should not be less than 3 feet, and it is unnecessary to have it more than 8 feet. Within these limits success does not so much depend upon the depth of the media, as upon the cubic quantity of filtering material bearing a certain relation to the amount of sewage to be treated. With ordinary domestic sewage there should not be less than one cubic yard of filtering media to each 150 gallons of dry weather flow of sewage to be treated. Success depends further upon even distribution of the sewage over the whole surface of the filter. There are various appliances for this purpose. The best up to date is the revolving sprinkler worked automatically by the sewage In cold climates, owing to frost this apparatus must be cut off in winter and alternative distribution provided by means of weeping pipes fixed 6 inches below the filter surface. The sewage must be fed intermittently over the surface by means of an automatic dosing tank at a rate of not more than two gallons per each square yard of filter surface, so as to allow of each dose to draw air with it and guard against any hydrostatic head forming in the filter, causing undue hurry in percolation or flushing by means of which the nitrifying organisms may be removed from the filter.

Such a biological system will so chemically change any ordinary sewage that it is no longer sewage. The effluent will be non-putrescible, incapable of further fermentation or producing any nuisance.

But what about the removal of intestinal bacteria and pathogenic germs? Is it pretended that this simple process of sedimentation and passing sewage through matured material of walnut size, and subjecting it to nitrification, is capable of retaining or exterminating the micro-organism of disease? Any man who makes this claim for either the above process or for any of the other known ordinary processes of sewage disposal, stands condemned as ignorant of the results of modern sanitary research work.

The biological method, or the land intermittent filtration process, will greatly reduce the number of B. Coli, and other bacteria, but will not efficiently reduce their number to bring the effluent anywhere near the bacterial standard required for drinking water. Fortunately the greater number of bacteria are not isolated as individuals, but are either in colonies held together by gelatinous matter, or are wrapt up and held by suspended solids. The result is that the retention of the solids in the settling tanks will retain from 60 to 70 per cent. of the bacteria entering with the sewage. A further reduction is effected by the retention of organic solids in suspension and organic solids in solution absorbed in the filter to the amount of about 85 per cent. of the number entering the filter. So large, however, is the original bacterial count, that the resultant percentage is still in a proportion to render the non-putrescible effluent unsafe for dietetic purposes, unless mixed with a large volume of pure water. The life of the resultant bacteria in an effluent practically free from organic matter and thoroughly oxidized, is very short.

It, therefore, cannot be denied that although it is absurd to speak of nitrified sewage as potable water, a great and beneficial work is accomplished.

This nitrified and non-putrescible sewage effluent can be rendered practically sterile if required. The process, however, is in most cases unnecessary. Slow sand filtration as applied to drinking water, is effective to the extent of about a 95 per cent. further bacterial removal. Sterilization can be effected by chlorine processes at a cost of from 80 cents to one dollar per 1,000,000 gallons of sewage treated. The question in all such cases to be considered is the character of the stream into which the effluent enters and mixes. In many cases it will be found that the stream or river receiving the sewage effluent, is organically more impure than the purified sewage, or in other cases, that the volume of the stream or river is so great in proportion to the sewage effluent that an analysis of a sample taken one hundred yards below the effluent will compare equally with one taken above the effluent.

In the case of rivers or streams passing through settled areas, pollution does not depend solely upon the sewage of combined communities. There are a hundred and one other causes which may constitute polluting sources. In the case of a community drawing water from any such source, it would appear, apart from the question of whether sewage is treated or not, that a duty still remains to provide that such water is rendered beyond suspicion. In Europe, in Great Britain, and in the United States this question of the relative responsibility as between the degree of purification required for sewage effluents on the one hand, and the obtaining of a pure water supply on the other, has received a great amount of attention. The concensus of opinion is that the responsibility must be divided. It is considered unreasonable to ask a community to discharge a sterilized sewage effluent, on the other hand, it is considered reasonable that those responsible for the supply of water should take all necessary measures to deliver that water in a pure condition. Sewage purification to the extent of producing a non-putrescible effluent, goes a long way towards making the work of supplying a pure water an easy one. In fact, if measures to this extent are not adopted, the supply of a pure water becomes almost a practical impossibility.

The production of a non-putrescible sewage effluent means, an effluent which will not change the visible character of a stream, it will not affect fish life, and when 1,000 times diluted, may be safely used for watering cattle one hundred yards below the effluent outlet; and when 10,000 times diluted with equally pure water, may be used for dietetic purposes half a mile below the effluent outlet with comparatively no risk.

The main point, however, as far as drinking water is concerned is this, that whenever water is drawn from any suspicious sources, such as surface water from settled areas, such water should be treated by either mechanical or slow sand filtration, or rendered sterile by any of the well-known methods of ozone or hypochlorite.

The foregoing general description of a biological plant applies more particularly to what is termed the percolating filter process as distinct from the "contact bed system." This paper would be incomplete without a reference to the "contact" system.

The percolating system is the most modern development of biological treatment; the "contact bed" was the earlier method of application. With the former the sewage is allowed to percolate continuously through the filtering material from the surface to the base—with the latter the shell holding the filtering media is made water-tight so that the filter remains full of sewage for a period of time. The rule generally in vogue is, say an hour to fill with sewage, an hour for the tank to remain full of sewage, and an hour for the tank to remain empty for a period of rest or recuperation.

The principal of the contact bed has no scientific basis; it is purely empirical. It was a question of how best to bring the sewage into contact with every particle of filtering material so that the nitrifying organisms might have full scope for their energies. The obvious solution was, fill the tank to the point of saturation and give every organism an equal chance. In order to give these organisms a good and a long chance, a period of contact was assumed as necessary. After what was supposed to be a sufficient period of contact, the outlet valve from the bed was opened, the treated sewage drawn off, analyzed and disclosed an abundant presence of nitrates and nitrites, proving that the desired chemical change had occurred. It was at once assumed almost without debate, that the nitrifying organisms fed, as it were, upon the organic matter in the sewage and rested their jaded appetites during the period when the bed remained empty. Dibden, and others in England preached this from the very house tops, and contact beds were scattered over the land, as the end-all and final conclusion of the sewage problem. The humor of the whole farce lay, however, in attaching to these contact beds preliminary treatment in the form of septic tank action. It was claimed that the septic half of this treatment represented anaerobic fermentation, fermentation apart from light and air. It was further claimed that the second half the contact bed treatment represented aerobic fermentation, or fermentation in the presence of free oxygen.