4, 1908. It is No. 895229. The deep tank of Black and Phelps, developed at Brooklyn, N.Y., provided with trellis baffles set at right angle to the flow, and the tank-aerator with slate colloiders of Clark, at the Lawrence Experimental Station, should be referred to, as well as the activating tank of Dr. Gilbert Fowler, which was, as he has himself freely stated, developed from the experimental work of Clark, seen by him at Lawrence in 1912.

In January, 1910, the Board of Estimate and Apportionment of the city of New York secured the professional services of Colonel (now General) William M. Black, Corps of Engineers, U.S.A., and Professor Earle B. Phelps, Professor of Chemistry, Hygienic Laboratory, U.S. Public Health Service, Washington, D.C., to conduct for the guidance of the municipal authorities, some investigations relative to the problem of sewage treatment and discharge into the local waterways.

In connection with this assignment, Messrs. Black and Phelps began experiments in February, 1910, on sewage treatment by means of forced aeration in tanks, at the Twenty-sixth Ward Sewage Works in Brooklyn.

The apparatus used by Black and Phelps consisted of tanks in which were placed laths made up in frames or trellises, in such manner that the interior space of the tank was practically filled with strips of wood, the surfaces of which were about one inch apart in every direction. These surfaces were made as extensive as possible for the residence of bacterial growths. Compressed air was supplied at the bottom of the tank, which was filled with the sewage to be treated. This plan of treatment gave remarkable results, which were later presented in a report to the Board of Estimate and Apportionment and published in 1911.

These experimenters found it possible to reduce the demand of the sewage for oxygen 33 to 50%, in a retention period of about three hours, by using about two volumes of air per volume of sewage, and to obtain a higher degree of purification by applying more air.

The Black and Phelps experiments were about the earliest that indicated the discovery of a practicable and successful method of treating sewage by compressed air.

Aeration experimental work received a new impetus at the Lawrence Experiment Station in 1911, and it was while visiting this station in 1912, that Dr. Fowler saw the work, which led him to take up the same line of study on his return to England, with Messrs. Ardern and Lockett, the result of which was the activated sludge process. In these studies "it was established that a well-nitrified effluent could be obtained by six hours' aeration of Manchester sewage, in intimate contact with one-fourth of its volume of activated sludge."

Progress with the new method in England has been checked by the war, but studies are being made for several institutions. At Worcester, half of the sewage of the city is under contract to be treated by this method, and at present about 1,000,000 gallons of sewage a day are being treated under this contract, which provides that not more than four parts of suspended matter per 100,000 of sewage shall be present in the effluent, and that it shall be non-putrefactive. These conditions are being successfully complied with.

Following the work at Manchester of Messrs. Ardern and Lockett, the process was successfully tried at Salford on a larger scale, making use of the existing roughing filter beds.

The reports of the English experimenters were received with great interest in America. The writer's attention was called to the paper of Ardern and Lockett by Mr. W. L. Stevenson, of Philadelphia, and by Prof. Earle B. Phelps, late in the fall of 1914. Meanwhile, Mr. H. C. McRae, of Baltimore, had become informed of these reports and had communicated them to Mr. Leslie C. Frank, of the U.S. Public Health Service. At about the same time, Mr. T. Chalkley Hatton, chief engineer, Milwaukee, Wis, Sewerage Commission, had got into touch with Dr. Fowler and secured his co-operation in conducting experiments at Milwaukee.

The first work of which the writer has knowledge was, however, conducted by Prof. Edward Bartow, at Urbana, Ill., who started his aerating tank November 21, 1914, at Lawrence, Mass. H. W. Clark started an activated sludge tank in February, 1915. Early in March, 1915, experiments were commenced at Baltimore, Milwaukee and Brooklyn; at Chicago, by the sanitary district, in May; at Regina, Saskatchewan, Canada, May 18th; Houston, Texas, began experiments in September.

For the purpose of presenting the progress of the method in this paper, the latest available information has been obtained from nearly all American plants, where it is being studied. Most of these plants have been visited by the writer since the beginning of the present year. Before presenting this data, it may, perhaps, be proper to give an account of the author's aeration and activated sludge work at the Brooklyn, N.Y., Sewage Experiment Station.

By resolution of the Board of Estimate and Apportionment, this station was authorized April 18, 1912. To meet expenses, $50,000 was made available. Before designing the plant, all of the principal sewage disposal plants in America and Europe were visited.

The plant was put into service in the autumn of 1913, and has continued in operation to the present time. The study of every standard form of sewage treatment was provided for.

One of the principal objects in the design was to carry forward to a conclusion the work of Messrs. Phelps and Black, formerly done at the location of this plant. For this purpose an aerator tank and settling tank, following the design used by these investigators, were installed, and a compressor of ample capacity provided. The tank was 12 ft. in diameter and 25 ft. 8 ins. deep. Compressed air was supplied by means of a pipe-grid consisting of ¾-in. iron pipes arranged in five circles, connected by a cross of 1¼-in. pipe, through which air entered. The perforations were on top of the pipe as it lay, and were 1/16-in. holes, 6 ins. on centres. This grid, or grill, was placed on 7½ ins. of broken stone in the bottom of the tank and covered by a like amount of the same broken stone, passing a 2-in. ring, but retained by a 1-in. ring. It has given satisfaction through three years of service, but is beginning to need cleaning at the present time.

One important feature of this tank was the deflector discs, of which there were nine, shaped not unlike wheels, with a trellis work between the spokes. A supporting 4-in. vertical pipe passed through all of the hubs of these discs. The surface of each was horizontal and occupied the entire cross-section of the tank, which was thus formed into story-like compartments communicating through the trellis-work above referred to. They were designed to give a residence to bacterial growths, and to deflect the downward flow of sewage entering at the top of the tank, and to prevent downward streaming, and equalize and give a sinuous motion to the upward flow of air.

The sewage entered this tank from a measuring and quieting tank, and could be studied either on the continuous flow plan, for which it was originally designed, or on the full and draw plan.