14th, 16th, 17th and 18th shows the effect of moisture on the tubes.

The company's filtration plant at Avalon, Md., which has already been mentioned, consists of slow sand and mechanical filters, and an experimental ozone apparatus. Since the construction of the rapid filters, about two years ago, hypochlorite of calcium has been used for sterilizing the water in connection with filtration at this plant. The hypochlorite has not been used continuously, as at times the raw water contains but a few hundred bacteria per cubic centimeter. The object in using the bleach has not been necessary because of the failure of either system of filtration, but to lessen the cost of operation and at the same time to deliver water which was practically sterile.

Experiments also were carried on in the laboratory for a better knowledge of the action of the bleach upon the raw water, and to determine the bacterial efficiency under abnormal conditions.

The hypochlorite of lime used was received in 750 sheet iron drums. Only a small opening was cut in the drum so that it could be tightly sealed to prevent rapid deterioration of the chemical. Average analyses of the bleaching powder contained 34.2 per cent. of available chlorine. A 0.5 per cent. solution was used and was applied to the water through a graduated orifice. The storage solution tanks are of reinforced concrete and have a capacity of 41.5 gallons. The solution flows from the storage tanks to the orifice boxes which also are made of reinforced concrete. The head of solution upon the orifice is kept constant by a valve controlled by a ball float. The tanks and boxes before being used were painted on the inside with elaterite paint, so there has been no trouble from leaking. The orifices were graduated at the plant and have been checked from time to time as to their accuracy.

In making up the solution, the required amount of bleaching powder is first dissolved in a small quantity of water to insure thorough breaking up of all lumps. This solution is then put in the storage tank and the required quantity of water run in.

Under ordinary conditions the capacity of each tank is sufficient for four or five hours' supply. By making up the solution so often, the hypochlorite does not lose its strength to any appreciable degree, and it is not necessary to change the setting of the orifice unless there is a change in the character of the raw water.

The table given here shows the amount of bleach in grains per gallon applied to the water at different settings of the orifice. It will be noted that the chemical is given in grains per gallon, and not as parts per million of available chlorine or oxygen. The only object in doing this is that grains per gallon is more easily understood by the filter operators than the other terms mentioned.

There was an apparent increase in the bacterial reductions from the bleach when used in connection with sulphate of alumina, over the reduction obtained when bleach only was used. Experiments were undertaken in the laboratory to determine if this condition existed. Tests were made upon the raw water with conditions as near those at the filtration plant as was possible to obtain. One set of samples was treated with various amounts of bleach from 0.05 to 0.5 grains per gallon of water. To another set of samples were applied the same amounts of bleach, but to each jar of water was added sulphate of alumina at the rate of 0.5 grain per gallon. Several of these tests were made during the year and the curves here given were plotted from an average of these tests.

Although there was not a great difference in these results, still it is interesting to note that the curve plotted from the results when alum and bleach were used runs uniformly below the curve when bleach only was used. With highly polluted water this condition would no doubt be more pronounced than it has been here.

The color of the raw water at Avalon ranges from 5 to 65 parts per million, most of which is not in true solution, but in a collodial state. The water is more highly colored during the spring and fall floods than at other times of the year. The effluent from the mechanical filters is colorless at all times, also the effluent from the slow-sand beds, when the color of the applied water is below 20 parts per million. When the color of the raw water is greater than this, there is always some color in the filtered water from these beds.

By the use of hypochlorite of lime it has been possible to reduce this organic stain from 5 to 15 per cent., the percentage reduction depending on the character of the color, the amount present, and the quantity of bleach used.

Table to be used in the application of hypochlorite of lime.

Capacity of storage tank, 41.55 gallons.
Charge of bleach, 2 pounds.
Orifice graduated in inches.
Rate of filtration, 1,025,000 gallons per 24 hours.

Graduation on Orifice Scale.	Drop of Solution in Tank in Inches per Hour.	Hypochlorite of Lime. Grains of Hypochlorite of Lime Delivered per Hour	Grains per Gallon of Water Filtered, One Filter in Operation.	Grains per Gallon of Water Filtered, Two Filters in Operation.
1	1 in.	583	.026	.013
2	2 in.	1166	.032	.026
3	3 in.	1749	.078	.039
4	4 in.	2332	.104	.052
5	5 in.	2915	.130	.065
6	6 in.	3498	.156	.078
7	7 in.	4081	.182	.091
8	8 in.	4664	.208	.104
9	9 in.	5247	.234	.117
10	10 in.	5830	.260	.130

An attempt was also made to determine the effect of hypochlorite upon organic matter as measured by the required oxygen. These experiments, as those upon color, were done at the laboratory and consisted of treating liter samples of raw water with bleach varying from 0.05 to 0.5 of a grain per gallon and determining the organic matter before and after treatment.

From the data at hand, the reduction of organic matter by the use of hypochlorite was hardly noticeable even with water high in organic matter, and when comparatively large quantities of the chemical were used.

To determine the efficiency of the bleach on the operation of the mechanical filters, a two months' test was run. The filters were operated during the month of November, using only alum. During December, from the fourth to the end of the month, hypochlorite of lime was applied with the coagulant. There was but little change in the character of the raw water during this period, so the results can be compared fairly well. By the use of a very small amount of the hypochlorite (averaging 0.087 grains per gallon) it was possible to reduce the alum from 0.87 to 0.58 of a grain per gallon.

The percentage of water used in washing the filters was reduced from 4.1 per cent. to 2.9 per cent., at the same time