grease for various purposes, and the tankage is used for fertilizers.

Columbus is a city of about 185,000 inhabitants and the reduction plant has cost about $220,000. The sale of the grease and tankage brings more revenue than is sufficient to pay the cost of operation, plus the capital charges, as will be seel below:

Financial Statement for 1913.

1,095,594 lbs. of grease sold	$40,839.35
2,095 tons of tankage sold	14,223.31
Hides	1,247.39
Miscellaneous	489.73
Total receipts	$56,799.78
Total operating expenses	$39,560.25
Gross profit	$17,239.53
Allowing 4 per cent. interest and 20-year sinking fund	$16,292.00
Net profit	$ 947.53

The total quantity of garbage received was 20,710.74 tons, so the net profit amounted to about 4.57 cents per ton.

Garbage, however, is only one portion of town refuse and incidentally it may be mentioned that the householders in this large city, have to dispose of their refuse, other than garbage, by arranging with any one of the 140 private contractors.[4]

Columbus is now installing a Sterling destructor to cremate rubbish only. Natural gas is available and consequently the proportion of ashes is stated to be small.

Garbage reduction plants are capable of being operated with profit in cities of over 100,000 inhabitants. Mr. C. O. Bartlett, however, expresses the opinion that any small place producing one ton of garbage per day can be successfully treated in this manner.[3]

A full description of the reduction plant erected at Boston for the Boston Development and Sanitary Company, is to be found in the "Engineering Record" of May 10th, 1913, and of the Columbus plant in Mr. Irwin S. Osborn's report of January 1st, 1913, to which those interested in this process are referred for further particulars.

A number of towns in Britain have adopted the Lightning Dust Manipulator, for instance, Southwark, a large borough in London, Halfax, Hove and others. The process consists in pulverizing the raw refuse into manure. This is done by means of high-speed revolving hammers striking the refuse against the breaking block and a final disintegration effected by trituration between the hammers and the grinding plate. Southwark sells about 20,000 tons of manure annually. The manure is similar to black mold, and as the Southwark works are located in a populous part of London, and the plant has recently been extended, the process is practically inoffensive. Hove is one of the fashionable seaside resorts in South England and Halifax is a large commercial centre in Yorkshire.

The text of this paper is Refuse Destruction, and the remainder of the writer's observation will be confined to it.

For the sake of a clearer definition, furnaces operated at a temperature of about 1,500 degrees Fahr. or less, will be called incinerators, and those which have a working temperature of over 1,500 degrees will be called destructors. In America these furnaces are called low and high temperature incinerators respectively. It seems preferable to know what is referred to by a distinctive name, rather than by a qualifying term which is often omitted.

Fire is the oldest and best-known method of disposing of offensive rubbish. It has been adopted by all races and in all ages, with more or less satisfaction. Burying offensive matter is another ancient and effective way of getting rid of such matter.

The first engineer who successfully designed a furnace to effectually destroy town refuse by fire was Mr. Alfred Fryer, of Nottingham, England. This was in 1874. He built two such furnaces in Manchester in 1876 and these have been extended and improved and are still in use, which fact at least suggests that Fryer had evolved a scheme based on right principles.

This innovation, however, met with a hostile reception. The public prejudices against the adoption of such furnaces were so strong that it is surprising it survived.

Following Fryer, there were several aspirants who claimed to have designed furnaces superior to Fryer's, for example, Pickard's "Gommand," Wilkinson, of Birmingham; Healy, of Brighouse; Heard, of Paddington; Burton, of London; Stafford and Pearson, and others, but Fryer's furnace held its position. These, and some which were designed later on, were of the incinerator class—low temperature, slow burning, producing soft clinker and obnoxious gases. Mr. Charles Jones (Ealing) in 1885 introduced his "fume cremator" which was an ample proof that something was needed to improve the combustion.

Mr. William Horsfall, in 1887, brought out the first high temperature furnace, which improvement gave a new impetus to the process. Horsfall also improved the furnace by arranging for a front exhaust of gases, by which means all gases had to pass over the active grate before being discharged and by so doing the fume cremator was found to be unnecessary and was ultimately abandoned.

From 1887 to the present time many improvements have been introduced, such as steam jet blowers, forced air draft, regenerators or air pre-heaters, continuous grates, twin grates, mechanical feeders and clinkering, dust catchers, steam producers, and so on. To deal with each of these would entail a long paper, as each maker has devised certain features in connection with furnaces, etc. They will, therefore, be referred to collectively as far as possible.

Incinerators, then, are the survivors of the earliest types and destructors are the later developments.

Incinerators are furnaces capable only of slow combustion and require some form of drying-hearth or device for reducing the moisture contained in the refuse, preparatory to creation. Some incinerators are charged with large quantities of refuse at one operation, the result being the lowering of the temperature of the furnace, the prolonging of the period of cremation as the combustion is more often local than general, the passage of green gases and the production of soft clinker and little steam. An analyses of the gases and a record of the maximum and minimum temperatures in incinerators will doubtless show that the work done is not altogether satisfactory.

Experience has shown that with destructors the same as with other furnaces, the percentage of carbon dioxide, oxygen and carbon monoxide contained in the gases in the main flues, is in proportion to the completeness of the combustion of the fuel and the carefulness of firing and clinkering.

It is manifest that not even the best coal-fired furnace can produce satisfactory percentages of the above con-

[4] Report on Disposal of Refuse, Newark, N.J., 1912.