

AMERICAN SOCIETY OF CIVIL ENGINEERS.

INSTITUTED 1852.

TRANSACTIONS.

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685.

(Vol. XXX.—December, 1893.)

THE SEWERAGE SYSTEM OF MILWAUKEE.— DISCUSSION ON PAPER No. 651.*

By D. J. WHITTEMORE, F. P. STEARNS and G. H. BENZENBERG.

D. J. WHITTEMORE, Past. Pres. Am. Soc. C. E.—I wish, as coming from Milwaukee, to make some remarks upon the paper by Mr. Benzenberg. I wish to call the attention of this Congress to the condition of the Milwaukee River before the work of flushing commenced, and which the writer of this paper, through his natural modesty, has not adequately emphasized. Along several miles of the river many of the best and most extensive mercantile and other establishments are located, covering the ground between the shore and adjacent streets completely. Into the river was flowing 60% of the sewers of a city of 200 000 population, and of course the river was foul. This is a mild term. It was so filthy from noxious and nauseating exhalations that I venture to say Chicago River would be termed clean in comparison. A person could not pass over it without having a feeling of nausea. Occupants of the buildings were made ill. Removals from its banks were contemplated by many, and real estate in its proximity depreciated in value.

* "The Sewerage System of Milwaukee, and the Milwaukee River Flushing Works" By G. H. Benzenberg, M. Am. Soc. C. E. *Transactions*, Vol. XXX, page 367.

While the people universally demanded a remedy, a majority had little faith in the plan proposed by the writer of the paper under consideration. Having had some experience with centrifugal pumps, and knowing the general dimensions of the work proposed, I myself had grave doubts of its success. I knew the duty developed by the Bridgeport pumps in this city, and pumps of like nature used to drain marshes in Italy; hence I came to the conclusion that with no greater duty and efficiency than those, the project proposed by the writer of the paper under consideration would prove a failure. What was the result? Within one day after starting the work the nuisance was completely abated, through the agency of pumps and machinery which developed a duty of about 76 000 000 ft.-lbs. per 100 lbs. of coal used, being quite double the duty developed by any pumps of somewhat similar nature of which I then had or now have knowledge. Informing a distinguished German engineer who had made machines of this nature a subject of careful inquiry (Edward Hambro, of Carlsruhe) of the result of this work, he replied that the people of Milwaukee had the most efficient centrifugal pump in the world. It is not often that the engineer's work is so heartily appreciated within 24 hours after its completion as was that of the writer of the paper under consideration, by the people of Milwaukee.

In this connection it may be proper to ask why the city of Chicago, whose authorities naturally must have known of the existence of this pump and of its remarkable efficiency, has recently attempted to employ an untried device for a similar purpose, which attempt, as I am reliably informed, has resulted in lamentable failure.

F. P. STEARNS, M. Am. Soc. C. E.—I wish to express my appreciation of the value of Mr. Benzenberg's paper. It is a very complete and concise description of a very interesting system of works. I have been particularly interested in the centrifugal and screw pumping machinery at Milwaukee, both on account of the large capacity of the pumps and the high duty obtained with them. The duty obtained with the centrifugal pump is, so far as I know, much higher than was ever before obtained with a pump of this character, and the results have raised this class of machinery very much in my estimation, for sewerage works, where as a rule only a low lift is required. In large works there is a very great saving in the first cost of foundations and pump wells as well as machinery by using centrifugal instead of reciprocating pumps.

In making preliminary estimates of the cost of the new metropolitan system of sewerage for the cities and towns in the vicinity of Boston, it was found that it would be very much cheaper to put in two pumping stations on the line of the main sewer, lifting the sewage one-half of the total height at each, with centrifugal machinery, rather than to pump to the full height with reciprocating engines at a single pumping station. The use of two pumping stations in this case was particularly advantageous, because it permitted the sewer (about five miles long) between them, to be laid at a moderate depth below the surface of the ground instead of at a very great depth. It is worthy of note, however, that the estimated cost of the two pumping stations with centrifugal machinery was much less than the cost of a single station with twice the lift, provided with reciprocating pumps.

G. H. BENZENDORF, M. Am. Soc. C. E.—In connection with the expense of forcing the water through the flushing tunnel, that question having been asked, I found it was not very much more than that of a high duty water-works pumping engine, that is, about 3½ cents or 3.78 cents per 1 000 000 galls. per foot. That is, upon a basis of using the best quality of hard coal, which cost, say, \$5 15 to \$5 25 per ton, delivered at the station. That quality of coal is used because the pumping station is situated in one of the finest residence sections of the city; where, if soft coal were used, the people would object. It makes the cost of pumping of course much higher than if a cheaper grade of coal were used.