for a period, nitrogen fixation would be secured through the activity of bacteria in the earth. Not only in this way is dispersed nitrogen recovered, but also by an active co-operation of germ life with certain leguminous plants. These organisms attach themselves in globules or clusters to the roots of the vegetables, and with both agencies at work some nitrogen is fixed in the fibrous structure of the legume. Disintegration and rotting of the plant enables the stored-up nitrogen to be fixed in the soil.

In the scheme of life, therefore, bacteria have very important and definite functions to perform. Without them the recovery of nitrogen for plant food would be impossible, and the circle of life created by the energy of heat would cease. Were it possible to destroy germ life as a whole, the result would be the total extinction of all forms of life.

There are, however, other types of bacteria which are pathogenic, and have the power of reproduction in the human body, causing many diseases to which humanity is subject. The proportion of these to the harmless bacteria is fortunately small, but as they give rise to such sickness as typhoid, cholera, diphtheria, tuberculosis, lockjaw, anthrax, influenza, etc., they must be kept down. These germs produce by-products which act as virulent poisons to the human system, causing the diseases enumerated together with many others. They gain access through the mouth, nostrils, cuts and breaks in the skin, and set about reproduction by incubation until the disease gets a hold on the body. If the powers of resistance of the body are very great, the organisms are disposed of, and the sickness is warded off. These resistive forces are not yet fully known, but science has established the presence of certain products in the body termed alexines which kill non-pathogenic germs. To combat the alexines the pathogenic bacteria create lysines to neutralize their action, and make the way clear for their depredations.

The invading bacteria are then attacked by the white corpuscles of the blood, which leave their usual habitation in the blood vessels and surround the attacking germs. The evidence of this is generally given by the appearance of inflammations, either internal or external, which break out and give off pus should the corpuscles be vanquished. With such contending influences in the body, disease is warded off by those in robust health, and the importance of maintaining these resistive powers cannot be overestimated, otherwise they will become useless through dissuetude.

The chief means of conveying the harmful bacteria to the body is by means of liquids which act as carrying agents in a greater degree than any other source. In consequence, our drinking water supplies are of national importance, and the elimination of harmful or pathogenic germs from them is the first essential to disease prevention.

Methods of Filtration.—The methods of filtration generally employed are to filter all water used for drinking purposes by means of sand filters, of which there are three distinct types—slow sand, gravity mechanical, and pressure mechanical. Of these the first and last are most commonly used in the older countries, while on the American continent the first and second are favored. In the slow sand filter the water is allowed to flow through beds of sand and gravel, into collecting pipes placed under the filtering material, at rates varying from one to six million gallons per day. They are generally constructed of brick and concrete, or both, and occupy a large area. Gravity mechanical filters are frequently constructed of the same materials, or of wood or steel, containing sand overlying gravel, while pressure filters are entirely composed of steel. Both of these latter types operate at rates up to one hundred and seventy-five million gallons per day. The ratings given are for an area of one acre.

Before the sand in all types of filters performs effective work, it must be coated with a film which retains the bacteria in the passage of the water through the filter. The slow sand filter forms this filter naturally by the growth of vegetation, the deposit of fine clay particles, and the agglomeration of organisms. In the mechanical type the film is deposited by the addition of alum to the water, before it is applied to the sand bed. The alum reacts with the lime in the water, or with added lime if the water is deficient, and forms a gel or albuminous coagulant which is insoluble, and deposits on the sand bed.

In course of time this film becomes too impervious, and it is necessary to clean the surface of the filter to allow the water to find its way through. In the slow sand filter this is performed by scraping off the surface to a depth of about ⅞ of an inch, and passing through a sand washer to make it ready for replacing when the sand bed gets too shallow to work satisfactorily. In the gravity mechanical and the pressure mechanical filters cleaning is carried out by the operation of valves to force the water back through the sand bed, where it is run to waste. Agitation is performed by means of compressed air or mechanical means to break up the sand, so that the reverse flow of water may do its work.

In the slow sand and gravity mechanical types of filters, water flows in by gravity or is raised by a pump, and allowed to flow through the filter under atmospheric pressure only, into a clear water reservoir from which the filtered water is pumped to the service pipes. In the pressure type of filter the water is forced through by means of a pump, or sufficient height of water to supply an equivalent pressure. The pressure filter is totally enclosed, while the other types are open.

It does not fall within the scope of this paper to enlarge on the merits of any particular type, beyond saying that with a properly designed plant and proper operation, they should all give equally high bacterial reduction. On leaving the filters it is common practice on this continent to treat the effluent with chlorine to further reduce the bacteria content, and approach as nearly as possible a sterile water. With this practice the writer is not at all inclined to agree.

Chemistry of Filtration.—It is well known that the work performed by sand filters is to remove suspended solids, and to act in such a way that both chemical and biological changes are wrought in the treated water. In considering the presence of dissolved substances in the water, it is found that chlorides do not vary much, neither increasing or diminishing in passing through the filters. Nitrates vary either to a greater or lesser extent, and sulphates and carbonates remain pretty much the same. In both slow sand and mechanical filters, the chlorine content, as indicated by the presence of chlorides, seldom varies, while in both cases the carbonates are reduced about one grain per gallon. Albuminoid ammonia is reduced by mechanical filters from 15 to 90%, according to the water treated, and an average of about 60% in the case of slow sand filters.

Free or saline ammonia is reduced from 33 to 50%, and sometimes as high as 95%, in mechanical and slow sand filters respectively. The oxygen absorbed varies