

tain, but by degrees a material percentage of zinc-blende made its appearance. In most cases under my observation this transformation took place gradually, although there were numerous instances where the zinc-blende replaced the clean galena and vice versa. The result of the steadily increasing percentage of zinc was that the lead smelters found it necessary to place a penalty of 50 cents per unit on galena containing more than 10 per cent. of zinc. This penalty was accepted by the high-grade mines of Sardon which were in a position to ship a galena product averaging from 80 to 90 ounces in silver, and 45 to 50 per cent lead. As an instance I might quote that during 1900 the Payne mine shipped 10,411 tons of galena averaging 83.79 ounces in silver, 45 per cent. lead, and 15 per cent. zinc, and that the penalty paid on zinc alone during this year amounted \$28,203.42, being equal to a deduction of \$2.71 per ton of ore shipped.

Other mines had similar experiences and found that the zinc contents, in spite of close hand-sorting, could not be kept within the 10 per cent. limit, and that different means would have to be resorted to in order to keep the galena free from excess of zinc. To overcome this difficulty mechanical concentration by water was eventually applied. Several 100-ton mills generally driven by water power, and nearly all constructed on the same plan, were built in a comparatively short time. Hartz jigs with two, or sometimes three cells, were used in separating the coarse galena from the waste rock as well as the zinc-blende and iron, all of which went through the tail-races. For the finer lead products, buddles and Frue vanners were used. The system of concentration employed often left much to be desired as to efficiency, but the point of keeping the galena contents within the zinc penalty limit was gained. From the above it will readily be seen that one of the essential features of concentration in the Kootenays was to send as much zinc through the tail-races as possible, and it must be admitted that this aim was carried out to a high degree of perfection. The tonnage of zinc thus wasted was immense, and its extent will probably never be known; it can only be roughly estimated from assays of the tail products which would often exceed 30 per cent. zinc and rarely go below 20 per cent. A considerable amount of silver contained in the blende also went into the various creeks with the tailings, but so as not to get myself into hot water, I prefer not to quote any assays. In summing up the various losses, we have:—

1. Direct loss to the mines due to zinc penalty payments.
2. Loss of zinc values in smelting lead ores high in zinc.
3. Loss of zinc and silver values run to waste, through the tail races of the various concentrators.
4. Hand sorted zinc ores left on the dumps or in the old mine stopes.

Of the above-mentioned losses the fourth item is the only one that can partly be recovered providing the material is present in sufficient quantities to permit of economic handling and concentration. At the Payne, Ruth, Ivanhoe, Wakefield and Alamo concentrators, this is now being done successfully. Furthermore, the Slocan Star, Washington, Jackson, Monitor, Rambler, and several other well known properties are now preparing to alter their present plants or erect new ones whereby they will be able to recover the "zincy" material on hand, as well as all zinc that in the regular course of mining is broken down with the lead ores. In order to give an idea of results that have been obtained, I may state that during the first ten months' run (May 31, 1902, to March 30, 1903) the Payne concentrator handled 33,000 tons of old and 7,000 tons of new stope fillings, from which 1,247 tons of high grade silver-lead concentrates were derived and sold to local smelters. In addition thereto 1,391 tons of 42-43 per cent. zinc-blende concentrates, containing 8 ozs. in silver per ton, were produced as a by-product at no extra cost. A 1,000 ton lot was disposed of to the Lanyon Zinc Company of Iola, Kansas, and netted the Payne Company, after paying an \$11 freight rate, \$8 per ton. Encouraged by these results the company at once added a magnetic separating plant, whereby they have been able to, at a cost of from \$1.50 to \$2.00 per ton, improve the zinc product from 42 per cent. to 55 per cent.

In the case of silver-lead-zinc mines situated at altitudes ranging between 1,700 and 4,000 feet, we find that the ratio of silver in the galena is of much lower tenor, or, approximately, one half ounce of silver to one per cent. of lead, while in many instances, the lead content is low and the percentage of zinc high. In the Kootenays an ore of this class is termed "low grade," and it will readily be understood that on these the penalty on zinc worked a severe hardship. In addition, the price of silver continued to decline, and when the American Smelting and Refining Company, in January 1902, withdrew from the Canadian lead market and compelled the producer in Canada to sell his lead at much lower prices in the Continental market in competition with cheap Spanish and Mexican labour, the "low grade" mines were obliged to shut down. To some considerable extent this last feature has been overcome within the past eight months by the liberal bounty of \$15 per ton granted by the Dominion Government on all lead mined and smelted in Canada. The bonus has particularly proved of great benefit to the mines in a position to produce a heavy lead ore or lead concentrates, but in order to re-open the low grade lead-zinc mines it will first be necessary for the owners of the same to make a by-product of the zinc, which may be disposed of at once if of sufficiently high grade to stand present freight charges, or be stored until such time as zinc smelting works shall be erected in British Columbia.