GARDNER-MACKINAW MINES

Work has been continued at these mines during the year 1919. They went on an operating basis July 1st; the hoist has shown a gradual increase, until at the close of the year it was averaging nearly 12,000 tons per month. The product from the two properties for the year was as follows:

Gardner Ore, or Low Sulphur,	2,913 tons	
Gardner High Sulphur,	16,245 "	
TOTAL,		19,158 tons
Mackinaw Ore, or Low Sulphur,	28,560 "	
Mackinaw High Sulphur,	21,608 "	
TOTAL,		50,168 "
GRAND TOTAL,		69,326 "
Rock, Gardner-Mackinaw Mines,		25,607 "
GRAND TOTAL ORE AND ROCK,		94,933 "

In my Annual Report for the year 1918 I stated that after Sulphur was found in these ores, the general plan of operation at these properties was as follows: To develop the ore body as rapidly as possible on the 4th level, also to raise and develop the ore on its upward extension to the 3rd level; to repeat this operation again on the 3rd level, on the 2nd and also on the 1st level, in order that the entire ore body above the 4th level might be opened and definite information obtained as to the Sulphur content within the shortest possible time. This program was underway during the latter months of 1918 and has been carried on throughout the year 1919. The ore body has now been fully developed from the 4th to 2nd level, and developed for nearly its entire length on the 2nd. No information has as yet been obtained, however, of the Sulphur content of the ore above the 2nd level. This territory, however, will be entirely developed during the year 1920.

The following is a brief description of the method of mining followed at these properties. It is a modification of the shrinkage stope method. As first planned, raises ten feet square were put up in every third stope the entire distance between levels and at intervals of 28 feet on the incline drifts were driven on the footwall through the pillar over to the line of the next stope. The stopes on each side were then put up as raises for a distance of 28 feet and connections made to this drift, which provided

an outlet to the raise. Mining was then started in these stopes, all the ore being removed to the hanging. Other sections of the stope were then put up and connections made to the traveling raise every 28 feet; these operations being repeated until the stope had been finished. On completing the stopes on each side of the raise it was then possible to make a stope out of the raise. This system was later modified and all stopes were started as raises and put through to the next level before stoping was started. Under this system of mining the men all enter their own stope from the level above, and the stope being outlined by a raise it is possible to keep the pillars more uniform in size between the stopes. After stoping is once started it is continued without interruption until the stope is completed. About 33-1/3% of the oreb broken in stoping is drawn out to make room for the miners to work. It is planned to maintain this reserve of broken ore in the stopes during the winter, drawing off only sufficient ore to maintain a product of approximately 12,000 tons per month. The large reserve of broken ore will be available for hoisting when shipping starts in the Summer. At the close of the year it was estimated that there were in excess of 20,000 tons of ore in the stopes on these two properties.

Some Mackinaw ore was shipped in 1919, but there has been no shipments of Gardner ore. Railroad tracks have not yet been installed to the Gardner shaft. The rock obtained from sinking operations was used for filling around the shaft; there was not, however, sufficient of this rock to complete the fill. The C. & N. W. Ry. Company has made a number of surveys and estimates of the cost of the work remaining to be done, but this work has not yet been undertaken. They, however, put in a loading track to the stockpile late in the Summer, but there was no ore shipped from the Gardner property in 1919.

When the mine was opened in 1918, it was decided to try the shrinkage stope method of mining the ore on both the Gardner and Mackinaw properties. This method has been followed during the past year, and a large number of stopes opened between the 4th and 3rd and 3rd and 2nd levels. This method has proven successful and has practically done away with shoveling and the use of timber. The stopes are dry; water Leyners and other types of water

drills are used in drilling so that there is no dust, and from the labor standpoint this is considered a very desirable mine to work in. There is only one possible draw-back to the system of mining, and it is extremely doubtful whether the increased cost of the regular sub-level system of mining would off-set this disadvantage. Under the present system of mining it is not always possible to make two grades of ore, based on Sulphur content; this is due to the fact that the Sulphur does not exist in uniform quantities from foot to hanging. In certain stopes there may be a seam of ore running low in Sulphur which, under the present system of mining, is mixed with the High Sulphur Ore. In my opinion, however, it is extremely doubtful whether any sub level system would permit the recovery of this Low Sulphur Ore, except at a prohibitive cost. Certain areas of the ore body seem to grade low enough in Sulphur from foot to hanging to permit of the entire product from the stope to grade as Low Sulphur. Several such stopes were found between the 4th and 3rd level; unfortunately, the upward extension of these stopes between the 3rd and 2nd did not yield Low Sulphur Ore. During the last six months of the year there has been only a very small output of Low Sulphur Ore. It is impossible to make any predictions as to the grade of the ore due to the fact that all mining operations are being conducted in unknown territory. In other words, the stope is started and completed before any definite idea can be gained of the average Sulphur content of the ore in the stope. From diamond drilling and other indications there is reason to suppose that the ore above the 2nd level will run lower in Sulphur than was the case between the 3rd and 2nd level.

The most gratifying feature of the work of 1919 was the increased tonnage proven up on the property as compared with the probable tonnage of a year ago. The cost of production also, owing to the increase in the width of the ore body, will soon show a decided decrease. At the end of the year it was estimated that there were in excess of 20,000 tons of broken ore in the stopes. The stopes opened in 1918 above the 4th level showed the ore to be only ten feet thick between the foot and hanging. The stopes opened in 1919, however, between the 4th and 3rd, as well as between the 3rd and 2nd, have shown the ore to be from 30 to 60 feet in width between the foot and hanging.