lection of minerals and rocks besides carrying out a series of experiments with ochre.

THE MINES' SECTION.

Mr. E. D. Ingall, on behalf of the Mines' Section, in which he is ably assisted by Mr. McLeish, reports that the value of the mineral production of Canada for 1904 was $60,343,165.

The report closes with an appendix to the Mines' Section Report, by Mr. M. F. Connor of the Assay Branch of the Geological Survey, and three small appendices by Dr. Ami of the Palaeontological division, on the geological position of various strata containing organic remains from various localities in the Yukon, North West Territories and Nova Scotia.

THE ELECTRIC SMELTING OF ZINC ORES.*

By Frederick T. Snyder.

The present method of smelting on a lead basis ores containing gold and silver, consists in fusing in a blast furnace a mixture of ores containing approximately 30 per cent. silica, 20 per cent. of the oxides of iron and manganese taken together, 25 per cent of alkaline earths, 5 per cent. of sulphur, 5 per cent. of zinc and 10 per cent. of lead. A modern furnace will handle 200 tons of such a mixture per day. The product of smelting this daily charge will be about 170 tons of slag, 6 tons of matte to be re-smelted, and 19 tons of lead, the lead carrying approximately all of the gold and silver which was in the various elements of the charge.

The zinc in the charge, amounting to 10 tons per day, does not appear in the product, it having been forced into the slag and thrown away. In general, at the average smelting plant, it is a commercial requirement that the furnaces should smelt and waste as much zinc in the slag as is technically practical, the reason being that lead and precious metals can be purchased more cheaply when contained in a zinc ore than when occurring in other forms of ore. The practical limit to the amount of zinc which can be slagged off is about 10 per cent. If more zinc than this is put into the charge a portion of it will be reduced to the condition of metallic zinc, which will be volatile at the furnace temperature. This volatile metallic zinc, meeting the oxygen of the blast, is oxidized to zinc oxide. Such zinc oxide being infusible, accumulates in the furnace, clogs it up, and stops the process of smelting. If it were not for the oxygen of the blast, both metallic lead and metallic zinc would be produced at the same time. If removed from the furnace in a metallic form, the value of the zinc which might be recovered from an average furnace charge would about equal half of the lead produced at the same time, and would exceed per year the first cost of the smelting plant.

The heat needed to smelt such a charge is usually obtained by the combustion of coke inside of the furnace. A blast is forced into the furnace to furnish the oxygen required for this combustion. If this coke were burned outside the furnace, and the resulting heat separated from he gaseous products of combustion and transferred within the furnace, the volatilized zinc would not meet the blast, and escaping oxydization, might be condensed and removed in metallic form. Electricity forms a possible way of doing this. If the coke be burned under a boiler, most of the heat of its combustion will be transferred to steam. A part of the energy of this steam can be changed through the medium of a steam engine and dynamo into electricity. Almost all of the energy of this electricity can be delivered into the furnace as heat. Another way of doing it would be to burn the coke in a gas producer and use the resulting gas to drive a gas-engine dynamo combination. In such a way more of the total energy in the coke would reach the furnace.

In average modern practice, 250 pounds of coke are burned per ton of charge. Ten pounds of this coke are required chemically inside the furnace for the reduction of lead. No blast is required for the burning of this part of the coke, as the oxygen is furnished by the lead oxide. Of the balance of 240 pounds, part would be saved in burning the fuel outside the furnace. To burn this amount of carbon inside the furnace requires the introduction of 2,700 pounds of air. To heat this air from an average atmospheric temperature to 400 degrees F., at which gases escape from the furnace top, requires the combustion of 19 pounds of coke as burned inside the furnace. When coke is burned inside a furnace, the combustion is not complete, and the gases as they issue at the top carry off an amount of chemical energy per ton of charge equivalent to the combustion of 76 pounds of coke under present conditions. If these losses be deducted there remains 145 pounds of coke whose heat of combustion would have to be put into the furnace electrically to enable a furnace to run on the present basis without blast.

Under conditions of good average modern practice, 70 per cent. of the heat in fuel burned under a boiler will be transferred into steam; 17 per cent. of the heat energy in the steam could become mechanical energy in a steam engine, and 90 per cent. of this engine power can be delivered from a dynamo as electricity. Of the energy of this electricity, 90 per cent. will become heat again inside the furnace. As the total of this cycle, some 10 per cent. of the heat energy of the fuel would be delivered into the furnace, freed from all gaseous products of combustion. If a gas producer and gas engine dynamo system be used, some 15 per cent.

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* Trans. C.M.I., March, 1905.