against a total head of 40 feet (which includes the suction lift) The pumps would be run by a pair of 400 h.p. compound engines.

There would be a battery of 10 horizontal tubular boilers, each boiler of 100 h.p. Eight of these boilers are intended to supply steam for the pumps, the other two for drying out the receiving reservoirs and the contents thereof, coke and sewage matter, preparatory to the latter being run into the boiler house as fuel to be used under the boilers. The sewage effluent, after passing through the receiving reservoirs, and having been rid of all suspended and solid matter, would be as well purified as any chemical process of precipitation can accomplish, and could be allowed to pass by gravitation from the pump into Lake Ontario without further treatment, at any depth desirable below the surface, where diffusion would at once take place. But, if still further purification were at any future period insisted upon, either by local boards of health, or Governmental authority, two alternatives are open for such a purpose, viz., either by intermittent land filtration for which very much less than half the area suggested by the city engineer at page 12 of his report, would suffice; or, by the construction of two sets of artificial filters of the following materials and dimensions: Half an acre of coke filters, 3 feet 6 inches in depth, six acres of sand filters, 2 feet 3 inches in depth, the cost of which would not, in all probability, exceed $28,000. The last mentioned artificial filtration areas are larger, proportionately, than the supplemental filters in use at Glasgow, Scotland, for a similar purpose. The first alternative would necessitate the purchase of about 200 acres of land, besides its preparation, also an extra pump, while the cost of the last would be limited to material and construction only, as the sewage effluent would gravitate from the pump discharge to the filter beds.

In immediate proximity to the boilers and receiving reservoirs, there would be a brick chimney 250 or 300 feet in height. The object of such a high chimney is, by a powerful draft and steam heat, to carry off the objectionable fumes arising during the process of drying out the contents of the reservoirs, for which purpose a system of steam coils connected with one or two of the spare boilers is designed. Also, besides ventilating the reservoirs, it performs another very important function during the flow of sewage by creating a tremendous draft from the fresh air inlets upwards, and thus oxygenating the sewage most thoroughly, as the latter falls from one strainer to the other. Each receiving reservoir is capable of passing, and partially purifying from 2,000,000 to 4,000,000 gallons of sewage daily, after which it would be shut off from the sewer, thoroughly drained, and then subjected to a drying temperature of 300° F., which, assisted by the draft of the tall chimney would desiccate in a few hours the coke strainers and several tons of faecal matter intercepted by the upper screen, sufficiently to be used as ordinary fuel under the boilers, to which means have been designed to run them with a minimum of labor.

Such is the brief description of a very simple and economical plant, by which Toronto's sewage problem can be solved; and I wish here to point out particularly that this scheme involves an innovation hitherto unknown, or at least unpractised, so far as I am aware, in any sewage plant anywhere, i.e., the total and profitable combustion of the solids. By this process there is no resulting sludge to press and get rid of at considerable expense, the fuel bill is lessened, while the solid matters disappear in vapor.

It may be interesting to state here that, in any extensive chemical precipitation process the disposal of the sewage sludge has always been found an enormous drawback, as each million gallons of sewage treated produces from six to eight tons of pressed sludge cake, which it has been found impossible to get rid of without extra expense. Were such a system brought into use here, it is no exaggeration to say that the city would find itself compelled to hire daily, either a train of cars, or a small fleet of barges to haul it away. Farmers might take a very small percentage of it, but the great bulk would have to be carried away at the expense of the city, and 16,000,000 gallons of sewage daily treated chemically, mean 128 tons daily of pressed sludge cake. With regard to the coke strainers experience has shown, beyond a doubt, that after drying out, that material is as useful for fuel as before; and I shall show presently how it decreases the fuel bill, after having served its purpose as a strainer in the receiving reservoirs. It should be mentioned that this plant is amply capable of handling 16,000,000 gallons of the dilute sewage of Toronto per day, and that the receiving reservoirs can be added to if necessary; also that each of the pumps will discharge 25,000,000 gallons per day of 20 hours, with ease. The daily consumption of coke for straining purposes would be about 25 tons, or 175 tons per week, and the daily cost of pumping 25,000,000 gallons against a head of 40 feet would be 12 short tons of anthracite coal. Reduced to dollars and cents the daily cost for coke, coal and wages, may be represented as follows:

Pumping, 12 tons coal, steam drying, 3 tons coal; 15 tons coal, say at $3.75		$56 25
Deduct 25 tons coke recovered from reservoirs valued at one-fourth its weight of coal=6.25 tons at $3.75	$23 43	
20 tons desiccated faecal matter, equivalent to 4 tons combustible matter, but not taken into account		23 43
		$32.82
The daily cost for labor would be:		
Wages of two engineers at $2.50	$5 00	
Wages of four firemen at $1.75	7 00	
Wages of twelve laborers at $1.75	21 00	33 00
		$65 82
Add 25 tons coke required daily for strainers (high figure) at $4		$100 00
Total daily cost of maintenance		$165 82
Or $60,524.30 per annum		

ESTIMATED TOTAL COST OF DISPOSAL WORKS.

Excavation	$30,000
Brickwork	30,000
Concrete	4,200
Iron work	6,000
Drying apparatus coils, piping, etc	10,000
Ducts, or flues from receiving reservoirs to chimney	3,000
Flues from boilers to chimney	3,000
Roofing and carpenter's work	4,000
Bricking in boilers (10)	3,000
One centrifugal (24-inch) pump, one pair of 400 h.p. compound engines, 4 horizontal tubular boilers, aggregating 400 h.p.; feed pump, piping to connect boilers and engines, engines and pump set up on foundation, boilers placed ready to be bricked in	$15 000
In duplicate	30,000
Two additional boilers (steam drying)	2,000
Additional: suction and discharge piping, etc	1,000
Brick chimney (300 feet in height)	15,000
Coal and coke sheds	10,000
Eight branches connecting sewer with the different screening chambers, fitted with gates, and sundry other items	10,000
	$191,200

Note.—I am indebted to the Northey Mnfg. Co., Ltd., for the estimates as to the pumping apparatus and boilers.

It is important to explain here that the use of coke strainers has not been advocated without good reason. At Lawrence, Mass., U.S.A., experiments by the State Board upon the best known methods of sewage disposal have been tried during the last decade, and the results of the last two or three years, with regard to coke strainers, have shown that a 6-inch layer of that material has purified city sewage at the rate of 1,000,000 gallons per acre daily, and removed 62 per cent. of the organic matters (albuminoid ammonia), and 50 per cent. of that determined as "oxygen consumed," also that, at the rate of 4,000,000 gallons per acre daily, 38 per cent. of the total organic matter has been eliminated. The report of 1896 states emphatically besides, that coke straining removes organic matter as thoroughly from sewage as it is possible to do with any chemical or sedimentation process whatsoever, besides having the advantage of getting rid of the concentrated sludge liquor. It must also be remembered that, in the method which I have now advised, I have gone a step forward, by the retention of the solid faecal matter above, and entirely out of contact with, the coke strainers, thus relieving the latter of a very large per-