machine. Some improvements have been made in the details since. To describe it in brief: There is a steel box with a top but no bottom, which is lowered into the sand. This contains a set of revolving hollow arms from which jets of water play into the sand. There is a pump connected to the box which carries away the dirty water as it rises.

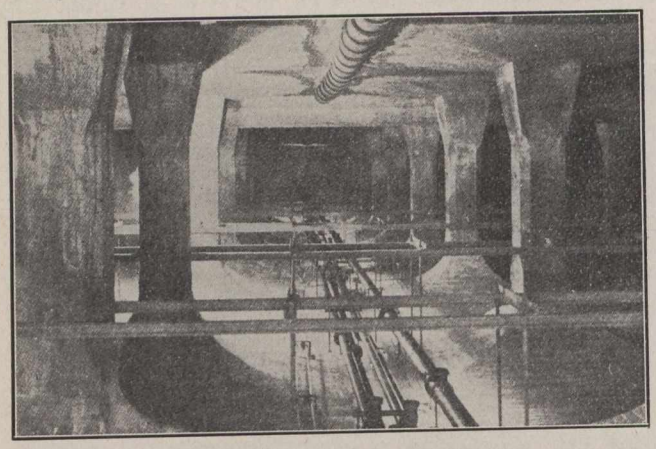

Fig. 6. Gallery, Filters During Construction, Pittsburg, Pa.

The machinery is carried on a bridge which moves along the filter. The machine travels across, thus giving two motions. Thus the entire area is covered. When I saw the machine the filter was treating Colorado River water of turbidity about 200 p. p. m. with a rate of filtration of 10 million gallons per acre per day. The filter contained fine said, about 0.17 mm. effective size, uniformity coefficient 2.07, and was washed daily, the rate of upward flow being about 1 foot per minute for the wash water. The machine has its application in specially designed plants, and if the first cost is made low enough, should allow a low cost of operation. Prior to the invention of this machine, Mr. Blaisdell invented a sand-scraping machine and a sand-replacing machine which he furnished to the Pittsburg filtration plant. The pictures will show you the details of this large slow

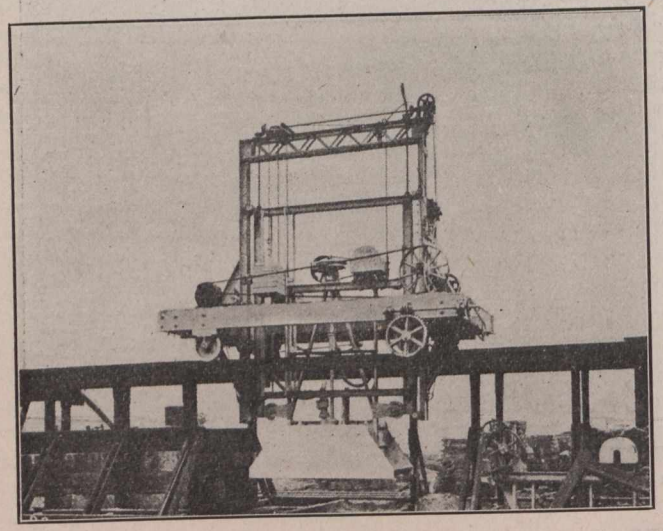

Fig. 7. Blaisdell Filter and Washing Machine, General View.

sand filter plant, designed under the direction of Mr. Morris Knowles, the groined arches, operating galleries, and the construction. The novel features are the two machines. The principal data of the plant are:

Nominal capacity—100,000,000 gallons per day.

Settling basins—1 basin 20 m. g.; 2 basins each 65 m. g. Total capacity, 150,000,000 gallons, or 36 hours flow.

Filters—46 beds, each 1 acre in area, covered with groined arches.

The scraping machine and the sand-replacing machine travel on tracks hung from the columns of the filters. The gauge is 12 feet. The scraper is intended to remove ¼" layers of sand when the water is drained 10 inches below the surface of the bed. The spirals are 16 inches diameter, revolving at a peripheral speed of 300 feet per minute. An automatic device works a 10" auxiliary spiral in and out between the pillars. The machine can travel at a forward rate of 2 to 10 feet per minute, and at a return rate of 50 feet per minute.

A 3 h. p. motor runs the bucket elevator and spiral.

A 2 h. p. motor gives the motive power and revolves the hose-reel.

A 2½-inch hose supplies the connection from the hopper to the pipes in which the sand is conveyed to the washers in a suspension of water.

The machinery for washing the sand in place, and the scraping and replacing machinery, show the steps taken

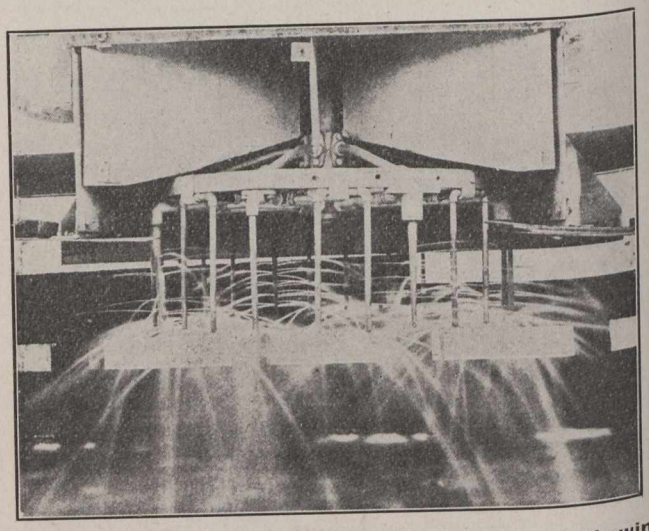

Fig. 8. Blaisdell Filter and Washing Machine, Showing Water Jets.

from the simple method first adopted with sand filters of scraping by hand, and wheeling the sand out of the filters. Later, sand ejectors were developed, to force the sand in a watery suspension through pipes. In small plants the hand scraping method is still as effective and cheap as any.

In conclusion, I wish to thank Messrs. Gregory, Blaisdell, and Knowles for their courtesy in allowing the exhibition of photographs and drawings, sent me for my personal use.

ELEMENTARY ELECTRICAL ENGINEERING.

L. W. Gill, M.Sc.

This series of articles will be continued for some months. They will be of particular interest to the student of electrical work and the civil engineer anxious to secure some knowledge of the simpler electrical problems.