ant that the products of the end reactions be removed as rapidly as they were formed. Otherwise the equilibrium point must sooner or later be reached, and the date at which it was reached would depend mainly on the rate of their removal. This was the rock on which all artificial filters splitsome sooner, some later. In anaërobic tanks certain foulsmelling gases were needlessly set free. In the presence of oxygen entirely different types of cleavage products were formed whose sulphur was ultimately oxidised in the most unobjectionable manner. There was no necessity to use noxious methods of protein cleavage when innocuous methods were at hand, and he considered that the aërobic method of treating sewage had the best of it all the way round. It was possible to construct a septic tank installation on a small scale where all might go well for a number of years, but large installations without exception failed. The time for these to reach t...e equilibrium point was only a detail. Proceeding to discuss the question of what was a safe sewage effluent and how it was to be produced, Dr. Sommerville said the Royal Commission had been considering those questions for eleven years and he might be pardoned if, like those gentlemen, he hesitated to make a categorical reply. No standard would ever be possible if all cases of each effluent must be produced with direct reference to the conditions of its district. Into streams from which drinking water was drawn no effluent which contained bacteria capable of producing disease should be allowed to enter. In the light of present knowledge it would seem that biological chemistry new afforded sufficient machinery in the form of methods to carry many problems of sewage purification several steps nearer solution, such as the determination of (1) the action on bacteria of intermediate and late products of dissociation of proteins, (2) the origin and methods of isolation of those enzymes which most rapidly and completely disintegrate proteins, carbohydrates, and fats, (3) the amount of absorption effected by different types of filtering material encountering different types of sewage, (4) the concentration of the substrata in the filtering medium which admits of the greatest enzymic change, (5) the influence of temperature on the dissociation and nitrifying processes (6) the duration in point of time of both sets of processes and of their individual phases, and (7) the. exact chemical and physical conditions which sustain the life and produce the death of the pathogenic bacteria of sewage and of sewage effluents. Here was work for another Sewage Commission.

THE PURIFICATION OF SEWACE.*

Interesting Results have been obtained at the Sanitary Research Laboratory in Co-operation with the United States Geological Survey.

The problem of purifying sewage so that it no longer transforms the rivers into which it is discharged into open sewers has been so far solved that these streams need no longer be disgusting to the senses and dangerous to the health of people living along them. The task of destroying the disease-breeding bacteria in the sewage and once more making the rivers available for drinking water has not yet been worked out on a practical basis, but investigations recently made by the United States Geological Survey in co-operation with the Sanitary Research Laboratory of the Massachusetts Institute of Technology and local authorities at Boston, at

*From the Technology Review.

Baltimore, and at Red Bank, N.J., show that this end, too, may be attained at a reasonable cost.

A recent bulletin of the United States Geological Survey says that the essential agents of sewage purification are provided and employed by nature, and sewage purification as practised to-day is but the intensive application of these natural processes. The improvements that have been made have not involved the discovery or application of new principles, but have merely increased the working efficiency of the natural agencies. From the old-time sewage irrigation field, with its maximum capacity of possibly 10,000 gallons an acre in twenty-four hours, to the present-day trickling filter capable of dealing with 2,000,000 or 3,000,000 gallons an acre a day, improvement has been steady.

The old-time methods, however, really destroyed the polluting substances, while the modern sewage filter does not. The liquid flowing from these filters looks to the untrained eye like the original sewage. There is almost as much organic matter in it as in the raw sewage, and sometimes more. Its nature, however, has been changed; the organic matter, though not burned up, has been charred or partly oxidized, and this charring has been sufficient to rob it of its foulness. In other words, its chemical composition has been so altered that it can no longer undergo rapid putrefaction and cause a nuisance.

The water, however, still needs filtration to make it fit to drink. Moreover, it may, and in many cases does, contaminate oyster beds, thus spreading disease and tending to ruin a great industry.

It has not yet been decided upon whom the responsibility rests for keeping the rivers clean, but the consensus of competent opinion requires that, if sewage is discharged within the region of important shellfish beds or into a stream which is used as a source of domestic water supply without filtration, such sewage shall at least be free from diseasebreeding germs.

The Geological Survey experiments, which are set forth by Earle B. Phelps ('99), in Water-supply Paper 229, just issued, show that the application of a small amount of available chlorine in the form of bleaching powder to the customary "purified" sewage effects satisfactory disinfection. The removal of bacteria by this means averages over 95 per cent., making the removal for the whole purification process 98 to 99 per cent. of the number in the crude sewage. The cost of disinfection ranges from \$1 to \$1.50 per million gallons of sewage, depending chiefly on the size of the plant. Five parts per million of chlorine probably represents the maximum amount required for the treatment of trickling-filter effluents of poorer quality. The results obtained with the amounts of disinfectant specified do not, of course, amount to complete sterilization, but they may reasonably be called "practical disinfection." Considerable additional cost is required to improve them but slightly.

THE LAST STACE IN THE CONSTRUCTION OF THE PANAMA CANAL.

The building of the Panama Canal is now in its fourth and final stage. The first stage was the sanitation of the canal zone; the second, the re-building of the Panama Railroad so as to supply facilities for transporting the spoil from the excavations to the dumps; the third, the excavation of the canal, the fourth, and last stage, the building of the Gatun dam and locks, and the locks at Miraflores and San Miguel. On August 1st of this year, the excavation (182,000-