

## DISCUSSION

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This department has been established by the editors in order to afford to those interested in questions relating to economic geology an opportunity for informal discussion. Contributions are cordially invited either in the form of discussion of more formal papers appearing in earlier numbers or bearing upon matters not previously treated. Letters should be directed to the Editor, Sheffield Scientific School of Yale University, New Haven, Conn. The full name of the author should be attached to all communications.

### *NOTE UPON THE OCCURRENCE OF MERCURY IN COBALT ORES.*

*Sir:*—Cobalt has been for a long time the subject of much geological investigation and speculation. Many thousand tons of ore have been shipped from its mines to various reduction plants in Canada, the United States and Europe for treatment by various metallurgical processes. As mercury occurs in combination with metallic silver and other closely allied silver minerals, presumably as an amalgam, in a number of widely separated localities in Europe and North and South America, it is surprising that it was not discovered in Cobalt ores until the writer accidentally detected its presence in the fall of 1910 while developing the Nipissing process for treating the high grade silver ores of the district.

Miller's<sup>1</sup> paper upon the Cobalt Area, published in September, 1911, contains the first published record of the occurrence of mercury in this district. He states that it was discovered by the staff of the Nipissing Mining Company, but inadvertently fails to give the writer individual credit for the discovery. As a matter of fact it was only after a considerable number of determinations had been made upon the ore and "metallics" from several mines, and they had actually seen the mercury, that I was able to convince

<sup>1</sup> Willet G. Miller, "Notes on the Cobalt Area," *Engineering and Mining Journal*, Vol. 92, p. 647.

the regular Nipissing staff that mercury did occur in Cobalt ores.

During the development of the Nipissing Amalgamation Process, the writer had frequent occasion to determine mercury in the tailing in order to establish the mercury loss occurring during amalgamation. The large number of interfering elements which were present in the ore made it necessary to check the method of estimation rather carefully. This was done by taking a California siliceous mercury ore of moderate grade, in which the mercury had been very carefully determined, as a standard. Varying proportions of the original Nipissing ore before amalgamation were mixed with the standard ore and the mercury determined in the mixtures by the method of estimation which it was proposed using upon the tailing. Based upon the assumption that Nipissing ore did not contain mercury, the ore mixtures gave results which were invariably too high. This was clearly due to some interfering element or the presence of mercury in Nipissing ore. Determinations were then made directly upon the Nipissing ore, and the gold beads used in making the determination assumed a white metallic coating which appeared to be mercury. The first determinations were made upon rather low grade ore and, consequently, the amount of mercury involved was very small; it was, therefore, not possible to positively identify the mercury by the appearance of the gold beads. Accordingly the coating was dissolved in nitric acid and subjected to various qualitative tests, which definitely proved it to be mercury. Later, when tests were made upon the metallic silver and dyscrasite, which contained a much larger proportion of mercury, it was at once evident without further confirmation that the coating upon the gold beads was mercury. After the completion of the Nipissing refinery the first charge refined under the direction of the writer in the new reverberatory furnace was a lot of silver nuggets directly from the sampling works. At the end of this operation sufficient mercury was recovered from the flue chamber, which had never been used before, to convince the most skeptical that mercury occurred in Cobalt ores. Below are given a number of determinations of mercury which were made some time ago upon Cobalt ores and metallics.

Mine.	Material.	Per Cent. Mercury.
Nipissing.....	Ore from Kendall vein .....	0.26
Nipissing.....	Ore from veins 63 and 64 .....	0.24
Nipissing.....	Ore from veins 63 and 80 .....	0.23
Nipissing.....	Ore from veins 54 and 64 .....	0.24
Nipissing.....	Ore from vein 64 .....	0.37
Nipissing.....	Ore from vein 61 .....	0.41
Nipissing.....	Ore from vein 12 .....	0.62
Nipissing.....	Concentrates from low grade Kendall ore ....	0.11
Nipissing.....	Tetrahedrite .....	0.22
Nipissing.....	Nuggets from veins 26 and 66 .....	2.32
Nipissing.....	Nuggets, general sample .....	2.52
Nipissing.....	Nugget .....	1.12
Nipissing.....	Surface nugget .....	1.12
Nipissing.....	Nuggets from a mixed lot .....	3.54
Nipissing.....	Nugget from vein 64 .....	2.70
Nipissing.....	Weekly sample of nuggets, vein 64 .....	2.56
Nipissing.....	Weekly sample of nuggets, Fourth of July vein .....	4.74
Nipissing.....	Weekly sample of nuggets, Kendall vein .....	4.37
Nipissing.....	Metallics from second class ore .....	1.12
Nipissing.....	Metallics from second class ore .....	1.40
Nipissing.....	Leaf silver .....	1.04
Nipissing.....	Several samples of low grade ore .....	trace.
La Rose.....	Nugget .....	1.34
Coniagas.....	Nugget from jigs .....	1.48
Chambers-Ferland..	Leaf silver .....	0.80
O'Brien.....	Tetrahedrite .....	0.50
O'Brien.....	Tetrahedrite .....	0.58

Knowing that tetrahedrite occurred in Cobalt ores it was at first assumed that it might be the mercurial variety (schwartzite) and, therefore, the source of the mercury. However, upon making further determinations, it was found that the mercury occurred entirely in the metallics which were chiefly metallic silver and dyscrasite and that the percentage of mercury in the tetrahedrite was a function of the amount of silver in these forms which it contained. (In fact, this is also true of all the ore.) Thus the sample of tetrahedrite from the Nipissing mine contained about the same percentage of mercury as the first four samples of ore noted. These five samples all contained approximately 2,000 ounces of silver per ton. Two samples of tetrahedrite from the O'Brien mine, containing approximately 4,000 ounces of silver

per ton, were found to have slightly more than double the percentage of mercury indicated in the Nipissing sample. It was also thought possible that the serpentine might be the source of the mercury, but this theory was disproved, at least as regards the Nipissing ores, by the fact that, while it was possible for the low grade ores to contain many times the proportion of serpentine that could occur in the high grade ores, yet in no case was more than a trace of mercury found in low grade ores assaying from 10 to 40 ounces of silver per ton. The metallics from the low grade and second class ore contain mercury, but the proportion in the low grade ore is so small that only a trace is indicated when mercury is determined in the whole ore.

In general, the purer forms of leaf silver contain a lower percentage of mercury than the more impure nuggets containing a greater percentage of antimony. Individual masses of the metallics show considerable variation in the percentage of mercury, but ore mixtures as treated in the mill show a far more regular content.

The evidence available seems to justify the conclusion that mercury occurs as an amalgam rather irregularly distributed in the metallic portion of Cobalt ores, with a tendency for the dyscrasite to carry a higher percentage of mercury than the purer forms of silver.

I am indebted to Mr. James Denny and Mr. Joseph T. Mandy for making certain of the mercury determinations cited in this article.

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