to bounties to ships carrying coal from Nova Scotia to Ontario lake ports. The revenue derived from Ontario manufacturers from the coal duties would, the Association tells us, be sufficient to pay interest on the cost of extending the Intercolonial to Ontario as well as to provide bounties for water transportation on coal. In other words, Ontario manufacturers must contribute $2,000,000 a year in the way of duty on their fuel with which to pay interest on $66,666,000 to be expended by the Government in railway extension, improvements in waterways, and bounties to steamship freight carriers.

Ontario manufacturers will no doubt be delighted with the proposition.

DR. HAANEL'S REPORT.

In a recent issue of this journal allusion was made to the fact that Dr. Haanel and the Commission sent to Europe by the Dominion Government to investigate the manufacture of steel by electricity has returned to Canada and would report the result of their investigations to the Government. Dr. Haanel has handed his report to the Minister of the Interior, which has not yet been published, but some of the more important facts contained in it are known, from which we condense as follows:

By far the most important experiments witnessed by the commission were those made by Mr. Keller, of Keller, Leleux & Company of Livet France. Some 90 tons of iron ore were used to demonstrate the economic production of pig iron by the electric process. The furnaces employed for these experiments were the furnaces used in the regular work of the company of making by the electric process the various ferros, such as ferro-silicon, ferro-chrome and so forth. The company at the time of the visit of the commission were under contract to furnish ferro-silicon to the Russian Government, but generously interrupted their pressing regular work to undertake the making of experiments for the commission. The furnace employed is of the resistance type, and consists of two iron castings of square cross section, forming two shafts communicating with each other at their lower end by means of a lateral canal. The cases are lined with refractory material. The base of each shaft is formed by a carbon block. These blocks are in electric communication on the exterior of the furnace by means of copper bars. The carbon electrodes to which electric current is distributed pass two-thirds of their length into the shaft. The electrodes are prisms 72 centimetres in diameter and 135 centimetres long. Three sets of experiments were made as follows:—(1). Electric reduction of iron ore and obtaining different classes of pig grey, white and mottled. (2). Electric reduction of iron ore containing a definite amount of carbon in the charge, with a view of ascertaining the amount of electric energy absorbed in the production of one ton of pig iron. (3). The manufacture of ordinary steel of good quality from the pig manufactured in the preceding experiments.

The different classes of pig iron were obtained without difficulty, and the furnaces throughout the experiments worked quietly and without the slightest accident, the gas discharging on top in flickering flames, showing that the gas resulting from the reduction of the ore escaped at low pressure. The workman employed were ordinary Italian laborers without any special training. A number of castings, such as columns, pulleys, gear wheels, plates and so forth were made the metal drawn directly from the furnace. The castings showed sharp edges, a comparatively smooth surface, and were sound throughout. For the determination of the electric energy absorbed the volt metre and ammeter employed to measure the volts and amperes were calibrated in the laboratory of the director of the electrical department of the University of Grenoble, who also ascertained the power factor of the alternator furnishing the electric energy. The electric energy absorbed per ton of pig was found to be .226 horse power years.

The following are the figures which go to make up the approximate cost of producing a ton of pig iron:—(1). Ore (hematite) metallic iron 55 per cent., 1,842 tons at $1.50 per ton, $2.76. (2). Coke for reduction 33 tons at $7 per ton, $2.31. (3). Consumption of electrodes at $5 per 220 pounds, 77 cents. (4). Lime 30 cents. (5). Electric energy 226 horse power years at $10 ; or e.h.y., $2.26. (6). Labor at $1.50 per day, 90 cents. (7). Different materials, 20 cents. (8). General expenses, 40 cents. (9). Repairs, maintenance, etc., 20 cents. (10). Amortization (machinery and building), 50 cents. Exclusive of royalty, $10.60.

To satisfy the commission Mr. Keller made experiments to illustrate his process of making steel. The details of the operation and the figures relating to his experiments are in the hands of Prof. Harbord, the English metallurgist, who accompanied the commission.

In regard to other processes it was found that Mr. Harmet, of St Etienne, who published papers and obtained patents on the electric process for smelting iron and making of steel, and Mr. Gin, of Paris, who has obtained a patent for the production of steel from scrap, have as yet no plant in operation by which their methods might be tested. Photographs of the furnaces employed, except the Stessano furnace at Turin, have in each case been obtained, also detailed working drawings of the furnaces examined.

In his general conclusion Dr. Haanel says:—"It must be pointed out that the results obtained at Livet were the results of experiments in furnaces not specially adapted to the work required to be done. With the improved furnaces of which the commission has secured detailed drawings, permitting on account of higher column of charge a more effective use of the reducing power of the carbon monoxide evolved, and the employment of machinery for charging the furnace to reduce the cost of labor, a much better figure than the one given will result.

The processes of electric smelting must yet be regarded as in the experimental stage, no plant existing at present where iron ore is commercially reduced to pig by the electric process. The more remarkable therefore it appears that experiments made off-hand, so to say, in furnaces not at all designed to be used for the production of pig, should give a figure of cost which would enable an electric plant properly designed and managed to compete with the blast furnace. It is, moreover, reasonable to expect that as experience in electric smelting accumulates, the design of the electric furnace best suited to the conditions of the high temperatures with which the metallurgist has to deal will undergo changes which will reduce the absorption of electric energy to a minimum. The electric engineer will also be called upon by the new industry to design electric plants specially suited to the conditions of electric smelting. When it is considered that the electric process is applicable to the smelting of all other ores, such as copper, nickel, silver and so forth, that the furnaces are of simple construction and the regulation of the heat supply under perfect control, we may expect that the application of electric energy to the extraction of metals from their ores will not be long delayed, and that familiarity with handling large currents, and experience gained in electric smelting will result in displacing some of the costly and complicated methods by comparatively simple and economic processes. The immediate effect of a plant erected for the smelting of iron ores which will demonstrate the economic production of pig and the making of steel will arouse the faith of the industrial world in the new metallurgy, and other industries dependent upon electricity as the agent or to which electricity can be applied will follow as a consequence in the wake of this power plant.

At Gysang, Sweden, steel of superior quality is made by the smelting together of charcoal, pig and scrap in an electric furnace of the induction type, that is to say, a furnace without electrodes. This process corresponds to the crucible steel process, but it has certain advantages over the latter in that the melted materials at no time during the operation are exposed to gases, some of which when absorbed deleteriously affect the quality of the product. The furnace worked quietly and regularly, producing on the average four tons of steel in 24 hours. "Tapping" occurring every six hours, .116 electric horse power years were required per ton of product. The cost at the rate of $10 per electric horse power a year would be $1.16 per ton of product. At Kortfors, Sweden, the Heroult process of making steel is in operation, but the furnace is at present employed in the making of ferro-silicon.

At Laprah, France, steel is also made from melted scrap. The process differs from that at Gysang in that it permits of