The form of the bacteria bed is immaterial, so far as purification is concerned. The largest installations are rectilinear, but the governing factor in the shape or form is the method of distribution of the sewage, and as the fixed spray jet is the best for a large installation, the bacteria beds are generally rectangular in form. As the rotatory distributor is best for small installations, small beds are generally circular in form. A bed, therefore, to deal with only 300 gallons per day would be less than 5 feet in diameter, provided the medium be 6 feet in depth. The floor should be impervious concrete in situ, floated to a smooth surface preferably. On this floor a false floor consisting of what are called aërating tiles should be laid to retain the medium and facilitate the free discharge of effluent. The tile floor also forms a means of aëration, and the ready dispersion of gases, like carbonic acid gas, which inclines to harbour in the bottom of the bed, but the main advantage of a false floor is to facilitate a free discharge of those solids that accumulate in the bed, especially after excessive working. If a bacteria bed has been well built, and the medium properly selected, particularly as regards size of the pieces employed, the danger of chokage will be reduced to a minimum.

A percolation bed should be a permanent structure that requires no renewal and no displacement for cleansing purposes; and this can be obtained only by the employment of good rock or other hard substance that will not resolve or become friable by the action of water or atmospheric change; other qualities to be aimed at are roughness of surface and proximity to cubical form. There is nothing better than clean broken stone, but gravel, blue bricks, and hard ball slag, when broken and clean, may be regarded as almost equally permanent. The blue brick tends to break into flat chips in the cracker, and gravel, unless broken, presents too smooth a surface to the bacteria; not that a smooth surface is essentially bad, but it is too sensitive, and too readily denuded of the gelatinous substance harbouring the bacteria when the flow is increased by reason of rainfall, to be held in high estimatio nas a medium. The sizes to which the medium should be broken can be decided only after prolonged and careful tests, and a size suitable for one sewage may be quite unsuitable for another. It may be safely assumed that the smaller the medium the more complete will be the purification obtained, but a bed composed of small medium (⅛-inch) costs much more than medium size (1 inch diameter). Then the small medium will not take so much sewage, it will require longer periods of rest, and it will retain on the surface suspended matter which can be more economically dealt with subsequently.

In all sewage there are impurities that are readily eliminated as gas. There are also impurities that undergo change with extreme slowness, such as colloidal matter; and recent investigations show that there is reason for believing that it is colloidal matter that causes the notorious loss of capacity of contact beds and constitutes the bulk of the suspended matter, issuing from percolation bacteria beds. I am convinced that there has been a distinct want of knowledge regarding the real nature of the clogging of contact beds, and the more the subject is investigated the more will it be seen that the safest form of bacteria bed is one which allows the bed to perform the natural function of discharging the matter which is due to the chemical change that must inevitably take place in a sewage containing colloidal matter. Some prefer to eliminate the solids from the sewage before it is applied to the oxidizing bed, even if they have to use chemicals for the purpose; but this is not so obviously wise as would appear at first sight. For example, I have known many beds that gave off as filtrate liquid containing more suspended solids than were contained in the sewage supplied to them to the extent of two or three parts per 100,000. For the sewage under consideration a 1¼-inch stone medium would be excellent, and should be the same size from top to bottom. Those who are inexperienced in sewage purification place too much weight upon the appearance of the effluent. This should be guarded against, as a beautifully clear effluent may putrefy on incubation. An opaque-looking effluent, on the other hand, with ten or twelve parts per 100,000 of suspended solids, might pass such a test easily, a test which, after all, is the chief one to be complied with.

The primary function of the bacteria bed is to convert the ammonias into nitrates and nitrites; therefore to attempt at the same time by using a small medium to keep back suspended matter is only to prepare for further trouble. The solid matter appearing after passage through a coarse grained filter is comparatively easily removed either by passing it over a small sand filter or by allowing it to flow quietly in small narrow trenches cut in zig-zag form on its way to the nearest stream.

I hope I have not led you to assume that the only form of oxidizing bed which is capable of transforming noxious into innocuous matter is the percolation bed, because what is called the contact bed is quite capable of doing the same work in a different manner. It is not so popular as it was, and the statement of the Royal Commission that a cubic yard of medium, in the form of a percolation bed, is worth much more than the same measurement in the form of a contact bed, will do a great deal to deter engineers from using that form of bacteria bed in the future, unless perhaps where it is possible to purify by means of one contact (two contacts requiring about the same fall as one percolation bed), but I should imagine that that is so rare an event that it would be remarkable.

When my predecessor in this chair stated six years ago, in contrasting percolation beds with contact beds, that the latter were dead, he showed his keen insight into the relative merits of the two systems. He was not quite accurate when he said it, as Sheffield and Leicester have since that time adopted the contact form, but expert opinion undoubtedly favours the percolation bed, and it is because I believe it is the form which should be adopted whenever it is practicable that I have confined my remarks to that method of treatment.

There are many situations where a percolation bed could not be brought into use without resort to pumping, which in the vast majority of cases would be prohibitive as regards cost. I propose, therefore, to show that the next best thing to do is to utilize part of the garden as a sub-irrigation plot, but even here it should be borne in mind that unless the land be suitable as regards quality and area, and such that it can be drained to a depth of 4 feet, it is improbable that effective purification will take place by this method. The principle involved in adopting irrigation was formerly believed to be absorption of excrementitious matter, etc., by the soil, and utilization of the same by crops, whilst the water freed of its noxious qualities gravitated to the drains. Now we should prefer to say that the action is a complex one. The mechancilap roperty of straining slowly through the soil is not an inconsiderable part of the purification process, but the chemical changes that take place, due largely to the biological action of the nitrifying organisms, contribute in an even greater measure to the radical change. The effluent obtained by this process of sub-irrigation, where the conditions are entirely favourable, is excellent, but the difficulty of obtaining favourable conditions are great, so great that land treatment is not so popular as it was. If the land be too porous the liquid passes through unpurified; this is especially so on sandy or gravelly soils overlying rock, and if