

in the prices of the metals. In the case of the Canadian Copper Company, they appear to have been adopted because they represent the price at which the company sold the matte to the Orford Copper Company before both concerns were merged into the International Nickel Company in 1902. The practical effect is to credit the entire profits of the business to the refining stage, and to eliminate them from the mining and smelting stages. This is a convenient method for the companies, since no real change of ownership takes place between the mine and the finished metal. The result, however, is to unduly depress the figures of value in the Ontario statistics, and in dealing with the figures for 1915 the Bureau of Mines adopted a valuation of 25 cents per pound for nickel and 10 cents for copper in the matte. The latter figure has been increased to 18½ cents for 1916, since the price of refined copper has risen to an unprecedented height.

Losses in Mining, Smelting, and Refining.

The losses in each department are considerable, but in mining and smelting, at any rate, they are well recognized by the two large operating companies. It may be taken for granted from what the Commissioners have seen of the efficient working of these companies, and from the analyses supplied, that everything is being done to minimize these losses, so far as meets the requirements of companies having large quantities of rich ore for immediate use and in reserve, and very large supplies of low-grade ore proved and ready for working when needed.

As to losses in refining, it may be said that there is more room for improvement in the treatment of a matte containing about 80 per cent. of metals, nickel and copper, than in the simple production of such matte.

The losses on the roast-heaps through leaching are not definitely known, although they have been estimated by the Canadian Copper Company at about 11½ per cent. of the total copper and nickel.

In addition to losses in mining, and the leaching losses on the roast-heaps, the losses by the Canadian Copper Company in the slags from the smelting at Copper Cliff amounted in the year ending March 31, 1916, to about 8.9 per cent. of the total nickel, and about 9.6 per cent. of the total copper. Although their work is carried on with great efficiency, and it is not suggested that these losses can be reduced, the total, reckoned on 1,227,187 tons of ore raised in 1916, reaching, as it does, 3,100 tons of nickel and 1,400 tons of copper per annum, indicates the importance of any improvement which can be made in metallurgical practice.

The smelting losses of the Mond Nickel Company may be taken as similar, except that their roast-heap losses are less, as they employ heap-roasting to a much smaller extent.

The Commissioners have to express their appreciation of the frankness with which both companies have discussed the question of losses, and their willingness to consider any possible means of lessening them. They point out, however, and the Commissioners agree, that there is no reason to anticipate much further saving on smelting operations, and that the losses in the smelting of nickel-copper ores are always likely to be greater than those inherent in ordinary copper smelting, with which the treatment of the Sudbury ore is fairly comparable.

The losses in mining will be gradually reduced as the grade of ore mined becomes lower. That processes of flotation will in the future be applied to the Sud-

bury ores there is good reason to expect, and it is most probable that such processes will enable a larger proportion of nickel to be obtained from a given mine than at present. This will be effected, however, rather by making it possible to treat low grade ores necessarily or conveniently raised while extracting those of better grade, than by stopping actual leaks now existing in any of the stages of treatment. These leaner ores are now left in the mine, or in some cases are stored in dumps, but as the cost of obtaining them is small, being largely covered by that of mining the better ores, they could probably stand the additional expense of concentrating by flotation. A positive gain of this kind is as beneficial as an improvement in metallurgical processes for the prevention of actual smelting and refining losses, and is quite in keeping with the tendency of modern metallurgical methods.

High Average Content of Sudbury Ores.

It may be added that although the amount of nickel and copper varies from time to time in the different deposits, the average of the ore from the several mines has not shown any serious falling off. The copper may have increased relatively to the nickel, or the reverse may have been the case, but any increase in the amount of copper, so far as the Canadian Copper Company's deposits are concerned, appears to have been due to the inclusion of more rock matter, which is richer in cupriferous mineral than the massive ore. The whole of the Sudbury deposits have shown wonderful continuity, and the ratio of nickel to copper, commonly given for the whole field as two to one, is remarkably near the truth. The Mond Nickel Company's ore averages more nearly one to one, but this is due to the fact that the company has acquired properties which are inherently richer in copper than nickel, and that it is actually desirous of having a larger proportion of copper in their ore, on account of the ready sale of the copper sulphate, which is one of the primary products of its process, as contrasted with that of the International Nickel Company.

Sulphur Fumes.

A chapter of the report is devoted to the discharge of sulphur, in the form of sulphurous acid, in roasting, smelting and refining the Sudbury ores. While the subject has received attention from the operating companies, it has not been found possible to make any economic use of the large quantities of sulphur that are thus wasted. Attempts are constantly being made to minimize the damage caused by the escape of sulphur. It is believed that in the not distant future smelting methods will be developed that will do away with conditions that now exist.

The roast heaps are the worst offenders both in quantity and in injurious results. Roasting during the winter months is less harmful than at any other season of the year. The Mond Nickel Company is not now roasting during the summer months, and is making arrangements with a view of discontinuing roast heap practice altogether if possible. The British America Nickel Corporation does not intend to use roast heaps. The Canadian Copper Company has roast heaps continuously in operation carrying a total of about 250,000 tons of ore. The injurious effects will be considerably lessened by the recent change in location of the roast yard. Apart from the question of nuisance and injury, the roasting of the ore in heaps is not the best or most efficient metallurgical practice, and involves unavoidable losses of both nickel and copper. The sulphur driven off at the roast heaps,