

the salable part of the rubbish and including land, railroad sidings and paving is \$2,555,300. The gross annual operating costs, including fixed charges and the cost of picking over the rubbish, is estimated at \$92,510. The receipts from the salable material recovered, based on a value of \$2.25 per ton of rubbish handled, would be \$67,500 yearly, reducing the net cost of operation to \$25,010 per year, or 83.4 cents per ton of rubbish handled.

The garbage reduction works and accessories are estimated at \$538,200 for construction, and \$169,970 gross for operation, the same as in project C. The estimated annual income from the sale of grease and tankage, however, is \$210,000, leaving a net annual income of \$40,030 for the reduction works.

Combining these estimates for the incinerators and reduction works the total cost for project C is \$793,500 for construction, and with a population of 600,000 it is believed that there will be a net annual income of \$15,020.

**Summary.**—After a discussion of the relative merits of the four projects Messrs. Hering & Gregory recommended that the refuse be separated into three parts, to be collected separately, that the garbage be taken to a reduction plant, located east of the city and converted into salable products, the rubbish to be taken to incinerators within the city and there burned, either without or with picking. It is also recommended that the ashes be taken to points within the city where land-making or road foundations are desired.

The report enumerates the important factors which lead to the final recommendations regarding the refuse disposal problem at Toronto. The first point has to do with the low-cost electric power from Niagara Falls. When the investigation was started it was the opinion, both of the local authorities and of Dr. Hering, that incineration of the city refuse would be the most probable solution and that works for this purpose would be required. With the advent of cheap hydro-electric power in Toronto the usual revenue to be expected from the sale of steam produced at incinerator plants can not be counted upon to reduce operating expenses. It would be cheaper at Toronto to allow the heat generated at incinerators to be wasted and to buy power from the hydro-electric company than to pay the cost of converting the heat into power. In view of these unusual local conditions the reduction process of garbage disposal comes prominently into the commercial foreground. The results obtained by the reduction process at Cleveland and Columbus are regarded as evidence of the satisfactory results obtainable from such works when properly operated.

The second important point bearing upon the recommendations is that the disposal of garbage, rubbish and ashes only is considered; other refuse, such as street sweepings, dead animals, etc., is disposed of satisfactorily by present methods.

The third consideration concerns the combined or mixed collection of refuse. The reduction process demands a separate collection of the several classes of refuse, and this is more costly than combined collection. The report advocates an investigation into the possible economies of collecting the refuse by electrically-propelled wagons receiving power from storage batteries.

The treatment of the refuse after delivery was the fourth important point. From the preceding figures of cost it is apparent that the projects for reducing the garbage and incinerating rubbish require a much greater outlay for construction than the projects for incineration of garbage, rubbish and ashes; the increase is \$287,500 more without equipment for picking and \$304,200 more with such equipment. The operating costs for the reduction projects, however, due to the return from the sale of products, is very much less, the difference being \$117,790 per year without picking and

\$114,090 per year with pickings, assuming the population to be 600,000. Looking at the problem from the financial side, which it was the main object of the report to deal with, it appears that the reduction of the garbage is the most desirable means of disposal, although the necessity for separating the refuse is bound to cause inconvenience to the householder which a mixed collection would avoid.

## WASTEFUL SYSTEMS OF SEWAGE PURIFICATION.

In a paper read before the Manchester Section of the Society of Chemical Industry, Dr. Grossmann stated that if all the valuable manurial constituents which are contained in sewage could be utilized on the land they would represent a value of somewhere about \$200,000,000 a year. When the present system of sewage disposal by water carriage was adopted it was pointed out that it was the most wasteful system on economic grounds, but it was recognized that its advantages from a hygienic point of view should be such as to outweigh commercial considerations. The sewage, which is conducted by underground sewers to the sewage works to undergo further purification, consists of a liquid and a solid part, which are separated at the sewage works, and so far as the liquid part of the sewage (which ultimately finds its way into the rivers and the sea) is concerned, the present mode of purification, if properly carried out, will fulfil all anticipations with regard to public health; but as regards the solid part, the present mode of disposal is still a danger to the community. If that part which is generally termed "sludge" is carried out to sea there is a danger of infection to oysters, shell-fish, and fish; there is, moreover, a chance of this filthy material being washed back to places on the coast, as has been the case at several seaside places. If dumped on the ground it creates a nuisance, and if used on land for farming purposes there is the danger of infectious diseases being communicated to cattle and human beings from grass and crops grown on such land. Experiments carried out by the most eminent agriculturalists at the instigation of the Royal Commission on the treating of sewage and sewage sludge have conclusively proved that the value of sewage sludge, calculated on the dry substance which is contained in it, is no more than 10s. per ton at the outside, and as the sludge is produced at the sewage works in a state containing a large amount of water is cannot pay the farmers to use it unless the farms are in such close proximity to the sewage works that the cost of carriage and cartage is inconsiderable. Attempts have been made to reduce the cost of carriage by drying the sludge, but even after drying in the ordinary way it cannot be considered to be effectively sterilized, and is therefore still liable to carry infection. Moreover, it has been proved by the Royal Commission that it is worth even less after drying than before.

Dr. Grossmann gave calculations which showed the futility of attempting to dispose of the sludge by gasifying it in producers or of obtaining illuminating gas from it. The conclusions that he arrives at are that until the disposal of sludge is effected by sound hygienic methods there is still danger to the community; that no process for the disposal of sewage sludge can be considered satisfactory which does not enable us to return the manurial constituents contained in it to the soil in a thoroughly sterilized condition, and that sludge can never become a valuable manure unless it is previously freed from the greasy matters arising from soap suds and other fatty substances which in the sewers become mixed with the sludge, and which prevent its manurial constituents from being assimilated by the plants.