Filtration.—The filtration of water is practically limited to two standard methods on this continent—one being by means of graded sand and without the use usually of any chemicals; the other by mechanical methods for treatment with chemicals. Each method gives equally effective results, although the selection of which method adopted is governed generally by local conditions.

In the slow sand method of filtration the water is passed through beds of graded sand and gravel, without the addition of chemicals, at the rate of about four million gallons per acre per day, which at times may be increased 25 per cent. without loss of efficiency. The water is then collected in reservoirs.

With the mechanical system the water is first impregnated with a coagulant, such as sulphate of alumina, and allowed to stand in sedimentation basins for a few hours to allow a sufficient precipitation, after which the comparatively clear liquid is pumped through rapid sand filters at the rate of from 100 to 150 million gallons per twenty-four hours. It is then ready for distribution.

The first cost of mechanical filtration is considerably less than for slow sand filtration, besides requiring much less area for the plant, which ratio of cost will vary according to local conditions—as, for instance, the material upon which the filters are to be built, with the resulting foundations. The mechanical system can usually be built in half the time that is required to build slow sand filters. On the other hand, the cost of operation is largely in favor of the slow sand method, which averages, for operation, about $1.90 per million gallons, while for the mechanical mehod the cost would be about $4.70 per million gallons. This difference is principally due to, and varies with the cost of, the coagulant. This does not include pumping or capital charges in either case, although the additional head required for the mechanical operation is included.

The mechanical method will successfully treat any water, regardless of turbidity or color, while the slow sand method works best when there is comparatively little suspended matter or color.

With the conditions existing at Philadelphia it was found necessary to eliminate some of the suspended matter by means of a roughing filter, which removed a considerable amount of this suspended matter, and allowed the slow sand filter to be operated above their rating. This combination was effective in obtaining results at a lower operating cost than with mechanical filters, and at the same time successfully treated a water otherwise not altogether suitable for the slow sand method.

It might be supposed that mechanical filters would work best when bacteria and suspended matter were least, but many filter superintendents are finding that such is not always the case, and that in warm weather with clear water odors are produced in the filter, with shortening filter runs, caused by clogging of the sand. Examinations of the unfiltered water showed minute forms of life diatoms and a few algæ, accompanied with a fine, flaky matter, supposed to be the result of bacterial action on organic substances. This matter formed a gelatinous firm upon the sand grains, causing the surface of the sand to become abnormally compact, and with a tendency of its grains to stick together, which was not altogether corrected by washing. This clogging was successfully overcome by the judicious use of copper sulphate. After the copper sulphate treatment bacteria increased, probably because it reduced or removed unfavorable conditions, but no B. Coli was detected, and the increase in bacteria was eliminated by adding 0.25 parts per million of available chloride. While this trouble has developed and has been successfully treated at Louisville of the Ohio River water, using mechanical filters, on the other hand, at Toronto, with slow sand filters and Lake Ontario water, it was found that on account of the amount of suspended matter and sand carried to the filters that the filters were almost clogged up. It was also found that from the inset of frost until the warm weather in the spring it was not possible by the means provided to wash the sand scraped from the filter beds. The pipe lines and sand would freeze up during the washing process, necessitating the removal of the sand scrapings until the spring and the washing and re-sanding of the filters. From this we wish to point out that where any installation is contemplated there is need of a very careful study of the quality of the water, the local conditions governing not only the method of treatment to be used, but also the location of the plant.

It has been found that raw water can be treated with seven pounds per million gallons without developing any taste, and if after treating the water can be stored for three or four hours in a reservoir, or aerated, as much as 12.5 pounds per million gallons can be introduced without noticeable taste. It is better to obtain water of the best quality rather than depend upon the efficiency of purifying apparatus, chemicals, and the skill of employees, and in the case of New York a very interesting discussion has been going on as to the advisability of filtration outside of chlorination. Because of the diametrically opposite opinions advanced by the engineers of various municipal bodies interested, filtration outside of hypochlorite treatment was decided against, although it was shown that such treatment did not remove bacteria embedded in particles of suspended matter, decrease turbidity, lessen color or vegetable stain, or remove swamp tastes or odors.

The application of ultra-violet rays for purifying large quantities of water has not advanced very materially during the past year on this continent, although it has been used at Rouen, France, for the past three years. The simplicity of the apparatus, easy maintenance, and high efficiency seems to open a wide field for its application. It is necessary, however, before submitting the raw water to the rays that the suspended matter be removed, otherwise germs protected by such matter do not come directly under the effect of the rays. An ordinary sand filter can be run from five to ten times its ordinary rate and still produce satisfactory water for the after treatment of the ultra-violet rays. The water is exposed for the fraction of a second within an inch of the source of the rays, and this is accomplished by means of various mechanical apparatus, one or two of which are now on the market.

It is our opinion that this treatment of ultra-violet rays is worthy of consideration by consulting and municipal engineers in this country in future installations, and should also be investigated on a commercial basis by engineering colleges.

Andrew F. Macallum, Chairman.
J. Walter Ackerman.
G. A. Roess.

Ohio led the states in the value of her clay products with an output amounting to $34,811,508, or over one-fifth the total production for the United States. Pennsylvania was second, with a production valued at $21,537,221; New Jersey third, with $19,838,533; and Illinois fourth, with $15,210,990. Eight states produced clay products in 1912 to a value exceeding $5,000,000, and 26 states to a value exceeding $1,000,000.