centage of organic matter to be dealt with. Obviously this is equivalent to increasing proportionately the area of the straining surface. The total combustion of the solids under the boilers, and the riddance of the expensive and intolerable sludge nuisance, are also advantages which must weigh with, and appeal to, even the least thoughtful of municipal economists.

It has been said that intolerable smells would arise from this combustion process. Not so. The high chimney will cause any bad odors to be carried away and dissipated in the atmosphere, far above the highest part of the city or neighborhood.

I may instance the Townsend and St. Rollox chemical works chimneys at Glasgow, Scotland, besides others in England, Germany, and in the United States, situated in the midst of dense populations, which carry off immense volumes of most deleterious gases, without inconveniencing the people below; but a little consideration will satisfy the most sceptical that nothing need be feared upon that score.

Mr. Rust estimates the cost of 600 acres of land, and the preparation of 300 acres for intermittent filtration, at $240,000. This, of course, presupposes the land to effect the purification of the crude sewage as it comes from the sewers.

My estimate for a filtering area of suitable natural soil, such as is said to be available to the northeast of the city, would be a tract of only 200 acres, which is amply sufficient to effect the final purification of the partially purified effluent from the coke strainers, being at the rate of 160,000 gallons per acre daily, for 16,000,000 gallons of a daily output. Such an area, upon the basis of Mr. Rust's estimate, would certainly cost less than $80,000. In the event, therefore, of a pressing public demand for complete purification, by final filtration through natural soil, entire and thorough treatment would cost, by the method I have outlined, as follows:

Coke straining and combustion works, pumping station etc	$191,200
Land for above (Mr. Rust's estimate)	10,000
Extra pumps, boilers, etc., required for pumping to land northeast of the city	20,000
Force main (Mr. Rust's estimate)	115,000
Two hundred acres of land for filtration purposes, and preparation, being taken at exactly the third of Mr. Rust's estimate. This is manifestly too high	80,000
.. ..	$416,200

Which is only 57-100ths of the city engineer's estimate for the cost of intermittent filtration and 75-100ths of that of his chemical precipitation scheme, *which has still the sludge to deal with.* The three proposed processes now stand thus, as regards cost of construction:

Coke straining and combustion process, followed by intermittent filtration	$416,200
City engineer's estimate for intermittent filtration	730,000
City engineer's estimate for chemical precipitation	555,000

And, as regards cost of maintenance per annum:

Coke straining and final purification by intermittent filtration	$65,000
City engineer's estimate for intermittent filtration	70,000
City engineer's estimate for chemical precipitation	105,000

In conclusion, I may remark that the coke straining may be carried to any extent by more frequent changes of coke than I have allowed for, it is simply a question of more coke and less coal, but the quantity estimated (175 tons weekly), will purify quite sufficiently for all practical purposes, especially if followed by intermittent filtration.

RETAINING WALLS.

Editor CANADIAN ENGINEER:

In a communication, published in your journal a year or two ago, I commented on the failure of the Bouzy dam in France, when some 230 persons perished in the flood; I then advocated a thickness of dam equal to the height or depth of the impounded fluid. That and other failures of retaining walls of masonry seem to have brought about a general concensus of opinion among engineers that this is safe practice; and in fact, retaining walls of all kinds, now-a-days, are built in a way more or less in accordance with this view.

Dams of masonry up to the present era used to be made of *a thickness hardly greater than one-half the height or depth* of water to be held back. This was done under the assumption that the weight of masonry being at least, or even more than, double the weight of water. Such a thickness of wall would suffice to retain it in situ. So it would, if the masonry could continue for all time to remain an homogeneous mass, thoroughly bound together by its cementing mortar. But it is well known now that this cannot or at least does not continue to be the case indefinitely. Whether through time and infiltration or other causes, the cementing medium deteriorates and rots away to sand in the course of years, when the superincumbent layers of masonry become, so to say, dislocated and detached and capable under sufficient pressure of sliding or moving the one upon the other. *The friction of masonry on masonry or of one* course of stone-work on another may be taken at a resistance, so to say, of 50 per cent. of the weight or vertical pressure; and, as in the case of a stone disintegrated dam of which the thickness is only half that due to the pressure weight on depth of water at any point, the resistance is therefore only equal to or less than that pressure, and the dam must in the course of time give way.

Hence, I advocated, as said before, a thickness equal to the depth of water, as in that case the loose material itself without the binding of it together by mortar, would still be of a weight more than double that of water, and such that its 50 per cent. of frictional resistance would be in excess of the pressure brought to bear against it. I am led to these remarks by an illustrated article in the last issue of The Scientific American, descriptive of a dam now in the course of erection at a point some five miles west of Mateo, a suburb of San Francisco in California.

This dam is built of concrete, and is the largest of its kind in the world. Concrete dams were heretofore on the monolithic plan, or as if a solid homogeneous mass of material. Concrete, however, as may be seen, even in floors and sidewalks, is contractile and separates into parts, leaving fissures between them, and thus destructive of the impermeability of a water retaining structure. Hence they are now-a-days built in blocks, and given time to dry and contract before they are cemented together. This is the mode Herman Schussler, C.E., has adopted of doing his work. The component concrete blocks of some 30x40 feet in horizontal area being built in boxes or bottomless caissons, as it were, with movable sides, and made *to interlock or dove-tail, the one into the other, thus breaking* joint, as the saying is. These blocks are made of the unifo· · height of eight feet, and every layer thereof left to dry thoroughly and shrink before another layer of similar blocks is laid over it.

The dam alluded to bears out my views, and those of the profession at large, in that its thickness is equal to the height or depth of water to be held up. Its length is, or will be, when finished, not less than 832 feet on top, or at the crest. Its present height is 145 feet and breadth of base 176 feet, or equal to its finished height which, as it has to rise still by 30 feet, will be 175 feet. The thickness at the present height is 40 feet, or some five feet in excess of the depth of water above this point. The dam is curved or convex up stream to a radius of 637 feet, or versed sine, of over 100 feet, and its strength and resistance thus added to materially. The quantity of water impounded will be 19,000,000,000 (nineteen thousand million gallons). The down face slope or batter of the dam is one horizontal to four vertical. The up face slope is one to one, to within 60 feet of its full height, whence it is, like the outer slope, one to four, and the two slopes joined by a curve of a radius of 300 feet. The foundations were excavated down below the original surface to a depth of from 8 to 35 feet, until solid rock was reached, and to guard against fissures in even this, a trench was further sunk to a depth of 17 feet with a width of 5 feet at bottom and 10 feet at top, and this filled with concrete solidly rammed down with heavy iron rammers. This trench runs the whole length of the dam, following of course its curvature and reaching to its extremities at opposite sides of the valley. May we hope, sir, that these prudential measures will always obtain in the future, and that we have heard the last of the appalling catastrophies due to failures of such structures.

CHAS. BAILLAIRGE, C.E.

Quebec, December 19, 1898.