posed equal as regards quantity available, the quality consideration will determine the selection. Troubles associated with poor quality are not confined to surface water supplies but are also experienced in water from ground sources. With the established modern methods of water purification it is probably true that improvement of the quality of surface water supplies is more easily accomplished than is the improvement of quality of an objectionable ground water supply. In the consideration of quality it is well to give attention to the value of pure water. It has been shown that improvement of the hygienic quality of the water supply fully repays the community in many ways for the expenditure incurred in the establishment of a water purification plant. The saving of lives and reduction of morbidity from typhoid fever alone will reduce the expenditures of the citizens of the community to such an extent as to repay within a few years the financial outlay for a plant. Thus it can be shown that the city of Columbus has saved for its citizens over $500,000 per year since its water purification plant was established. Cincinnati has saved for its citizens $1,750,000 per year by purifying its water supply. In like manner it can be shown that it is economical to provide a soft water supply for a city even at a greater expense than would be incurred in the development of a water supply containing objectionable hardness. Modern standards of purity of a water supply require that its physical hygienic and chemical properties be satisfactory. Using this standard a pure water supply is an asset and an impure water supply an expense to a community.

Another consideration to be given in selecting a source of water supply is the cost of its development. It frequently happens, however, that a source of supply costing more to develop is the more economical selection. It will readily be seen that a supply cheaply developed which does not furnish an adequate quantity is really an expensive selection. It is well to keep in mind that the cost of development is purely relative, and within the financial limits of a community consideration of cost must be subservient to those of quantity and quality.

Purification of Water.—Having decided upon the development of a water supply which is not of satisfactory quality in its raw state, some means must be provided to produce a water of good quality. If the water is obtained from wells it may require aeration, softening and iron removal. The softening of water is expensive in proportion to the original hardness. Few attempts have been made in this country to soften well water supplies of municipalities. Aeration and iron removal are, however, well recognized methods of water treatment to improve the quality of ground water supplies. In Ohio we have about six plants for the purpose of reducing an objectionable iron content.

The purification of a surface water supply may be brought about by one or both of two general methods, namely, filtration and disinfection. Purification by storage and sedimentation has been advanced as an efficient means of correcting the pollution of water supplies but thus far has gained little recognition. Filtration improves the physical quality of the water as well as its hygienic quality. Disinfection removes the pathogenic organisms but does not affect the appearance of the water. It will, therefore, be seen that the field of disinfection as the only treatment is confined to water supplies of good physical quality. There are two well-known methods of filtering water. The first and older process is the so-callled slow sand filter and the other, a more modern method, is the so-called rapid sand or mechanical filter. As has been stated, the slow sand filter is a development of the early part of the nineteenth century, while the rapid sand filter has come into use during the past thirty years. The slow sand filter is more applicable to the treatment of a moderately clear water while the rapid sand filter can successfully treat a very muddy or turbid water. The slow sand filter consists of a watertight basin usually one acre or less in area, provided with suitable underdrains over which is placed the filtering material. In the northerly climates it is customary to provide a roof for the filter. The filtering material comprises three feet or more of sand, resting upon gravel surrounding the underdrains. The water to be purified is applied at the surface of the filter. It fills the voids of the filtering material and stands to a depth of about three feet above the surface of the sand. Its flow through the sand is controlled so that it passes downward at a rate of 0.4 foot per hour, corresponding to 69 gallons per day per square foot of area or 3,000,000 gallons per day per acre of area. This is a low rate of filtration. The water passing through the filter is stored in a reservoir from which it is pumped to the distributing system of the city. The mechanical or rapid sand filter differs from the slow sand filter in the preliminary treatment of the water as well as in the rate of filtration.

The rapid sand filter is a development of the last thirty years. It first attracted attention in 1885, when a plant of this type was constructed for the treatment of the water supply of Somerville, New Jersey. For the first fifteen years it was principally used in the treatment of water supplies for industrial use, such as paper mills and allied industries. In 1902 the first large municipal rapid sand filter plant was constructed for the East Jersey Water Company at Little Falls, New Jersey. Since that time the development of rapid sand filters in the United States has been very important. Among the largest plants in the country may be mentioned those at Cincinnati, New Orleans, Louisville, Columbus, Toledo, Harrisburg, Minneapolis, and Grand Rapids. The cities of Cleveland and St. Louis are now constructing plants of the rapid sand type.

The rapid sand filter plant differs from the slow sand plant in many respects. With the use of a rapid sand plant the water is always given preliminary treatment by a coagulant. It is passed through filters of much smaller area at much higher rates. Roughly speaking, the rate of filtration is forty times that used for the slow sand filter. The filtered water is received and stored in a covered reservoir in the same manner as is the case with slow sand filters. The cleansing of the rapid sand filter is accomplished by a reverse current of filtered water passed upward through the sand removing the layer or silt and coagulant collected at the surface. This differs from the cleaning of a slow sand filter, which is usually accomplished manually or by mechanical means.

The principal features of a rapid sand filter plant are the intake and low lift pumping station, the primary sedimentation basins, the coagulation basins, the filters and the clear well. The raw water is received through the intake, elevated to the primary sedimentation basins by the low lift pumps, and from this point passes by gravity through the plant to the clear well.

Primary sedimentation is required for turbid water carrying large quantities of silt. Thus the Cincinnati and Louisville plants have large basins where the water is allowed to settle for several days before it is passed through the purification plant proper. The use of primary sedimentation basins is not always required.