water and dish water; in short, all water that can be disposed of in order to facilitate in the tank the decomposition and disaggregation of foeces and all other decomposable matters which may chance to be there."

Col. Waring, in describing his device in 1894, says: "In so far as the decomposition is necessary, the settling-basin is, in a less degree, subject to the theoretical objections that are made to the cesspool. It is, however, to be considered that this settling-basin, which is perfectly tight as to its walls, is so small that the volume of water passing through it takes up the products of decomposition, and carries them on to the drains before they assume a condition at all comparable to that of the permanent cesspool. It is found, practically, that the arrangement is inoffensive and safe." He adds further: "The aim should be to avoid putrefaction and secure as nearly as possible a complete and rapid resolution with a sufficient supply of oxygen."

In the disposal of house-wastes therefore, as in the disposal of sewage, all authorities agreed that nitrification or oxidation was essential throughout, and that putrefaction, always objectionable, must be avoided.

The Septic Tank.—At a time when the attention of sanitary authorities and the most advanced thinkers on this subject, including the Massachusetts State Board of Health, was directed to nitrification or oxidation as the ne plus ultra of sewage disposal, Mr. Donald Cameron was working quietly in an opposite direction, and when in 1895, he published the result of his experiments and described the operation of his tank at Exeter, his statements were received with many reservations. Instead of following the beaten path, or unbroken chain of nitrification or oxidation, Mr. Cameron had worked out a theory of his own, involving the cultivation of a separate colony of putrefactive germs or anærobes, and ascertained:

1.—That such exclusively anaerobic colony will spontaeously increase to the point of equilibrium with the solids, and thus prevent the accumulation of sludge.

2.—That, reciprocally, this exclusively anaerobic colony will be supported indefinitely by the incoming solids.

3.—That the product of this exclusively anaerobic colony will be acceptable to the succeeding aerobic colony in the filter, for further purification.

4.—That such product is made even more acceptable to the aerobic colony by intermediate aeration.

Let us pause for a moment to consider what a completely pioneer idea was this of cultivating an exclusive anaerobic colony. Go, if you please, outside of this art into any art. Where was there any precedent or parallel for the idea that any germ which individually was pernicious could be made useful by being colonized? So far as we know, in the case of every other pernicious germ the greater the number the the greater the evil, but here Cameron ascertained not merely that the greater the number the lesser the evil, but that when the number was increased to the maximum the evil was reversed into good.

The Cameron process was such a radical departure that for a time everybody was skeptical; by sheer force of merit, however, it was finally accepted as the most modern and the most efficient system of sewage treatment, although so revolutionary in its character. The extent to which the sewage world was started by Mr. Cameron's reversal of all previous methods is well illustrated by the fact that there were two public inquiries made at Exeter, England, by the local government board; it was made the subject of debates and discussions before scientific societies all over the world by engineers, chemists and bacteriologists. It was heralded as a new process, a wonderful discovery, and the beginning of a new epoch in the art of sewage disposal; even a new word in the art of sewage disposal was coined to designate Cameron's discovery, namely, the "Septic Tank" system.

This system consists of a tank of suitable dimensions. and so arranged that a mass of putrefactive organisms or anaerobes are developed therein of a character and quantity sufficient to liquefy the solid matter of the flowing sewage. It involves the complete separation of the anaerobic or putrefactive germs from the aerobic or nitrifying organisms, so that the work of both is performed unimpeded by the presence of the other; the septic tank is the work-shop of the anaerobes, where ideal conditions are provided for their development and activity, i.e., the absence of air, light and agitation; while in the contact or filter beds these conditions are completely reversed, and an ideal home for the development and activity of the aerobes is provided. The result accomplished by the Cameron process is the liquefaction and purification of sewage on a practical and efficient scale, "avoiding the formation of sludge."

It may be divided into three periods:—

1.—The septic, liquefying, putrefactive or anaerobic period.

2.—Aerating period.

3.—Filtering, aerobic, oxidizing or nitrifying period.

The first of these, or the septic period, involves two stages:—

A.—The maturing or ripening stage.

B.—The liquefying stage.

The length of time that the maturing or ripening stage will take to develop varies, because it will depend on the character of the sewage to be dealt with and other varying conditions, but with an average sewage under normal conditions, substantial septic action will not be completely established in less than from 6 to 12 weeks, and during this time there will be a rapid, but decreasing, accumulation of solids in the tank. When the maturing stage is complete, and septic action established, an equilibrium exists between the incoming solids and the anaerobic bacterial action set up in the tank; this constitutes the liquefying stage, and as a result of this liquefaction practically no more solids accumulate.

We come now to the second, or aerating period:—

As the liquid effluent leaves the septic tank it is impregnated with gases produced by anaerobic action, or putrefaction, and has a slight odor; to release these gases which are inimical to aerobic action, the effluent is exposed to air and light in thin films, and as the gases escape during this exposure or aeration, a corresponding volume of air is absorbed, so that not only are the anaerobes and aerobes entirely separated, but the effluent is put in the best possible condition for the third or final period referred to above as the "filtering, aerobic, oxidizing or nitrifying period."

The nature of this operation will depend on the character of the outlet, and degree of purity desired; where the volume of sewage is small compared with the stream or other body of water into which it is discharged, or when a high degree of purification is considered unnecessary, the tank effluent mav be discharged without further treatment; when on the other hand, a higher degree of purification is essential, local conditions will determine whether aerobic bacterial contact, sand filtration, or irrigation shall be resorted to, and to what extent.

Aerobic bacterial contact consists of two or more beds, constructed preferably of concrete, so as to be made watertight, and filled with suitable material, such as coke breeze, cinders, or furnace slag, screened and freed from dust and fine particles. They are filled alternately, allowed to stand full from one to three hours and then emptied by means of suitable valves; as the sewage leaves the bed the air is drawn down into the interstices of the filtering material, so that it is thoroughly aerated before being again filled. This alternate filling, emptying and aeration is controlled by an automatic alternating gear, so that the operation is not dependent upon the fidelity and vigilance of an attendant.

Sand filtration and irrigation, the other methods of subsequent treatment, are too well-known and understood to need explanation.

It is impossible to lay down exact rules defining the dimensions and proportions of septic tanks, or as to the most desirable method for the subsequent treatment of the tank effluent; these are matters that depend not only on the character of the sewage to be dealt with, but also on the nature of the outlet and local condition generally. For these reasons, each case must be considered independently in order that due benefit may be derived from any natural advantages that may exist locally as affecting the efficiency or economy of an installation.