of the water system. In using the above data to make an estimate of the total operating expenses, we shall employ as a unit the cost per million gallons of water filtered. Assuming an average yield of 50 million gallons per acre between scrapings, the total cost would be as follows:

Scraping and removing at $45 per acre	$0.90 per mill. gals. filt.
Washing 100 cu. yds. sand at 25c. yd	0 50 per mill. gals. filt.
Replacing, etc., at 40c. yd	0.80 per mill. gals. filt.
Superintendence, etc	0.25 per mill. gals. filt.
Total	$2.45 per mill. gals. filt

To this should be added the cost of bacterial analyses of the effluents which should be made as frequently as possible in order to test the working of the filters. In many of the European plants a fully equipped laboratory is included in the equipment; and some of the superintendents, like Pieike, chief engineer of the Berlin works, are also expert bacteriologists. The actual cost of the operations discussed above for some American filters is as follows:

Poughkeepsie, N.Y., for 20 years aver.	$2.90 per mill. gals. filt.
Hudson, N.Y., is given as	1.38 per mill. gals. filt.
Mount Vernon, N.Y., a little less than	2.00 per mill. gals. filt.
Ashland, Wisconsin, estimated to cost	2.25 per mill. gals. filt.

The following table furnished by W. B. Bryan, Esq., chief engineer, East London Water Co., gives the yearly cost of filtration of the London Water Companies from 1890 to 1895:

COST PER MILLION U.S. GALLONS.

Name of Company.	1890-1	1891-2	1892-3	1893-4	1894-5
Chelsea	$ .72	$ .75	$ .62	$1.16	$ .60
East London	1.42	1.54	1.42	2.63	1.69
Grand Junction	1.33	1.24	1.30	2.00	1.68
Lambeth	.86	1.01	1.20	1.46	2.54
New River	1.02	.93	1.17	1.43	1.03
Southwark and Vauxhall	$1.17	$1.15	$1.26	$1.53	$1.34
West Middlesex	1.01	.97	1.42	.95	.96

To get the total cost of maintenance, we must include with the operating expenses the charges for interest and sinking funds. This will of course depend upon the cost of construction; and the latter will vary with the maximum rate of filtration adopted, and the proportion of the total area to be out of use while being cleaned. These being decided upon, it will then be easy to calculate the first cost per million gallons of daily yield. For example, if, with the rate chosen, the daily yield of the plant will be 2,000,000 gallons per acre of the total area of beds, the first cost per million gallons will be half the cost of construction per acre, and so on. The diagram gives the cost per million gallons filtered, corresponding to different construction costs, which will pay the interest and sinking fund charges necessary to cancel the whole first cost with interest at the end of 40 years. For example, with a first cost of $60,000 per acre, and a net yield of 2,000,000 gallons per acre of total area, the cost per million gallons with interest at 4 per cent. would be $4.15. With interest at 4½ per cent., and a first cost of $80,000 per acre, first cost would amount to about $6. Add to this $2.50, for the expense of operation, and we should have $8.50 as the total cost of filtering 1,000,000 gallons of water, or 1,000 gallons for less than 9-10 of a cent.

Having now discussed the method and cost of sand filtration, the next and last question to be considered is the nature of the results which this process can be depended upon to produce. There can be no question as to its efficiency from an aesthetic point of view. The complete removal of even the most minute particles in suspension, together with a large part of the dissolved organic matter, ensures the entire elimination of any characteristics the water may possess which would be disagreeable to sight, taste or smell. Yet it is because of the effectiveness of the purification from a sanitary standpoint that this system is especially noted. This is due to its destructive effect upon the bacteria, which is almost sufficient to cause their disappearance during the passage of the water through the filter. The average reduction in a well designed and well managed plant will be as great as 98 or 99 per cent., as shown by comparing the number of germs in the effluent with that in the applied water. But in reality it is even greater than this. For it has been shown that of the few bacteria which are present in the effluent, a certain number come from the underdrains, and have therefore not passed through the filter at all. These belong to some of the species of water bacteria, and, consequently, will be quite harmless. From tests made on the experimental filters at Lawrence with an easily recognized and hardy species, the actual reduction was found to be from 99.9 to 100 per cent. Now, when it is considered the filter is capable of producing such effects upon bacteria which exist normally in water, it will be evident that the effect upon the pathogenic or disease germs which are out of their natural habitat and in a decidedly unfavorable environment will be much greater. Thus what may be called the "hygienic efficiency" of this system must be remarkably high. The process is comparable to nature's method of purifying the surface water which furnishes the underground supplies; and if properly carried out, the water produced is probably of almost equal wholesomeness. The continued experience of places where sand filtration plants have been in operation for some time only goes to strengthen this conclusion.

In America the method is only just beginning to be employed. Up to the year 1892 there were but two plants of this description in the country, viz., those at Hudson and Poughkeepsie, which have been already referred to. Since that time 14 new ones have been completed, and three others are under construction, the latter including the large plant at Albany. The experience to be derived from these plants is too limited to be of much value for some time to come; but the officials connected with the majority of them have invariably expressed their entire satisfaction with the method of working and with the results obtained.

(To be continued).

Industrial Notes.

The Calgary Milling Co. will build an elevator.

At Truro, N.S., T. G. McMullen is completing a pulp mill.

Goderich, Ont., has voted a bonus of $10,000 to the Kensington Furniture Co.

Windsor, Ont., is buying a site for a drill shed to be built there by the Dominion Government.

The contract for the new public works office at Regina, Assa., has been let to Willoughby & Mallard.

G. H. Hopkins and J. D. Flavelle have bought the Lindsay, Ont., waterworks. F. K. Begbie will be manager.

The ratepayers of Woodstock, N.B., will vote on a bylaw to give a $50,000 bonus to a pulp mill on October 16th.

Kamloops, B.C., has voted $27,000 to improve the waterworks, and $15,000 to extend the electric light plant.

An addition will be erected to the John H. Stratford Hospital, Brantford. An isolation hospital may also be built.

The overhead bridge across the M.C.R. near Kingsmill, Ont., which was recently burned, is being replaced by a new one.

H. M. Whitney, Boston, president of the Dominion Iron and Steel Co., has given $25,000 to build an hospital in Sydney, Cape Breton.

The Canadian Rubber Co., Montreal, has ordered a 100 h.p. Mumford Improved boiler from the Robb Engineering Co., Amherst, N.S.

Joseph Black, Toronto, has been continued as editor of The Iron Moulders' Journal by the Iron Moulders' Association of North America.

The boiler inspectors in Montreal are enforcing the city by-laws requiring the use of smoke consumers, and heavy fines are being imposed.

The L.E. & D.R.R. is pulling down its grain elevator at Port Stanley, Ont., which was built four years ago, and removing it to Sarnia.

Smith's Falls, Ont., has appropriated $150,000 to put in a system of water supply and sewage. Willis Chipman, C.E., has prepared the plans.

Graham Moon, of the Postoffice Department, Ottawa, is said to have invented a roller boat, which it is claimed is better than Knapp's failure.

The Kingston School of Mines is trying to secure $6,000 to equip a new laboratory. The expenses last year were $2,070 in excess of the receipts.