MUNICIPAL DEPARTMENT

THE FINANCIAL MANAGEMENT OF WATER WORKS.*

In studying the questions relating to water rates Mr. Coffin tabulated the available statistics of the water works in 52 cities and towns, mainly in New England. The very large cities were left out, the largest city on the list having a population of 90,000 and the smallest town 1,450 inhabitants.

For the purpose of comparing these systems on a common basis Mr. Coffin obtained the total economic cost of running each system by adding together three items—viz., the actual annual cost of maintenance as reported, 4 per cent. on the cost of construction for interest, and 1½ per cent. on the cost of construction for depreciation. The actual interest paid was not taken, as that would not be a fair basis of comparison, as in some cases the bonds are paid and in others a higher rate is paid on old bonds. Similarly the depreciation fund was computed instead of taking the amount paid into the sinking fund. From the sum of these three items is subtracted the amount paid by private consumers and the amount that the water department should receive on the basis of three gallons per capita at 15 cents per 1,000 gallons for public purposes. The difference of the expenditures and these two sources of revenue is the cost of fire protection to be raised by taxation. An examination of the tables shows that of the 52 systems there are 14 in which the revenue from private consumers is sufficient to meet the annual expenditure and 19 in which the private revenue and that computed for public purposes, except fire protection, equals the expenditures. There are 33 in which from 0.8 to 57.3 per cent. of the total expenditure must be met by taxation. In four of these cases this percentage exceeds 50. These results are sufficient to show whether or not water works are self-supporting and sufficiently high. The amount to be raised by taxation in 39 places where water is pumped averaged $42.74 per hydrant. The minimum was 80 cents and the maximum $106. The percentage of taxation to total expenditure for these hydrants ranged from 0.80 to 57.30, the average being 28.86. The cost of construction per consumer of these works averaged $38.41, ranging between $10.50 and $80.40. The tables show roughly that the cost of construction per capita is greatest in those systems that raise the greatest per cent. by taxation.

No solution that considers all the conditions of the problem has been advanced to adjust rates to the requirements of expenditure or in fixing those for new works. The only method known to Mr. Coffin is the usual one of comparison of rates without regard to cost of construction per capita, cost of water per 1,000 or 1,000,000 gallons, etc., which is irrational and gives no assurance that the revenue will be approximately equal to the requirements.

It is possible to estimate quite closely the expenditures, especially in existing works, but the question is how to adjust rates to meet expenditures. In existing works experience furnishes a guide, but there is none for new works. There can hardly be a theory advanced for the adjustment of fixture rates. It is possible that with water sold by meter, rates could be devised that would bear some relation to the revenue required. Data is lacking for this at present. In the tables is given the yearly cost per capita based upon the number of consumers—that is, the number of persons living on the pipe line. This annual cost per capita is perhaps the most scientific unit for comparing the yearly economic cost of water works. This unit of cost seems to have no law of relation to the number of consumers, but is largely influenced by the cost of construction per capita, and in a less degree by the consumption of water per capita. The fixed charges of interest and depreciation are approximately 75 per cent. of the total cost of maintaining water works, therefore the item of first cost is the controlling factor in the yearly expense account. While not conclusive, a guide may be had from a consideration of the different rates given. The minimum of the yearly cost in pumping systems is $1.22, the maximum $5.62, and the average $2.58. The cost per 1,000 gallons based upon the total expenditure and total amount pumped ranges from $0.065 to $0.257, averaging $0.115. This cost is for total pumping and does not represent the cost of water that can be delivered and registered at the meters of consumers.

After quoting Mr. Brackett's paper referred to above in regard to the large percentage of water lost between the pumping station and the taps of the consumers, Mr. Coffin states that in a case that came under his notice where the pumpage was 300,000 gallons, but 75,000 gallons was used by the consumers. A large portion of the leakage was located on a few streets, but there was no surface indications. As such cases may be more common than is generally suspected, the desirability is suggested of having recording instruments on standpipes and reservoirs, and some means of measuring the draft in gravity systems, so that its amount and distribution throughout the day may be known.

While the tables show that there are very few works whose rates are not high enough when a sufficient sum is appropriated for fire protection, rates should not be lowered without carefully studying needs of the future and the possibility of improvements in the works. More attention must be given in the future to the quality of the supply not only as a whole, but in cases where the supply is good for only portions of the year. Sand filtration is now practicable, and should be adopted in such cases. Consumers are entitled to the best water that can be had at any reasonable cost. Many distribution systems are inadequate to furnish a suitable fire protection. Many believed to be sufficient have never happened to meet contingencies that may occur at any time, and have never been intelligently studied. A curve was plotted from the statistics of average daily per capita consumption from 75 towns having from 1,000 to 1,000,000 consumers living on pipe lines. The consumption per capita seems to follow a general law of increase with increasing populations. The formula of the curve is $40 (N \times 0.001)_{0.14}$, where N represents the total number of the consumers.

* Abstract of a paper by Freeman C. Coffin, M. Am. Soc. C. E., read before the New England Water works Association at the annual convention at Lynn, Mass., June 1, 1896.

BERLIN'S NEW SEWAGE SYSTEM.

Berlin has dealt successfully with the drainage question. Until about a quarter of a century ago the disposal of sewage was effected in primitive fashion; open drain courses, badly built and with inadequate fall, ran through many of the streets, discharging finally into the River Spree, for whole condition contamination would be far too mild a word. A commission was appointed which, after visiting various countries, especially England, with the view of practically studying different systems, reported in favor of sewage irrigation on land at a distance from the city. The flatness of the plain on which Berlin is built would not allow of any gravitation scheme, and consequently it was found necessary to adopt steam pumping. For the same reason the sewage could not all be collected at one spot, and it was therefore decided to divide the city into twelve drainage areas. The ground at the seven sewage farms was well suited for the purpose, consisting only of sandy wastes, then growing only stunted firs and birches, but now converted into fertile fields. The total area of the land which could be devoted to sewage irrigation is 22,500 acres; only about 11,000 acres are at present needed. The following extract is from Dr. Legge's account of these Berlin farms: "No deleterious effect has been noticed on the health of those living on the sewage farms, and, indeed, at some of them, as at Blankenburg and Malchow, the city has built hospitals for convalescents, for consumptives, and for women recovering after child-bed, and the patients seem to thrive in them as well as they would anywhere else."

The question of whether the germs of typhoid fever and cholera pass through the soil into the drainage water has naturally formed a subject of inquiry, but many bacteriological examinations conducted specially with the view of clearing up this point, have answered the question in the negative. Until 1892 the laborers working on the sewage farms were remarkably free from typhoid fever, although in 1889 Berlin was visited by a severe epidemic; in 1892 a few cases occurred among some farm workers, who were believed to have drunk largely of the effluent from the farm, but in these instances other possible sources of infection could not be excluded. It is satisfactory to note that, notwithstanding the enormous cost of working these Berlin sewage farms, the expenses have, in most years, been covered by the sale of the produce, and in one year (1889) the surplus amounted to $11,511.

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