beyond distances of 50 feet showed absence of B. Coli in 1. c.c. tests, and beyond 160 feet showed absence of B. Coli in 10. c.c. tests. In all cases the nitrogens were high and indicated organic matter undergoing decomposition. The Commission concluded: "With low velocities polluted water passing through fine sand for a distance of twenty-five feet may be considered as practically safe for use."

As a rule, subsoil water in sand or gravel travels very slowly; in fact, usually not more than a few inches per day. The bacteria of typhoid are very sensitive organisms, and do not live long in a free state. The most important factors in their preservation is the presence of mucus and epithelium, which accompanies their discharge. The probable action of the sand or soil is to remove the larger particles containing the bacteria, and the others, in a free state, perish because of unsuitable environment.

It is when we have conditions by which organic particles containing the bacteria pass direct into a water supply that absolute danger occurs.

Protection of wells from direct surface pollution is of more importance than the leaking sewer pipe situate at some distance from the well, when the space is occupied by sand or material of a good filtering nature.

MODERN FILTER PLANTS.†

By Langdon Pearse.*

It is not my intention to take up any new phase of the problem of filtration, but simply to show you a number of slides illustrating typical modern plants of the mechanical or rapid filter type and of the slow sand type.

First, I want to call your attention to a noval use of an abandoned reservoir for a coagulating basin in connection with a mechanical filter plant of the old pressure type. This is part of the system of the People's Water Company, Oakland, California. There is a battery of 12 filters built to run about four million gallons a day at a rate of 100 m. g. d. per acre; often ten to fourteen million gallons a day are forced through. No time was allowed for the period of reaction and coagulation. Mr. DeBerard and I endeavored to improve the operation of the filter plant by using an old reservoir with a capacity of 1,500,000 gallons, giving from 2½ to 4 hours period of flow. We built a baffle around the inlet at the center and constructed a number of orifices in an old flume box. We had upwards of 80 orifices, about 2½ inches in diameter, under a head of about 2 feet, which we used to measure the raw water. The coagulant was applied by a grid, in the flume, supplied from a couple of 5,000 gallon tanks by an orifice box. The old flume was originally built to screen out the algae in the water through muslin. We thus secured regularity in the application of a known amount of coagulant, time for reaction and settling, and cut down the filter washings from three to two in twenty-four hours. The overload on the filters is so great that the bacterial efficiency and removal of the turbidity seldom exceeds 60 per cent. The sand is exceedingly coarse, about 0.69 mm. effective size, uniformity coefficient 1.64.

The first plant of modern design I wish to show you is that at Harrisburg. Mr. J. H. Fuertes was the consulting engineer. It is a plant built at a low price, but accomplishes good results. The various details of the settling basins, filters, coagulant mixers, boiler room, engine room, etc., are shown by the slides. I would call your attention particularly to the type of controller here used on the filters, an orifice box with a float, controlling a hydraulic valve by means of a four-way cock. The strainer system is also noteworthy, built up of a cast iron manifold from which extend horizontal 1¼-inch galvanized wrought iron pipes six inches on centers, drilled with 7-32-inch diameter holes, 3 inches center to

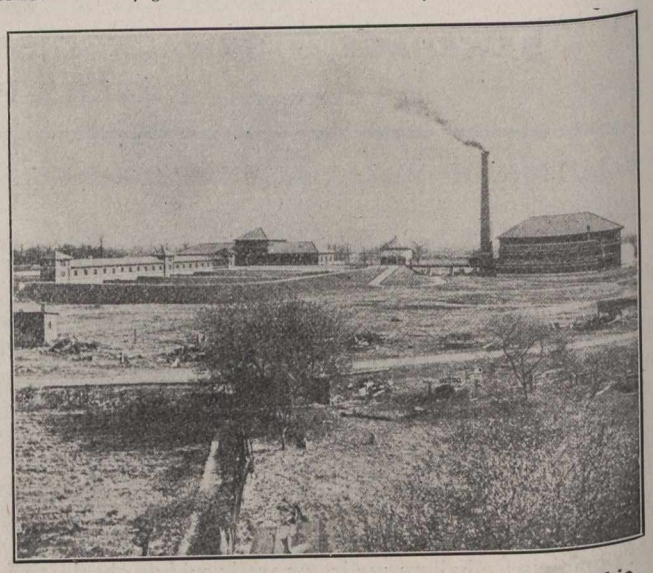

Fig. 1. Filtration and Softening Plant, Columbus, Ohio.

center. This strainer system works on the combined principle, that is air and water are discharged alternately through the same strainer system.

The principal data of the plant is as follows:

Capacity—12,000,000 gallons daily nominal.
Settling basins—4,000,000 gallons, 8 hours storage.
Two secondary coagulating basins—33 x 45 x 16 feet, 334,000 gallons.

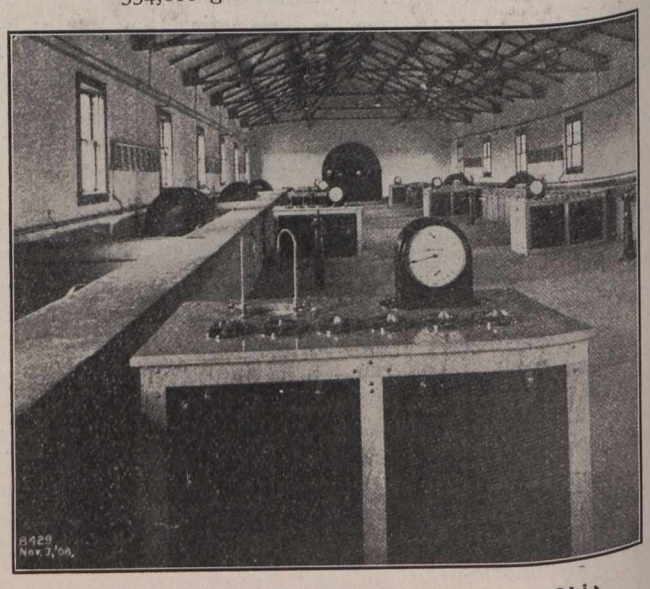

Fig. 2.—Interior Filter Gallery, Columbus, Ohio.

Filters—12, 16′ x 27′ x 9′, 0.01 acre area.
Sand, 30 inches. Effective size, 0.38 mm. Uniformity coefficient, 1.3.
Clear well, 760,000 gallons or 1½ hours' storage.
Amount of wash water used, about 2.5 per cent.
Bacterial removal in 1908, average for year 99.62 per cent.

The Susquehanna River water is very variable in character, and at times is so soft that soda ash has to be used

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