

pumps—beyond the last possible point of contamination. Then steps were taken to remedy the condition causing the contamination to the reservoir.

A small city in Michigan derived its supply from wells. The State Board of Health discovered a cross-connection with a pipe leading from the river.

Chlorination was ordered to be installed at such a point that whether the cross-connection was open or not, all of the water would be treated with liquid chlorine.

Many cities having supplies from underground sources have conditions similar to those at South Bend, and frequently have epidemics of intestinal disorders in their cities. Because a water comes from a deep well is no criterion of its purity as it is supplied to the consumer, if proper precautions are not taken to prevent its contamination. Frequent analyses of all water supplies should be made. Given the proper conditions, a spring, deep well or other originally pure water can and will become contaminated as quickly as a surface water.

Liquid Chlorine in Hospital Camps

Liquid chlorine is now being used in many of the government hospital camps in the United States and abroad, for the preparation of the Carrel-Dakin solution, which is used in the treatment of wounds.

A recent use for liquid chlorine has come to the notice of the writer. An Illinois city having a deep-well supply that has an iron content of two parts per million, aerates and filters the water to remove the iron. Recently considerable difficulty has been experienced due to the growth of crenothrix in the storage reservoir and distributing mains. Liquid chlorine is being used for killing this organism, because copper sulphate treatment has been unsuccessful.

Tanneries discharge liquid wastes carrying the anthrax organism. This germ is what is known as a spore former, and it is very difficult to kill it. The U.S. Bureau of Animal Industry has recently issued regulations governing the treatment of these wastes with liquid chlorine.

Packing houses discharge liquid wastes that have very disagreeable odors. Recent experiments on a large scale in a packing house indicate that it is possible so to treat these wastes with liquid chlorine that the odors will be rendered practically unnoticeable.

By means of liquid chlorine treatment, many other kinds of trade wastes can be successfully disinfected and the odor reduced to a point where no nuisance will be committed.

Swimming Pools Dangerous

Little thought has been given by the layman to the gross contamination that results from the use of the average swimming pool. The shower bath that is made a preliminary to the swim at most pools is usually a sham and does little good. A pool is certain to become highly polluted as a result of bathers using it. The modern method of keeping a swimming pool in a sanitary condition is to pump from the pool water at a rate sufficient to empty the pool in 18 to 24 hours. This water is forced through a pressure filter to clarify it and then it is sterilized with liquid chlorine and returned to the pool. In this manner a definite amount of polluted water is withdrawn from the pool and the same quantity of pure water returned to the pool continuously. No heating of the water is necessary in this purification process, as the water remains at the temperature of the pool.

Liquid chlorine is used as an adjunct to various methods of sewage treatment. The city of Cleveland, Ohio, is to install fine screens to clarify the city sewage and these screens will be followed by liquid chlorine dis-

infection. At many of the government camps, the sewage is sterilized by liquid chlorine, following treatment by septic tanks, filters and other systems. The amount of chlorine required is much greater than in the case of water purification, and varies from 40 to 90 lbs. per million gallons, depending upon the character of the sewage and the degree of purification desired.

As an example of what can be accomplished by chlorination of the water supply, the case of the city of Chicago offers excellent proof. Previous to 1900, all of the sewage of the city found its way into Lake Michigan, from which the water supply is taken. In 1900 the Chicago Drainage Canal was opened, which served as a method of disposing of the greater portion of the sewage. The Chicago River, formerly flowing into the lake, was reversed and was made to flow in the opposite direction, carrying with it the city sewage and a definite quantity of lake water for dilution purposes. As time went on, more and more sewage was diverted from the lake, and control was exercised over the dumping of dredgings in the lake, discharge of lake boat toilets in the vicinity of the water intake cribs, and other similar sanitary measures. The curve showing the typhoid fever death rate of Chicago is remarkable, because it shows what the above-mentioned measures accomplished, and it demonstrates what partial disinfection and what entire disinfection of the water supply will accomplish. Chlorine disinfection was in use at some of the pumping stations during the period 1911-1916, but during 1917 all of the water pumped by the nine stations was chlorinated. The drop in the typhoid fever death rate from 5.2 to 1.7 is wonderful. During 1917 only one sample of water out of 1,779 samples collected for analysis, or .06%, showed the presence of B.coli. in 1 c.c. B. coli was present in 5.4% of the 10 c.c. portions tested. In 1916 there were 135 deaths from typhoid fever, and in 1917 only 43.

Baltimore's Experience

Baltimore's water supply is derived from lakes. Previous to the use of chlorination, the average typhoid fever death rate for the period 1907-1910, inclusive, was 35.38. Hypochlorite treatment was begun in June, 1911. For the years 1912-1915, inclusive, the rate was 23.13 or a reduction of 34.6%. In September, 1915, a filtration plant was put into service and a further drop resulted in the typhoid fever death rate. Liquid chlorine was substituted in 1916 for hypochlorite of lime.

Jersey City was one of the first cities to adopt chlorination of the water supply, beginning the treatment in September, 1908. The average rate for the years 1900-1907, inclusive, was 18.7. For the period 1909-1917, inclusive, the average rate was only 7.3, or a reduction of 60%—truly a remarkable showing for water disinfection. The change from hypochlorite to liquid chlorine was made in February, 1913.

The curve shows typhoid fever death rates for Detroit from 1900 through 1917, but only the four-year period 1909-1912 was considered in comparing the average rates before and after chlorination, in order to have the time periods comparable.

Hypochlorite treatment was begun in March, 1913, and the change to liquid chlorine was made three years later, in March, 1916. The average rate before chlorination was 19.25, and after chlorination 15.05, per 100,000,—a reduction of 21.8%.

How Waukegan Saved Lives

Waukegan, Illinois, is one of the many cities drawing its water supply from the Great Lakes which were forced to install water disinfection because of the large amount of