

FRANCIS MINE:

The principal work of 1917 at the Francis Mine consisted in the development of the 4th and 5th levels, and in cutting the sump and pump house. In the latter part of January and the entire month of February all development work was temporarily stopped while the rumers in the skip and cage compartments were being over-hauled and repaired, and casing plank put in between the skip and cage compartments. At this time several of the steel sets, which had buckled due to swelling of the ground near the 3rd level, were taken out and four wooden sets installed in their place. Considerable ground was removed behind them, the opening being filled with lagging in the hope that no future trouble would develop at this point. Development work was resumed on March 1st, and continued on two 8-hour shifts throughout the balance of the year.

The product for 1917 was as follows:

Ore,	1,778 tons
Rock,	<u>19,642</u> "
Total Hoist Ore and Rock,	21,420 "

The greater part of the product was obtained from No. 1 cross-cut on the 5th level. The estimate of ore in sight, based on diamond drilling, which has been made for the Michigan State Tax Commission, was 102,200 tons. The figure used by the Tax Commission for the past several years has been 250,000 tons. The development work of 1917 has not been sufficient to permit of an estimate, based on the actual ore in sight, so that no attempt was made to change the previous estimates. The work in detail for the year is as follows:

Up to January 1st, 1917, the only work done on the 4th level had consisted in cutting in 10 feet on the East side and South Side of the shaft. During 1917 the plat was completed and the ground excavated for a loading pocket, and pocket installed. The main haulage drift has been extended to the south-east for a distance of 467 feet. This drift was driven in granite and

arkose for a distance of about 420 feet, at which point the contact of the decomposed slate was encountered. No. 1 cross-cut was turned off to the South at the contact and extended 85 feet. This cross-cut reached the contact of the slate and ore after advancing 58 feet, and up to December 31st had passed through 27 feet of high-grade ore. The average analyses of this ore was: Iron 60.50: .080 Phos. When the curve for No. 1 cross-cut was turned off, the main haulage drift was continued ahead a short distance, so that drifting could be resumed here later on.

FIFTH LEVEL:

On the 5th level the work of cutting a plat and installing pocket was completed early in the year, after which drifting to the ore body was started. The main haulage drift was extended to the south-east a distance of 680 feet from the shaft, and was then turned and driven due South 125 feet across the formation. It reached the contact of the arkose and slate at a point about 560 feet from the shaft. After cutting through 10 feet of decomposed gray slate it passed through 75 feet of graphitic slate and then into a decomposed ferruginous slate. It was then turned South across the formation, as it was expected that it would cut the extension of the ore passed through by No. 1 cross-cut 150 feet to the West. At the end of the year it had advanced as far to the South as No. 1 cross-cut, but no ore as yet has been found. Two raises have been cut out on the side of this drift and ore will soon be encountered above the level.

No. 1 cross-cut was started at a point 440 feet south-east of the shaft and driven due South for a distance of 300 feet. This cross-cut reached the contact of the arkose and decomposed slate after advancing 84 feet. It passed through 10 feet of this material, then through 25 feet of lean ore and jasper, and then 20 feet of decomposed slate and into ore. It then passed through 120 feet of good ore averaging about 58.50 Iron, with the phosphorus ranging from .030 to .600. It then passed through ten feet of slaty paint rock, beyond which about 20 feet of second-class ore was encountered. It was continued beyond the ore a distance of about 30 feet in decom-

posed slate and arkose. The formation in the North end of this cross-cut dipped to the South while the formation near the breast dipped to the North. Dips taken at several points between the two contacts varied from horizontal to half a circumference or  $180^{\circ}$ , while near the center of the deposit the foot wall was struck in the bottom of the drift. The ore body at this point was found in a trough, the width of which, from foot-wall to foot-wall, is approximately 175 feet, of which 140 feet is ore. It is evident that the pitch and dip of the ore body, as calculated from diamond drilling, does not hold true for this part of the 5th level. The formation on the upper levels, which is regular and dips about  $50^{\circ}$  to the South, has flattened out and rises again on the South side of the ore body. It was decided advisable to drill a hole across the formation from the breast of this cross-cut to find out if the roll in the foot, which produced the trough here, was merely local, in which case it was probable that ore might be again encountered on the other side of the roll, further to the South. If the cross-cut was actually in the bottom of the trough it would not be possible to strike the other side of the roll within a reasonable distance. This diamond drill hole was drilled horizontally across the formation for a distance of 322 feet, the first 226 feet being in arkose, then 34 feet in granite, beyond which there was eight feet of arkose and the hole was stopped in hard granite. The information obtained from this drill hole proved, beyond question, that the ore cut by No. 1 cross-cut is undoubtedly the bottom of the trough at this point. Two raises have been put up from No. 1 cross-cut in order to develop the ore. No. 1 raise, which is located about 15 feet South of the foot-wall was put up a height of 52 feet above the back of the level - 39 feet being in ore and 13 feet in slate. The contact of the ore and hanging slate was 54 feet above the floor of the main level. No. 2 raise is located 50 feet South of No. 1 raise, ~~cut~~ and was extended to a height of 45 feet above the back of the level, 22 feet being in ore and 20 feet in hanging slate. The contact of the ore and slate was 32 feet above the floor of the cross-cut.

SUBS ABOVE THE 5TH LEVEL:

In order to determine the size, dip and pitch of the ore body it was decided to open two sub-levels above No. 1 cross-cut. This would permit of the ore body being actually outlined with all its irregularities, which it was impossible to do on the main level. A sub was started from No. 1 raise, 41 feet above the floor of No. 1 cross-cut and drifts driven due East and West from the top of the raise. At the close of the year the West drift was in 26 feet and the East drift 12 feet. The material encountered so far in both drifts has been very low grade. The formation dips in the regular manner to the South at this point, but the enrichment of the ferruginous slate has not been complete. In an effort to encounter good ore, both drifts are being turned to the North towards the foot-wall, and when good ore is encountered it will be followed by both drifts.

A sub-level has been started 24 feet above the floor of the main 5th level from #2 raise. Two drifts were started; one to the East and one to the West, the same as in No. 1 raise. The total drifting on this sub-level, up to the close of the year, amounted to 40 feet. The greater part of the material developed thus far has been second-class ore. It also appears here that the enrichment of the ferruginous slate has not been complete, as small masses and pieces of altered slate are frequently found in the ore. The formation in this sub-level dips to the North. The results of the work thus far on the sub-levels has been rather discouraging. Both No. 1 and No. 2 raises continued in good ore all the way up to the slate, yet when drifts were started some distance below the slate very lean ore was found on both subs.

No. 2 diamond drill hole was drilled from the side of the main haulage drift at a point 265 feet South-east of the shaft. This was a horizontal hole, drilled to the South across the formation. The following materials were passed through: Arkose, 92 ft: slate 26 ft: arkose 43 ft: ferruginous slate 49 ft: second-class ore 10 ft: ore 10 ft: second-class ore 35 ft.



The hole was stopped in second-class ore at a depth of 265 feet, on account of caving ground. As good ore and second-class ore were encountered in this hole it shows unmistakable evidence of the ore formation extending this far to the West. It may, however, be the upper part of the ore body, or merely a local enrichment in the ferruginous slate. This will later be determined by drifting on the sub levels.

The last of the year the tail drift at the shaft was extended 105 feet West of the pocket.

PUMP HOUSE:

The pump house was excavated in the granite about 50 feet North-east of the shaft. It was planned to locate two pumps here, a large pole pump and a smaller centrifugal pump. The pump house is divided and supported by a granite pillar 12 feet thick. The ground here is firm, and it has been possible to cut the pump house without installing any supports. Concrete foundations for both pumps have been installed and a concrete floor laid over the bottom of the entire pump house. The pole pump has arrived at the mine and it will now be installed. As soon as this pump is in commission the centrifugal pump, which is now operating on the 3rd level, will be moved down to its permanent location.

SUMP:

At the close of 1916 a drift had been started from the cage compartment 12 feet below the main 5th level and extended 12 feet to the East. Work was resumed on this drift in March, 1917, it being turned slightly to the North to come under the line of the suction for the two pumps. It was extended 100 feet to the East, at which point it branched: one drift being driven to the south-east and connected on an incline to the 5th level; the other drift was driven to the North for 140 feet in hard granite. This latter drift was then stripped to a width of about 16 feet and a height of 10 feet, this drift forming the main part of the sump. To complete the sump it will be necessary to put in a concrete seal at the shaft; also several walls about 6 feet high to separate the settling basin from the suction; also to separate

the suction of the two pumps. At the bottom of the shaft a drift was driven to the North, which is used to clean up the dirt that spills from the loading pockets and skip. Near the breast of this drift it is planned to put up an incline raise, which will hole to the settling basin of the sump. This raise will later be used to draw off the mud which accumulates in the sump.

Barring unforeseen accidents, it is hoped to have the pumping plant at the Francis Mine completed and in operation by April 1st, 1918.

S U M M A R Y:

Development work only has been done during the past year at the Francis Mine. This work has not yielded results as rapidly as would have been the case if this mine had been developed on the old system of opening at the top of the ore body, near the sand, and mining downward. It has been necessary to develop levels at a depth where there was very little information available from diamond drilling, and where even the location of the drill holes are subject to considerable variation, due to deviation of the holes. The expense connected with the work of 1917 has been heavy, due to the high wages and to the large increased cost of supplies. The mine has not yet reached the point where it is possible to start mining. It must be borne in mind that the over-burden of sand at the Francis Mine is very deep and that all the ore mined here must be taken without breaking the hanging. This has rendered it advisable to find the bottom of the ore body and start mining at this point, working upward towards surface. At this time it is uncertain whether the 5th level is the bottom of the deposit. The indications thus far are that it is located near the bottom of the deposit, but it is possible that at some point not yet developed the ore may be found to go deeper. The width of the ore developed in No. 1 cross-cut is due to the flattening of the deposit, and does not indicate that the ore body is any thicker than was indicated by the diamond drilling. If ore has been found in No. 2 cross-cut it would have indicated a large horizontal area at the

bottom of the trough, but ore has not yet been encountered here, which tends to the opinion that the horizontal extent of the ore on the 5th level is not very large. The physical character of the ore bears out the conclusions reached from a study of the diamond drill cores. The ore is evidently an enrichment of the ferruginous slate, and as such is very soft and plastic in character. It resembles the plastic ores of the Stephenson and Princeton Mines. The general phosphorus content varies from .030 to .600, indicating that the product from this territory will probably run from .200 to .300 in phosphorus.

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FRANCIS SURFACE:

Considerable surface work has been done during the past year at the Francis, and the mine is now practically equipped, ready for operation, as far as the surface plant is concerned. A small amount of additional work remains to be done in dividing up the old boiler house into a boiler room and storage room for supplies, as well as an oil house.

During the year an addition was made on the North end of the shop building to make the building large enough to accommodate the Machine, as well as the Carpenter and Blacksmith Shops.

Concrete piers and timber supports were put in for a water tank which has been set up on a platform, 25 feet above the ground. This tank will provide water pressure sufficient to supply the heating plant and dry, the water for it being obtained from well points driven into the sand near the engine house.

The old concrete foundations for the permanent hoist were blasted out early in the year and the foundations installed for the two new permanent hoists. The cage hoist was installed and went in operation on July 22nd. One skip was put on with the cage, and they have been operated in balance. The cage hoist was received late in the summer, and it has been set up on the foundations; the motor, however, has not yet arrived at the mine.

A steel pulley stand has been received and erected between the engine house and shaft house.

The permanent trestle leading to the stocking ground was completed during the year; there were 22 bents erected on this trestle, and seven temporary bents for stocking ore. A small stockpile collar has been laid sufficient to hold a few thousand tons of ore. Owing to the shortage of labor throughout the summer it was not possible to do much grading of stockpile grounds. The stocking grounds are located about 600 feet from the shaft. This was made necessary through complications in ownership of the land adjacent



to the shaft, which made it advisable to stock the ore on a piece of land which was owned entirely by The Cleveland-Cliffs Iron Company. To do this it was necessary to have a very long trestle leading to the stockpile grounds. This fact, together with the high cost of labor and supplies, has materially increased the cost of the trestles for the Francis Mine over the general cost at other mines. A permanent rock trestle was also erected on the North side of the shaft. There were seven permanent bents and seven stocking bents erected for this rock trestle.

The top tram system has been laid out so that one top tram car will carry both the ore and rock. Concrete piers have been placed under the legs of the permanent ore and rock trestles, this work being about 60% completed by the end of the year.

A top tram shanty was erected on the landing floor, near the shaft, this building being of wooden frame with concrete plastered walls and concrete floor, in order to make it fire proof. An endless-rope top tram plant of the latest design has been installed, and has been in operation during the last two months of the year.

The work of grading for the pocket and stockpile tracks was started by the C. & N. W. Railway company late in the year. This work has not yet been completed, but has advanced to a point which will permit of its being completed by the time of the opening of the shipping season in 1918.

FRANCIS MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR - 1917.

<u>GRADE</u>	<u>IRON</u>	<u>PHOS.</u>
Francis,	57.77	.203

ORE STATEMENT - DECEMBER 31ST, 1917.

FRANCIS NO. 2

Output for Year,	1,778
Shipments,	0
Balance on Hand,	<u>1,778</u>

Ore encountered in sinking shaft during 1917.

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