appearing chemically the same. The advice given by one well-known engineer is to find a gas works producing good tar, and use only the tar produced there.

The tar macadam is laid on the roadway in three grades, over a good foundation, which is always shaped up to the proper convexity. The aggregate of the surface is composed of broken stone, obtained in the vicinity: 60% broken to a size of 2½ in.; about 30%, 2½ in. to 1¼ in.; and 10%, ¾ in. to ½ in., for closing up interstices. The last-mentioned size is kept separate and used during rolling operations. The tar macadam, after being spread and levelled, is rolled into a smooth surface but not rolled to the same extent as an ordinary water-bound macadam road. A 10-ton roller is used for this work, as better results are obtained than when a heavy roller is used. After the roadway has been open for several weeks, a coating of tar is applied to the surface of the road, and covered with stone chippings, not larger than will pass through a quarter-inch mesh.

Engineers differ considerably about the preparation of materials, and no standardization is at present possible. Heating the stone dries it, and renders it in a better condition to absorb tar. On the other hand, it is contended that artificial drying is detrimental, and also that it is better to dry the stone by storage under cover. It is doubtful whether the latter method can be effectual for, though the stone is preserved from actual wetting, it will, in wet and humid weather, absorb moisture from the air.

As to the necessity of boiling the tar, there should be little doubt. Tar varies very much in the amount of volatile matter present and careful boiling for 2 or 3 hours will render the consistency more stable and more tenacious. If the tar is poor a little pitch may be added to enrich it. The boiling, however, must never be carried too far or the residue will be brittle. Considerable care must be exercised with the boiling. In preference to boiling, some engineers store their tar for some months before use, and in this case it is kept in concrete or iron tanks, set below the ground level, and fitted with valves, etc., to permit the escape of volatile gas. The tar should, in this case, be drawn from the bottom of the tank, and a pump must, therefore, be fitted to effect removal under this condition.

General.—The estimate of $3,172,119.55 would appear at first sight to be an enormous expenditure, but a study of the details and close examination of the streets in the city will convince anyone of the vast amount of work that has to be done and it has to be remembered that good roads cannot be constructed without a heavy expenditure of money.

The opinion is expressed that the first work to be undertaken is the construction of roadways which form the main arteries or trunk roads in the city.

The report is concluded by a paragraph pointing out that proper maintenance is as important as good construction, but that it cannot reasonably be expected that the small amount of about $50,000 given annually for the maintenance of roads in Ottawa is anything like sufficient.

Maintenance consists in keeping a roadway as nearly as practicable in the same condition as it was when originally made. The repair of a roadway is the work rendered necessary to bring it up to its original condition after it has become deteriorated by neglect to maintain it. There is a wide distinction between the two operations; the former keeps the road always in good condition, while the latter makes it so only occasionally.

ELECTRIC IRON SMELTING.

By Jens Orten-Boving, M.I.Mech.E., London, England.

THE method of producing iron and steel by the use of electric current has lately received much and well-deserved attention in Canada. It may, therefore, be of some interest to learn some data regarding the recent experiences and developments in Sweden. Before doing so, the fact might be pointed out that there is no other country in the old world so like Canada as Sweden. Both are mainly agricultural countries with a relatively sparse population; both have an abundance of water power, forest and high-class iron ore; both have splendid transport facilities, i.e., rail, lake or canal, and the climate is marked by similar fluctuations of temperature and by the remarkably clear, invigorating atmospheric conditions.

During the last five years some very remarkable developments in the iron industry of Sweden have taken place by the introduction of electric reduction of iron ore, producing pig iron, and by electric refining of low-quality steel to high-grade steel.

This article will deal with the two processes separately, although in many plants the refining should be an integral link in converting the ore into fine steel by one continuous process.

Electric Reduction of Iron Ore.—The system which has met with real commercial success is that of Electro-Metals, Limited, which has been described on several occasions in various technical papers. Other methods have been tried repeatedly but they have all been abandoned and to-day the Electro-Metal furnaces are the only ones in use in Sweden. The following is a list of Swedish furnaces:—

Working now.	Number.	Power consumed per furnace.	Total power consumed.
Strömsnäs Jernwerks A. B.	1	3,000	3,000
Uddeholm A. B. Hagfors ..	3	3,400	10,200
Stora Kopparbergs Bergslag A. B. Domnarfvet.....	1	3,600	3,600
Building now.			
Strömsnäs Jernwerks A. B.	1	3,000	3,000
Nykroppa Jernwerk	2	3,400	6,800
	8		26,000 h.p.

These furnaces will produce approximately 80,000 tons of pig iron per annum. The Stora Kopparberg Co. are putting down 10 more furnaces, not included in the above.

There are, further, a great many installations contemplated and it is certain that wherever there is cheap water power the old blast furnaces will be replaced by electric producers. Generally speaking, it holds good that wherever one horse-power per annum can be produced cheaper than the cost of two tons of charcoal or coke (depending on what class of iron is to be produced) it is a commercially successful undertaking to substitute electric heat for carbon heat.

The operation of the electric reduction furnace is much simpler than that of a blast furnace and everybody who has been visiting the Swedish works returns impressed by the extreme simplicity of the affair. Fewer hands are required as well as less skill than for a blast