Because of the nuisance which results from the ordinary anærobic or hydrolytic fermentation of sewage, the tendency has been to discard this process and employ ærobic methods wherever it is possible to do so. It is a simple matter to obtain a clear, non-putrescible effluent by passing the sedimented sewage over trickling filters, or by means of the activated sludge process, without any nuisance arising. The inoffensive treatment of sludge, whether from plain sedimentation tanks or from activated sludge process, has until recently proved very difficult, because sludge is putrescible and the only method yet known of digesting it to a non-putrescible residue is by the anærobic process.

What Treatment Must Involve

The treatment of sewage by modern methods must involve:—

1. The thorough screening of coarse material from the sewage.
2. The complete separation of grit and other readily sedimented inorganic matter in suitable grit chambers before the sewage passes over into the sedimentation tanks proper.
3. The complete separation of all organic material capable of being sedimented in special tanks.
4. The treatment of the effluent from the sedimentation tank on bacteria beds to form a clear, non-putrescible effluent.
5. The treatment of the sludge without nuisance to yield a non-putrescible, easily handled residue.

Of these phases, the third and fourth may be combined, as they are in the activated sludge process, while the treatment of the sewage by efficient screening and grit chambers is absolutely essential as a preliminary to any disposal system.

The object of the chemical engineer, or sanitarian, is to convert all the contained organic matter in sewage into inorganic matter, or something which is no longer putrescible. To be ideal, there should be no nuisance connected with any part of the process, from beginning to end—an ideal which only now we are beginning to believe possible of accomplishment.

The activated sludge process would have brought us pretty close to the ideal solution were it not for the fact that activated sludge is colloidal in character, will not readily separate from its water content, and is putrescible. But because of this drawback the most difficult task remains unsolved, and we must seek elsewhere for the solution of the sludge problem. According to our experience in Toronto, continuous aeration of activated sludge for two weeks will not produce a stable residue; it still has to undergo anærobic action before it can become a stable, inoffensive material.

Public Resents Stream Pollution

With the increase in knowledge on the part of the general public on questions of public health, there is a growing objection to the pollution of water-courses by sewage, not only because of the possible danger of typhoid fever and other intestinal diseases, but also from the aesthetic standpoint.

Of course, there are occasions, during periods of heavy rainfall and storms, when the sewage of any municipality, unless it has a special system of sanitary sewers, will have to be by-passed into the nearest stream or lake. This occasional pollution is not what people object to, but rather to the principle which approves of the deliberate fouling of our water supplies and their subsequent purification.

The dwellers on streams below towns are more and more resenting the conversion of those formerly limpid streams into foul and turbid water-courses because some tanner, manufacturer or town upstream throws waste products into them. And, because of this growing hostility to the interference of what are felt to be the reasonable riparian rights of property owners by the deliberate pollution of streams by irresponsible parties, it is becoming less easy for manufacturers and towns to solve their disposal problems by the simple process of carrying a pipe line to the nearest water-course and letting their wastes empty into it.

The ideal method of sewage disposal, sought for so long and so patiently by sanitarians, is actually now appearing in sight. Gradually we have learned the basic principles involved in the disposal of sewage, and, because these are purely biological in character and could not be learned through laboratory experiments, but only from deductions based upon experiments on a very large practical scale, it has taken a long time to establish them.

What would constitute an ideal method of sewage disposal? To the writer it would mean the carrying on of the whole process without any nuisance whatever, at the minimum cost and with the production of a non-pathogenic and non-putrescible effluent which could be turned with safety into the nearest water-course. The entire process, moreover, should, if possible, be carried out in tanks of simple and economical design that would not involve an elaborate pumping plant or the construction of bacteria beds.

Leaving the small septic tank out of the question, every system of sewage disposal of any scale involves the separation of suspended material from the sewage, and treatment of the effluent and sludge independently.

Effluent Stable, Sludge Putrescible

It has hitherto proved impossible to digest sewage in tanks in such a way as to yield both a stable effluent and a non-putrescible sludge. The closest we have come to this is in the activated sludge process, where a clear, stable effluent is produced, as well as a partially stabilized sludge. If the activated sludge produced was a perfectly stable material which could be readily dewatered, we would have an ideal method, but the sludge from an activated tank is still colloidal and clings to its contained water with the greatest obstinacy; consequently, it cannot be readily dried out on any kind of filter beds, though apparently about 40% of its contained water may be readily removed by centrifugal action.

The prevailing methods of sewage disposal in America include the activated sludge system, plain sedimentation tanks alone or in combination with trickling filters, the double-tank system of Travis or Imhof, and sludge digestion tanks. The ordinary large septic or hydrolytic tank has to a large extent been superseded on account of the nuisance with which its operation is attended, and the various types of contact beds, which were common in England, but are now out of date, never gained a foothold here.

The small septic tank for household use is a very valuable method, because it is automatic, liquefies solids, and, since the whole process is carried on underground, is inoffensive. The liquefied effluent from the small underground septic tank flushes periodically into a system of underground tiles placed not far below the surface of the ground; from this tile system it soaks into the soil, and any organic matter present is destroyed by bacterial action, while any gases are absorbed by the soil.

An advance on the large septic tank was the double-chambered tank of Travis and Imhof. These types permit the sludge which settles out from the upper tank to fall through into the lower tank, where it undergoes digestion independent of the tank above it. Sometimes this kind of digestion is satisfactory and does not create bad odors; at other times the digesting sludge in the lower tank boils up into the second tank and is very offensive. Consequently, many of these double-chambered tanks have been abandoned. One very valuable fact was established by the process, namely, that it is possible under certain conditions to digest sludge anærobically without offense.

Sludge Valuable as Fertilizer

The activated sludge process, which is excellent in that it is carried out in tanks, removes all colloidal matter in suspension and turns out an excellent, clean and non-putrescible effluent, is also essentially a biological process. It depends, however, on an ærobic flora, quite different in character from that which operates in the anærobic systems mentioned above. The process produces a sludge which quickly separates from the sewage, leaving a clear and almost colorless supernatant water. Sludge presses or centrifugal action