

be divided. But they have served their purpose if they have emphasized the fact that the laboratory process gives results which can not be obtained in any other way, and that these results may be relied upon to guide and direct practice in engineering affairs.

English technical papers admit that the painstaking processes of German laboratories have so well guided German manufacturers that Germany not only competes with England in many lines of manufactured goods, but in some has driven her from her markets. We have a new country, in which large engineering enterprises, both public and private, are always being pushed and are calling for economy in expenditures; and there is a strong national desire for an outlet of manufactured goods through exportation, which can only be secured on merit, in competition with the world. With these facts in mind the conclusion is obvious that there is room and need in this country for research laboratories. All such laboratories are but means to ends. They are not only contributors to the public fund of information, but they infuse into every branch of construction and of operation a spirit of accuracy and a desire for excellence.

LOUISVILLE FILTRATION EXPERIMENTS. BY GEO. W. BENTON.

The 1st of August, 1896, completed the routine work of one of the most unique series of experiments the scientific world has had the privilege of witnessing.

The question under investigation was the chemical and bacterial condition of the Ohio River water, as furnished the City of Louisville, Ky., and the relative merits of the several systems of filtration seeking establishment there, and proposing to do away with the mud and its accompanying bacterial impurities, so familiar to the citizens of and visitors in the great cities adjacent to the Ohio, the Missouri and the Mississippi rivers.

The peculiar yellow clay suspended in the Ohio water will not subside even on standing, and ordinary schemes of filtration utterly fail in its treatment, even in times of low water.

In view of the conditions, Mr. Charles Hermany, Chief Engineer, and Mr. Charles R. Long, President, of the Louisville Water Company, decided that the only sure way to treat the question was by means of an experimental plant erected on the ground and operated for a term of months, which should give them definite knowledge of the water in every stage. In accordance with this

plan, Mr. Long issued an invitation to all the large concerns engaged in the filtration of water on an extensive scale to establish experimental plants at the pumping station. The terms of the arrangement were as follows:

Each company entering the competition to establish its own plant and operate it with its own representatives in charge; the Water Company to provide temporary buildings for the housing of these plants, the necessary steam power, and the unfiltered water to be used in the experiments. The entire operation of the plants to be under the supervision and control of a competent staff of engineers and scientific experts in the employ of the Water Company, who were to have access at all times to the several plants, keep accurate records of metre readings, both of filtered and unfiltered water, to take samples at any time and at any stage, to examine the chemicals used as to quality and quantity, and to note the expense of the power required for operating the machinery.

Four companies entered the competitive test, namely: (1) The O. H. Jewell Filter Co., of Chicago, presenting the Jewell Filter; (2) The Cumberland Manufacturing Co., of Boston, presenting the Warren Filter; (3) The Western Filter Co., of St. Louis, presenting two filters, the Western Gravity and the Western Pressure; (4) The John T. Harris Magneto-Electric Purifying Co., of New York, presenting a process based on electrolysis.

These filters are doubtless well known to those interested in water examination, as they are extensively advertised, and time will not be taken to consider the details of their operation.

Work began October 1, 1895, with a laboratory force of three, including Mr. George W. Fuller, Chief Chemist and Bacteriologist, in charge; Mr. R. S. Weston, Chemist, and Mr. C. L. Parmelee, Engineer. This force was gradually increased until, at the close of the period of work, there had been added to those already mentioned Mr. J. W. Ellms, Chemist; Mr. G. A. Johnson, Clerk; Mr. H. C. Stevens and Mr. R. E. Bakenhus, Engineers; Mr. Hibbert Hill, Bacteriologist, and myself. I can not refrain from expressing at this time my high appreciation of the enthusiasm and untiring energy, the skill and scientific value, of the experts named. The volume of work was enormous, and during the month of July, when I had the privilege of ranking as one of the force in the bacterial laboratory, our chemical thermometers frequently ranged (expressed in Fahrenheit degrees) 98 to 100. The excessive heat had no effect upon the work. Every man seemed infested by the work bacillus, and spread contagion throughout the whole plant. During July, not counting specie work, which constantly went on, over fifteen hundred bacterial samples were plated and counted; in many cases, recounted the second time. The chemists were equally busy.

Ethical as well as business reasons prevent the announcement of even approximate results, the complete elaboration of which will appear over Mr. Fuller's name early in 1897, whether in public form or as a private report to the Louisville Water Company I am not informed. In any case, the matter which it will contain concerns not Louisville alone, but the world as well. It is to be hoped that water experts will have access to it. I believe that I am entitled to say, however, that Ohio River water has been successfully filtered in quantity, under the most extreme conditions, during the course of these experiments. It has come from the filters clear and sparkling, on days when the chemists found in the neighborhood of 3,500 parts of solids per million, and when the river showed 12,000 to 25,000 bacteria to the cubic centimeter, I have counted six to ten individual colonies in the filtered water.

The equipment of both chemical and bacterial laboratories was complete and thoroughly up to date. The methods for bacterial work, preparation of media, classification, etc., were mostly taken from unpublished manuscripts. The steam sterilizer was largely replaced by the autoclave, at a pressure of 20 pounds and a registered temperature of 126 degrees Celsius. Color tests were a feature of the chemical work, the method being that of the Massachusetts State Board of Health.

Chemists and bacteriologists can not praise too highly those members of the Louisville Water Company, who, in the face of much criticism, and at such great expense, have not only made possible the solution of the question of their own water supply, but that of the great cities of the Mississippi basin, and at the same time placed in Mr. Fuller's hands the means of enriching our experience in the handling of refractory sources of potable waters for cities.

Indianapolis, December 30, 1896.

GEO. W. BENTON.

A "TORNADO" IN RUSH COUNTY, INDIANA, AUGUST 1, 1896. BY W. P. SHANNON.

On the first day of last August there was a destructive storm along the southern line of Rush County. Approximately, we may say, it began near Milroy in Rush County, and ended near Metamora in Franklin County, running from west to east on a line bearing but little to the south. It was not continuous. The most destructive part of its course was shortly after the beginning, on my old home farm. I visited the place two days after the storm. My brother, H. F.