tank is divided into two stories by a false bottom; the upper part serving as the sedimentation chamber and the lower part for the storage and digestion of the sludge. The false bottom is arranged into slits in such a way as to allow the settled solids to pass into the digestion chamber and yet not allow the gases or sludge to pass through into the sedimentation chamber. By this means the liquid passing through the tank remains practically unchanged by any septic action which takes place in the deposited solids. This type of tank is usually twenty to thirty feet deep and the decomposition of solids under head produces a sludge full of gas bubbles under pressure. When the sludge is withdrawn the gas expands and the resulting sludge is very porous and easily drained and dried.

Another development in tank treatment is the tank originated by Dr. Trans at Hampton, England. This tank not only removes settling solids, but a portion of the finely divided non-settling solids. This is accomplished by hanging plates in the sewage flow and on these surfaces aggregate the small particles of solids until a settling mass is formed which sinks into the sludge tanks. Like the Imhoff tank, the Trans tank has a separate compartment for sludge digestion, but unlike it, allows a portion of the flow to pass through this digestion chamber.

The Disposal of Sludge.—Whatever method of tank treatment is used, some means must be found to dispose of the sludge produced. Even the best sludge contains considerable amounts of putrescible organic matter and this organic matter, together with the high per cent. of water, renders the sludge problem somewhat difficult to solve. Part of the sludge treatment really takes place in the tanks due to the action of the bacteria in breaking down the organic compounds, but the removal of the water or drying of the sludge must take place outside. The sludge from deep tanks, where the sludge is drawn off under pressure, contains less water than that from shallow tanks, or that from tanks which have the supernatent water removed before cleaning. The best sludge will run as low as 75% moisture, but even then it is too wet to handle easily. Methods used for sludge drying are filter pressing, draining on sand beds and drying in centrifugal machines. Strictly speaking, these methods do not finally dispose of the sludge, but the dried sludge can be used for filling in low land or for fertilizer. Without drying, sludge can be disposed of by trenching the land and filling the trenches with wet sludge and eventually plowing the sludge underneath the soil. At Columbus, Ohio, the sludge is run into the river during the winter when the flow is sufficient to dilute the sludge without nuisance.

Although there are undoubtedly valuable fertilizer constituents in sewage sludge, the great difficulty in realizing this value is due to the high per cent. of water in even the dried material. To have value as a fertilizer it must not contain over 15% of water, and about the best that sludge-drying methods to date have been able to accomplish is 50% moisture. Probably the next few years will show developments in successful sludge utilization.

For the removal of dissolved organic solids, the earliest method is that of land irrigation. This method simply controls the flow of sewage over an area of land, this land being utilized for farming. Land irrigation given satisfactory effluents requires large areas of land, gives rise to nuisance from odors and flies, and on the whole is more costly than the modern methods. The sewage farms in Berlin cover about 43,000 acres, and those which are being abandoned gradually in Birmingham, England, 28,000. The financial aid realized from the sale of crops is not as great as might be expected and this method is generally going out of use.

A step in advance is the intermittent sand filter, as developed by the Massachusetts Board of Health. This filter consists essentially of a graded bed of sand or gravel, four or five feet in depth, well underdrained by lines of tile laid with open joints. Sewage applied evenly to the surface at regular intervals percolates through the bed and runs off in the drains. Bacteria and other microorganisms form a jelly-like covering on the surfaces of the sand grains and in conjunction with the air present oxidize the impurities. It is necessary to operate this type of filter intermittently in order to admit the air required for oxidation. Although excellent results are obtained with intermittent filtration, the same objection holds as with land irrigation. For large plants this type is very seldom adopted now-a-days, although for small quantities and where high degree of purification is required, it is extremely useful.

The Contact Bed and Sprinkling Filter.—The experiments of the Massachusetts Board of Health with sewage filtration through coarse gravel, led to further investigation on a practical scale in England and two forms of filters of coarse material were developed, the contact bed and the sprinkling filter.

The contact bed consists of a tank filled with broken stone to a depth of 4 or 5 feet, the bottom being underdrained and devices for the control of the sewage flow provided. The method of operation is to fill the bed with sewage, allow it to stand full for a short period, then drain until empty; this process being constantly repeated. While standing full some of the solid matter is deposited upon the surfaces of the stone, and while draining the air admitted, aided by the bacterial films developed on the stone, oxidizes the organic matter. It is necessary to pass the sewage through two or more beds of this type successively to get a well-oxidized and stable affluent. The use of coarse material allows much larger quantities to be treated than with sand filtration, although in time the voids become filled with solids and the material has to be renewed. The affluent from contact beds is usually non-putrescible and inoffensive, but is not as good as that from a sand filter. Contact beds, however, can be operated at a rate of 500,000 gallons per acre per day, while the best a sand bed can do is 100,000 gallons. The cost of operation is also much less

A sprinkling filter is essentially a bed of broken stone 5 to 8 feet in depth, placed over a concrete floor. The floor is covered with an under-drainage system for the rapid removal of the affluents and for ventilation. The sewage is applied to the surface of the filter in the form of a fine spray through a series of sprinkler nozzles, spaced symmetrically over the bed, these nozzles being fed by a system of distribution pipes connected with some sort of dosing apparatus. In passing through the air the sewage absorbs oxygen, and as in the other methods described, the bacteria growing on the filter stones, use their oxygen to oxidize the organic matter. On account of the continuous application of sewage and the constant supply of oxygen, the rate of filtration with a sprinkling filter is very high, running from one to three million gallons per acre per day. Usually final settling basins are provided for after treatment with this type of filter.