's duty. It is not sufficient merely to copy some existing installation which is successful under probably entirely different conditions. The two principal factors in the solution of this problem are the character of the sewage to be treated and the extent to which it must be purified. If the sewage is of purely domestic origin there is not much difficulty in selecting a method which will satisfy all reasonable requirements, but, if it contains a large proportion of laundry wastes, brewery liquors or other trade wastes, great caution must be observed in coming to a decision, and it is in these cases that the engineer has the greatest need of practical experience. Text-books and reports of Royal Commissions and other expert authorities may be studied assiduously, but will be of little avail if the engineer is not in a position to

form a correct judgment on the basis of his own experience. It may be argued that all engineers cannot possibly obtain practical experience in the disposal of all kinds of sewage, but if any engineer is confronted with the problem of dealing with some special type of sewage of which he has had no experience it should be his duty to secure the assistance of some brother engineer who has the necessary qualifications.

Another important factor in the selection of the most suitable method of treatment is that of fall. If there is not sufficient fall for any particular scheme unless pumping is resorted to, and some other equally suitable method can be arranged to do without pumping, the latter should be adopted. From the foregoing it will be seen that there is great scope, even in the preliminary considerations, for the exercise of ingenuity and experience on the part of the engineer in designing a scheme which will satisfy the ideal under the conditions at his command.

#### **Grit Chambers and Screens**

The method of treatment having been decided upon it becomes necessary to consider the details of the scheme. There would not appear to be much room for setting up an ideal in connection with grit chambers and screens, yet even these minor details may be more or less satisfactory in their design. The purpose of the grit chamber is to arrest as much as possible of the mineral matter in the sewage and not to retain any organic matters in suspension which can be dealt with in subsequent stages, due regard being had to the character of the sewage. As the mineral matters deposited are not acted upon or reduced in any way they must sooner or later be removed, and it is in the lack of means for the removal of the deposit that grit chambers usually fall short of the ideal. In the author's opinion frequent removal (daily if possible) is the most satisfactory system to adopt. It is more likely to be done regularly if it is made a daily operation than if it is performed at irregular intervals, and the quantity removed is less in bulk, and thus more easily disposed of. On the other hand, it is difficult to enforce frequent and regular removal when proper facilities are not provided. The ideal grit chamber is of such construction that it arrests all mineral matters, but no organic matter, and is provided with every facility for removing the deposit at regular and frequent intervals.

With regard to screens, the author has seldom observed screenings from any type of screen, the larger portion of which might have been allowed to pass into the subsequent tanks without increasing the quantity of sludge by more than an infinitesimal fraction of its total volume, and he considers their use, except in pump wells, and a few other exceptional cases, as unnecessary. As, however, the Royal Commission hold the contrary opinion it will be necessary to provide screens in many cases, and the ideal screen is one that will perform the work it is expected to do without becoming choked too readily, and thus backing up the sewage. This ideal is probably unattainable but there is no reason why engineers should not attempt to approach as nearly as possible to perfection. Among the very usual defects are want of width, and lack of depth below the water level; and one of the most difficult problems to solve is the suitable spacing of the bars—that they shall be sufficiently narrow to arrest the matters they are required to intercept, but wide enough to allow all others to pass. The use of mechanical methods of cleaning screens tends to prevent frequent choking, but even in these cases the matters arrested are generally of such a nature that they might be allowed to pass into the tanks, and there are a large number of small works where mechanically operated screens cannot be used.

(To be Continued.)