solids. Floating solids consist of garbage, rags, paper, sticks, etc. The suspended solids are smaller particles carried in suspension by the sewage; and the dissolved solids are those in solution. The suspended solids are divided into settling and non-settling solids, the settling solids being those which will settle out when subjected to quiescent sedimentation, and the non-settling those which will not. The aim of proper sewage disposal is to prevent nuisances from the decomposition of these solids and to also prevent injurious effects to health from the disease bacteria.

Natural Purification of Sewage.—When sewage is discharged into a body of water, the forces of nature immediately begin its purification; bacteria and oxygen oxidise its organic constituents adverse conditions of temperature and food supply destroy large numbers of harmful bacteria and thus, under some conditions, disposal by dilution is both practical and scientific. It is estimated by various authorities that the amount of water in a stream receiving sewage must flow at a rate of 3 to 6 cu. ft. per second for each inhabitant contributing to the sewers. In lakes, the extent to which disposal by dilution can be used, depends entirely upon local circumstances, in respect to location of outlets, currents, location of water supply inlets, etc. Where disposal by dilution can be used it is important to prevent deposits of solids and to keep the oxygen content of the diluting water from becoming exhausted.

Screens to Collect Floating and Suspended Solids.—Under some conditions, where disposal by dilution can be practised, it is necessary to remove the floating solids. In this case screening is usually resorted to. Screening is also used previous to further treatment to protect pumps and prevent scum-forming materials from entering tanks. There are many types of screens, the most common, probably, is the bar screen. This screen consists of iron bars, spaced at regular intervals and inclined vertically to the sewage flow. The spacing of the bars varies from one-half to several inches. Sometimes two or more sets of screens are used, the spacing of the bars in the second set being less than that in the first. The material collecting on the bars is removed and destroyed. Of late years, especially in Europe, mechanical screens of fine mesh have been used and with more or less satisfactory results. Fine mesh screens not only remove the floating matter but also a portion of the more finely divided suspended solids, and in some cases they have been used in place of sedimentation tanks.

In America the best known mechanical screen is a cylindrical framework of steel, about 6 feet in diameter and 12 feet long, upon which wire-cloth of 40 meshes to the linear inch is fastened in removable segments. The wire-cloth is protected by a copper screen of larger mesh and heavier wire. This screen is revolved slowly and the wire-cloth is washed by the jets of water. The sewage enters at one end of the cylinder and, passing through the cloth, leaves behind the floating and some of the suspended solids. The screenings are carried by a worm to the outlet end of the screen where they can be collected and disposed of. For burning, the screenings can be dried in a centrifugal dryer and mixed with coal. This type of screen removes 15 to 20% of the undissolved solids contained in a sewage. It is a somewhat expensive operation and is unnecessary where tanks are used.

Settling Tanks.—Tanks with and without the aid of chemicals have been used for many years for the settling out of sewage solids. Plain settling tanks are those receiving sewage untreated by chemicals and from which the deposited solids or sludge are removed before very much decomposition has taken place. Usually they are built rectangular in plan with sloping floors for sludge drainage. In the design of sewers, it is the aim of the engineer to keep the cross-section small enough to prevent low velocities of flow, thereby preventing deposition; on the other hand, in the design of settling tanks it is essential to obtain as low a velocity as possible in order to increase the amount of sedimentation. The length of time that sewage stays in a tank is much less important than the velocity with which it flows through, provided the period of retention is not so great as to cause undesirable decomposition. A very efficient type of tank is that designed by Mr. Watson for Birmingham, England. This is a cylindrical tank with a conical bottom, the sewage enters above the bottom at the centre of the tank and, flowing upward, slowly passes out through wires arranged around the top of the tank. The solids settle out into the conical part and can be removed by the hydraulic head without interrupting the operation of the tank.

Tanks for chemical precipitation are of various shapes but are most frequently rectangular in plan and the addition of chemicals take place just before the sewage enters the tank. The chemicals commonly used are lime and copperas; these, when mixed, form a flaky precipitate which carries down the particles of suspended solids. In some cities where trade wastes from iron manufacture enter the sewage the amount of iron in the sewage is sufficient to give a good precipitate when lime alone is added. The tanks can be cleaned by draining off the supernatent tanks to the level of the sludge and the sludge removed by sludge pumps. The sludge in chemical precipitation tanks is very heavy and rather difficult to handle. Chemical precipitation has the advantage over plain sedimentation that it removes some of the non-settling solids as well as the settling. It is, however, more expensive.

The Function of the Septic Tank.—The so-called septic tank is an attempt to utilize the decomposing action of bacteria in reducing the amount of organic solids to be dealt with. The septic tank is similar in design to the plain settling tank, but it is operated with very infrequent removal of the sludge. The period of retention of the sewage in the septic tank is usually much longer than in the settling tank. After the sewage has been retained a short time the oxygen originally present is exhausted and the putrefactive bacteria which work best in the absence of oxygen, begin to break down the organic matter. The organic solids are decomposed into liquids and gases thereby becoming somewhat less in quantity. At one time it was thought that this action would prevent the forming of any sludge, but while there is some reduction in the quantity of sludge, it is much less than was formerly thought. Besides, when a tank of sewage is undergoing rapid decomposition bubbles of gas bring quantities of sludge to the surface, often forming a scum on the top of the tank as well as on the bottom. The effluents from septic tanks are often more offensive than those from plain settling tanks, due to products of putrefaction.

Within the past few years a two-story tank has been derived which attempts to combine the advantages of plain sedimentation of the settling solids with the sludge digestion by the septic process. Tanks of this type have been devised by Mr. Imhoff, of Essen, Germany, and are known as Imhoff tanks. These tanks are coming into general use both in America and abroad. The Imhoff