supplying a total of about 1,500,000 people, or about one in every six of the total population. Thirty-nine of these plants are rapid sand filters serving about 1,000,000 people.

In foreign countries there are some 81 municipal rapid sand filter plants with a total daily filtering capacity of about 175,000,000 U.S. gallons, and serving about 3,500,000 people.

Summarizing, the following shows the existing status of water filtration so far as the available data will allow:—

Table No. 3.—Status of Municipal Water Filtration in North America

January, 1917.	United States.	Canada.	Totals.
Number of places.			
Rapid sand	682	39	721
Slow sand	54	6	60
Total	736	45	781
Total population served.			
Rapid sand	13,411,000	1,000,000	14,411,000
Slow sand	4,882,000	500,000	5,382,000
Total	18,293,000	1,500,000	19,793,000
Proportion of filtered water population to total population.			
Rapid sand	1: 7.6	1: 9	1: 7.7
Slow sand	1:20.9	1:18	1:20.6
Total	1: 5.6	1: 6	1: 5.6

Early Conceptions of Water Filtration

The earliest type of water filter was a bed of porous material through which water was passed to free it of visible impurities. So far as its relationship to disease prevention is concerned, filtration of municipal water supplies is an art which has been developed within the past 30 years. Some of the ancients had vague ideas of its hygienic usefulness, but for the most part such conceptions grew out of an apparent desire to obtain clearer or cleaner water. Although the germ theory of disease was not advanced until 1849, and although the idea that disease in any form could be water-borne had its practical genesis at about that time, it seems certain that some of the early philosophers came to the conclusion that something more than mere clarification was effected by water filtration. Thus we find in "Ousruta Sanghita," a book of medical lore written in Sanscrit probably some four thousand years ago, the statement: "It is good to keep water in copper vessels, to expose it to sunlight and filter through charcoal." The writings of Hippocrates and Pliny also disclose facts which indicate clearly that the ancients had some regard for pure water and a distrust in polluted waters.

Similarly, William Walcott's patented process (1675) for "making water corrupted fit for use" undoubtedly aimed at something more than mere clarification, but it is equally certain that the inventor did not know just what; and in 1790 Johanna Hempel patented a contrivance for filtering water, using sand, gravel and pulverized glass as the filtering media. It was not until 1829, however, that the first municipal water filter of which there is comprehensive record, was built by the Chelsea Water Company at East Chelsea, London, in compliance with the recommendations of the Royal Commission on the Metropolitan Water Supply. This filter was designed to operate merely as a mechanical strainer to effect clarification, although it is significant that in the same year that this filter was built typhoid fever was recognized as a specific disease. The germ of that disease was not discovered until 1880, some 50 years later, and it was not well understood until 1884, or some 33 years ago.

About 20 years after the construction of the East Chelsea filter the British Empire was visited by a severe cholera epidemic, and at about the same time the theory was advanced by an English scientist that cholera was a water-borne disease and that the general cause of the epidemic could be traced to the polluted water supply. Three years later (1852) came the really first important step in water filtration history. This took the form of an Act of Parliament which made compulsory the filtration of the entire water supply of the Metropolitan District of London.

While practical modern water filtration, if we may use the term, sprang into existence with the construction of the small East Chelsea filter in 1829, and while the art developed slowly in England and on the Continent during the ensuing 60 years, it remained for the stupendous cholera epidemic in Hamburg in 1892, and the happy experience of Altona, the sister city of Hamburg, to stamp indelibly on the public mind the conviction that impure water is responsible for much of the public sickness, and to furnish unmistakable proof of the efficacy of water filtration in making polluted water safe and minimizing the dangers invariably arising from the consumption of such waters. Actually, then, water filtration as an accepted science, and the important developments therein, must be considered as about 25 years old, or less.

It is also well known that as late as 1885, judged by comparative chemical analysis of raw and filtered water, the result was not at all favorably considered by sanitarians, as the purification effect by filtration, according to the standards of that time, was practically negligible. It is to be noted that in that day organic matter, whether living or dead, was believed to be the chief cause of water-borne disease. One of the most important factors in advancing the knowledge of water filtration at that critical period was the exhaustive work of Professor Percy F. Frankland, who, in 1885, by applying the then modern methods of bacteriological analysis to water filtration, showed that while from a standpoint of removal of the chemical constituents from water filtration was a disappointment, it was a marked success in the removal from water of bacterial life.

Scientific Investigation of Water Filtration

The earliest investigations on slow sand filtration were conducted at Boston, Mass., and Louisville, Ky. Then followed the inauguration in 1887 of the classic investigations of the Massachusetts State Board of Health at Lawrence, Mass. These latter investigations were followed by the construction in 1892-3 of the Lawrence City filter for the purification of the badly polluted Merrimack River water, and the decision to build this filter doubtless was hastened by the Hamburg epidemic of 1892 and the appearance of cholera in New York harbor in the same year.

Between 1887 and 1903 the water filtration experiments at Lawrence were confined to slow sand filters, but in the latter year a small gravity filter with a superficial filtering area of about 4 square feet, and containing 21 inches of relatively coarse sand (effective size 0.71 mm.) was put into operation as a rapid sand filter. The filters