

The purifying influence of precipitation by means of such chemicals as alum, iron, or lime can readily be demonstrated by chemical analysis. The hydrated alumina, ferric oxide, and lime carbonate, as they materialize into particulate existence from their solution in the water, entangle and carry down with them organic particles that would otherwise be less easily removed; and biological research shows that bacterial germs are swept from the water in like manner. That this operation is imperfect is demonstrated by the number of colonies which can be developed from the cleared water; that it is purely mechanical and not germicidal is indicated by our experimental knowledge of the action of such substances on various bacterial organisms, and by the fact that their presence does not exercise even an antiseptic influence on the bacteria of the water, as the number of these bacteria subsequently increases in the cleared water as rapidly as in a stored water which has had no such chemical treatment. The commercial interests concerned in artificial filtration invest these substances with the title of coagulants, as if the albuminoid constituents of inorganic life curdled into a bacterial *rigor mortis* as soon as the water became pervaded with the presence of the precipitant; but there is no warrant for a belief in any protective virtue other than that connected with a mechanical entanglement and precipitation.

The processes of purification that have just been reviewed remove suspended matters and more or less of the dissolved saline and organic substances that are present in the water, but none of them can lay claim to the removal or destruction of the causative agencies of the acute infectious diseases that are known to be propagated by an infected water-supply. These processes have been closely studied by the English sanitary authorities, who long ago came to the conclusion that sewage in a water is harmful because it may contain the germ of cholera or typhoid-fever, against which the most efficient method of artificial filtration constitutes no effective safeguard. Hence, the object of sanitary legislation in England is not to preserve the rivers as a drinking-supply, but to

prevent them from becoming a nuisance in their character of open sewers. The solids of sewage consist of a highly nitrogenized organic matter, the proper disposition of which in the economy of nature is as materials for the growth of the vegetable kingdom; and if these be separated, the water may be purified by percolation and filtration and returned to the rivers. Sewage has accordingly been treated in various ways for the separation of the solids and the reclamation of its water. In country houses and small communities a cesspool can be provided for the deposition of solids, the liquid overflow being conveyed by drain-pipes into the soil. The effluent water in such cases may be as pure to chemical tests as that of the stream into which it is discharged. But as communities grow, the difficulties attending the disposition of their sewage are proportionately augmented.

Various methods of precipitation have been tried with the view of paying expenses by the sale of the solids as a fertilizing material, while the separated liquids are turned into the water-courses, with or without an intermediate filtration through the soil. Sewage irrigation has also been tried on the large scale, and in many instances with satisfactory results. The advocates of irrigation point with considerable enthusiasm to the purity of the effluent water, and consider that this system will ultimately settle the vexed question of the disposition of sewage; and, indeed, such is the purifying influence of the soil, that the clear water of the outflow gives relatively good results on analysis. But, as we have seen in speaking of sewage-polluted wells, the purity which is evidenced by chemical tests fails to give an assurance of protection from typhoid-fever, and it is this protection, not chemical purity, which is the object in view. These advocates claim that typhoid-fever does not prevail in the fields which receive the sewage of an infected city, but it is the propagation by drinking-water, not by exhalation, in which we are interested, and typhoid-fever is known to have prevailed on fields where the effluent water was used for drinking. Indeed, how could we expect otherwise when we know that typhoid-