ATHENS MINE - 1918.

The production for the year was 37,588 tons, distributed as follows:

- Bunker Hill, 2,457 tons
- Athens, 35,111 "

The Athens product is distributed between the different interests as follows:

- Corbit Lease, 1,899 tons
- Mitchell Lease, 5,507 "
- Athens, 27,705 "

This represents the product mined during the development of the main levels.

UNDERGROUND.

The mine worked throughout the year on two 8 hour shifts. The cross cuts on the 8th and 10th levels started in 1917 were pushed to the Southwest as rapidly as possible toward the Bunker Hill line. Ore was struck on the 8th level April 1st and on the 10th and 4th levels June 15th and on the 9th level in July. It was of excellent quality but where encountered on the 8th and 10th levels, lying along the dike which was running nearly parallel to the drift, it slabbed off in large chunks making the progress in drifting extremely slow. In fact, the ore so far developed at this mine seems to be less granular and of softer texture, than that at the Negaunee and Muns. Most of the drifts have required forespoling and have shown so much weight that lining sets have had to be used. On the 8th level there was considerable swelling of the bottom of the drift so that this had to be taken up twice in order to keep the track down to grade. In new deposits it is natural to expect more or less water during the initial development, but a great many places in the Athens water under pressure has been encountered in the ore body. This has retarded the development somewhat.

The sections made from the drill holes indicated that the bottom of the deposit on the Athens to be about 2400 feet. The levels were planned with
this in mind and no ore was expected on the bottom level, the 10th, which was placed at 2400 feet below the collar of the shaft. However, ore was cut here at a distance of 420' East of the Bunker Hill line. A diamond drill, at this line showing 60 feet of ore below the level, while the development on the 8th level indicates that the hanging cuts off the ore at the Bunker Hill line at the 2200' elevation. The foot wall is composed of decomposed ferruginous slate more or less folded, while numerous small dikes cross the formation. The deposit on the North side of the lower levels is cut off by a diorite dike which is running nearly East and West and is standing almost vertical.

The 4th level was opened to test the formation to the East and on the Corbit Lease where it was afraid high sulphur ore would be encountered. The development of this Lease is now under way by high raises. No high sulphur ore has yet been found.

It was expected that the mine would go on an operating basis early in the Spring, but as soon as the ore was struck it was seen that the deposit was not shaped as the drilling sections showed. This necessitated considerable development before mining could start, which work was continued throughout the year and the mine will go on an operating basis January 1st, 1919.

FOURTH LEVEL.

The development here started from the shaft in March. The main cross cut being driven in a Southeasterly direction. Slate and quartzite, and diorite and slate were successfully passed through and the ore cut at 563 feet on June 15th. The formation dipped from 45 to 55° to the Northwest; it was crossed for 375 feet where lean ore was encountered. After driving a few feet in this material work here was abandoned. Later a diamond drill was placed in this drift and a horizontal hole drilled South for 260 feet. Iron formation was crossed most of this distance, but no merchantable ore was found. The hole bottomed in slate. Near the center of the ore on this main cross cut a drift was driven to the East to the Corbit Lease. This was extended to within 100 feet to the Lucky Star line in ore and then turned North and proceeded in that direction until the foot wall was reached. It was expected in driving to the East
foot wall would be cut and that the development raises planned in the Corbit would have to push up through this rock to the ore above. However, the ore on the Corbit Lease at the 4th level elevation is of excellent quality and we have no means of telling how far it extends below this level; probably not a great distance. The drifting in the ore formation here has been slow and practically all of the ground has had to be forepoled and even with this precaution small runs have occurred which have been impossible to avoid. The breast contained a considerable quantity of water and at a point about 125 feet East of the Corbit lot, the flow was so great that it was considerably more than the pumps could handle, however this has gradually drained off.

In November, a drift was started South through the center of lot 12 to determine the position of the foot; a small dike was encountered which ran practically with the drift so that development here was stopped to be taken up later.

CORBIT LEASE.

The development of the Corbit Lease, lot 13, is to be conducted through raises #410 and #412; these raises are being extended from the 4th level to the West and Southeast respectively at an angle of 65°. On December 31st, #410 had reached an elevation of 78 feet and #412 82 feet. The formation here has been dipping to the Northwest and North.

Sulphur content to date in raises #410 and #412 is:-

| Raise #410 | 15' to 78' | .030 |
| Raise #412 | 12' to 82' | .031 |

EIGHTH LEVEL.

On December 31st, 1917, the main cross cut from the shaft had been extended to the Southwest a distance of 426 feet. The material in the breast was diorite. The drift was continued in this direction and the ore was encountered April 1st at a distance of 1096 feet from the shaft. This ore was on the South side of a soft dike about 20 feet in thickness which was running in a East and West direction crossing the drift at such a slight angle that it gave us considerable trouble even before the ore was cut. The drift was extremely hard to hold requiring close timbering. The bottom as I have mentioned
above had to be taken up twice before we could keep it down to grade. This made drifting extremely slow. The drift was continued on the same Southwest course and after passing through 590 feet of ore went into the slate foot wall and was extended 270 feet in this material. The slate being very much altered and having much the appearance of a dike. Sticles even failing to determine definitely whether it was slate or dike material.

Five cross cuts were driven to the Northwest and two to the Southeast from this main level.

The first crosscut cut to the Northwest was 250 feet from where the ore was first encountered on the level. It was extended Northwesterly about 60 feet when the North dike was met. Here drifting was stopped. From the breast of this drift two holes were drilled by a diamond drill. These were #1 to the Northwest and #2 to the Northeast.

No. 1 passed through dike and diorite for a distance of 230' and then went into iron formation of soft ore jasper which from the character of the core looked like the hanging wall jasper. At 243' a water course was encountered. This water was under pressure so that drilling had to stop. A guage placed on the end of the casing pipe registered a pressure of 625 lbs. which showed that the origin of the water was within 750 feet of surface.

Hole #2 passed through dike, diorite, and dike for a distance of 234', when lean ore was encountered. This was crossed for a distance of 82 feet and the hole was stopped at 316 feet still in lean ore. Pressure was encountered here in the shape of mud so that the hole could not be continued. The drill rods were bent almost double due to the pressure from the end. It is possible that the ore would have been found if this hole could have been finished.

The second cross cut to the North was 180 feet beyond the first. This extended through the ore for 220' until it was cut off by the North dike.

The third cross cut 110 feet beyond the second also was extended to the Northwest until the North dike was encountered. Here, however, two bunches of jasper were crossed, the first 40 feet in width and the second about 15 feet. At 100 feet back of the breast in this cross cut a water course was met making
drifting extremely difficult.

The fourth cross cut was started in the slate and ran into the ore formation about 80 feet from the main drift. By the first of the year it had been extended 130 feet in ore.

The fifth cross cut was started in the slate foot wall and after being driven 120 feet from the main crosscut was stopped in slate. From subsequent developments it looks as though the hanging cut off the ore at this elevation very close to the Bunker Hill line.

The first cross cut to the Southeast was at a point about 200 feet from where the ore was first encountered on the 8th level. To date the breast is about 40 feet to the Southeast of the main drift in ore.

The second cross cut to the Southeast is about 440 feet from where ore was first encountered on the level. It is nearly opposite the second cross cut to the Northwest. Here ore was crossed for 100 feet and then slate foot wall very much decomposed which extended 110 feet, when 25 feet of ore was again crossed, beyond which the drift was extended 50 feet in slate foot wall.

Numerous dikes were encountered in the development of this level particularly near the South foot wall. Testing the formation above this level by means of raises was delayed until late in the year on account of pumping facilities, as early in the summer the 100-gallon pump was running to capacity. As soon as the 500-gallon pump was installed the development above the level was pushed.

Three raises were placed in the second drift to the Northwest. These were numbered, #821, #822, and #823, respectively. They are all being driven to the Southwest at an angle of 65° from the horizontal and placed at 60 foot centers. On the first of the year these raises were 124 feet, 120 feet and 106 feet, respectively, above the rail of the drift, but still in ore. In the 4th cross cut, #861 raise has been started in the slate foot wall near the ore. On January 1st, this was 62 feet above the level still in slate, the dip being nearly parallel to the direction of the raise.

NINTH LEVEL.

Drifting was started at this elevation at the top of #2 raise opposite
the shaft in February. The two raises were holed and the main cross cut to the ore body was extended in a Southeasterly direction for about 100 feet and then turned to the Southwest. In March a two compartment raise was started from the South side of the main tenth level drift and projected through to the ninth level. In May two contracts were placed at the top of this raise at the ninth level elevation. One drifting to the Northeast, the other to the Southwest. The drift to the Northeast met the drift being driven from the shaft about the middle of July. This improved the ventilation greatly and better progress was made in the drift to the Southwest from the two compartment raise. This drift was turned due South in order to cut the formation at right angles and to avoid if possible paralleling the dike which has been encountered on the 8th level above and the 10th level below. Ore was cut in July which at first was rather lean but it improved as the drift advanced. After crossing the formation for a distance of 80 feet, slate or dike was encountered. Work to the South was abandoned after drifting about 40 feet in this material and a drift to the Southwest was started in the ore formation; this was extended roughly 350 feet through mixed ore and dike formation and then turned due West. On the first of the year the breast was 1,675 feet from the shaft. Developments show that the formation throughout was badly cut with dikes and evidently considerable folding in the slate foot wall. A cross cut to the Northwest was started at a point about 250 feet to the Southwest of where the ore was first encountered. This struck the North dike about 105 feet from the main foot wall drift, here it was stopped. The main drift to the West will be continued until the Bunker Hill line is reached; this should be about February 1st.

In order to improve the ventilation a raise was started in the cross cut to the North in November. This will be pushed through to the 8th level elevation and holed to the second Northwest cross cut on the 8th. On the 31st of December this raise had reached a height of 110 feet on the incline. No further development will be done on this level until the cross cuts have been completed on the 8th level and the hanging definitely determined.

In March a small drift was started from the South dumping raise opposite
the shaft and driven to the Northeast. This holed to the shaft early in May, from this point a drift was started to the Southwest and early in July holed to the main cross cut driven to the Southwest from the two dumping raises. This completed the main cross cut through to the cage compartment at the shaft. In May a raise from the 10th level pump room holed through to the elevation of the 9th level and was connected to this level by a stub drift at a point about ten feet Southwest of the shaft ladder compartment. At 52 feet below the 9th level between the shaft dumping raises, a small man way raise was started. From the bottom of this raise small drifts connected with the two ore chutes. This raise will be used in cleaning down the raises in case the ore hangs up, which is likely to occur in ore of this character.

TENTH LEVEL.

On the beginning of the year the main cross cut from the shaft toward the ore body had advanced 450 feet. This cross cut was continued in a South-westerly direction and ore was encountered at 1424 feet from the shaft on June 15th; 170 feet beyond this point the drift was turned slightly to the right and extended through to the Bunker Hill line; the drift being in ore the entire distance. At a point 25 feet beyond the Bunker Hill line curves were made to the North and South and drifts extended due North and South. In the North drift the diorite dike was cut at 80 feet inside of the curve. The drift to the South cut through the dike then through a small seam of ore and the balance of the drifting, which was 80 feet beyond the end of the curve, was wholly in decomposed ferruginous slate. This was very highly stained with iron so to test the formation a drill was placed at the breast and a horizontal hole drilled due South a distance of 193 feet to the Breitung Hematite Mining Company's line, the formation the entire distance was ferruginous slate. The drift to the North cut the main dike on the 3400 foot coordinate slightly North of where this dike was cut by the main shaft cross cut. It was determined to test the depth of the formation on the Bunker Hill from the North drift. A drill was set up 40 feet from the North dike and a vertical hole drilled. This continued in ore 67 feet and then passed in to dike. At the end of the year this hole was 161 feet deep still
in dike. The dike is very much decomposed and is very similar to the dike to
the North. It was necessary to keep the casing down to within a few feet of
the bit as the material caved continually if not supported by the casing; If
possible this hole will be continued until the bottom of the formation is defin-
itely established. From this same position a hole will be drilled to the East
at an angle of 45° and one to the South at an angle of 45°. These should give
us the absolute location of the bottom of the trough at this point.

A cross cut to the South was started near the East line of Lot 2
300 feet East of the Bunker Hill line. Forty feet from the main drift foot
material was encountered; here as on the 6th level and on the Bunker Hill, the
material was very much decomposed and it is almost impossible to determine the
slate from dike. After drifting 60 feet this drift was stopped.

The raise near the center of Lot 5 started in February holed through
to the 9th level in April. This was a two compartment raise comprising a man
way and a rock or ore chute and intended to help the development of the 9th
level.

BUNKER HILL.

The 10th level drift on the Athens was driven onto the Bunker Hill
property with the idea of mining a triangular segment of ore on the Bunker Hill
side of the line just to the West of the boundary. It was expected that the 10th
level would be at the bottom of the ore formation on the Athens and the segment
of ore to be mined would be wholly above this level; however, when it was found
that the ore extended below the 10th level, it was decided that no mining would
be done on the Bunker Hill property for the time being. The only work to date
here has been the cross cutting of the formation to the North and South at a
point about 80 feet West of the Athens line and testing the depth of the form-
ation by a diamond drill, the ore being found to extend a distance of 67 feet
below the level at a point about 20 feet South of the dike.

UNDERGROUND IN GENERAL

The development of the mine was pushed during the year as rapidly as
possible not only on the four levels but in the pump house on the 10th level as well. Ore was struck somewhat earlier on the 8th and 10th levels than was anticipated, but it was of such character that instead of being able to speed up the drifting as we had hoped when ore was struck, they headway was retarded. The ore/dike immediately to the North of the ore was very much decomposed, the ore/dike material slabbing off in large chunks. Throughout most of the ore drifting forepoling was used and in most of the main level drifts lining sets have been installed.

The drill hole to the North from the 8th level encountering water pressure also warned us against too much development before adequate pumping facilities were had. These were delayed on account of our not receiving the special pipe fittings. The pump room was in readiness for the pump early in the year. From September 1st until November 1st we were in constant fear that a little extra water would be encountered when we already had more than we could handle with our pumps. During part of October water was hoisted daily by means of the skips and the main sumps were filled. Light bulkheads of concrete were placed on the 4th, 8th and 10th levels near the shaft where water could be impounded to a height of five or six feet in the main cross cuts where necessary. With the 500-gallon pump working satisfactorily the development above the 8th level as well as above the 4th can be carried on without any particular danger of the mine flooding.

The regular development was also hampered greatly by finding the deposits shaped very differently than expected from the cross sections, it being considerably narrower and deeper than was shown by the sections. To the North of the dike there is an ore formation on the Athens which should be developed at some future time. This was proved by the drilling from the 8th level. A deposit of merchantable ore there of considerable size may be developed. For the present, however, the development will be confined to the Area South of this large dike and lying between it and the slate foot wall to the South.

SULPHUR.

The Lucky Star property adjoins the Athens on the East. The ore here
contains a high percentage of sulphur making it practically unmerchantable. There were misgivings that sulphur might be encountered in the Athens ore body so sulphur analyses have been made weekly and the results watched closely. To date the development has shown the following sulphur content on the different leases:

Athens, 4th, 8th, 9th, and 10th levels, .027
Corbit Lease, 4th level and above, .027
Mitchell Lease, 4th level, .027
Bunker Hill, .029

SHAFT.

The principal work in the shaft during the year was the installing of the counterweight and dump discharge columns. Most of the counterweight pipe was placed in the shaft in December, 1917, the balance, 230 feet, in January. The counterweight was installed during January. In June a concrete support for the water column was placed in the ladder compartment of the shaft below the 10th level. This was heavily reinforced as the weight of the water column is tremendous. In September as soon as the long turn elbow for the discharge was received it was placed on this concrete support and the installation of the water column started. This is 10" in diameter and was built to withstand a pressure of more than 1000 pounds per square inch, as the water is pumped from the 2400' level direct to surface. The flanges on this column from the bottom of the shaft to within 600 feet of surface are of cast steel. Those in the upper section of the shaft are cast iron. The thickness of the wall of the pipe varied from 3/4" for the bottom sections to 1/4" at the top of the shaft. Great care had to be taken in this installation to avoid the possibility of any gaskets blowing out when pumping started.

The only work still to be done to complete the shaft is the wire divisions between the cage and pipe and ladder compartments.

PUMP INSTALLATION.

Early in the year the pump house was completed. This consisted of two rooms, North and South. The North room was made 24' x 40' or large enough
for the installation of one pump and also provide room for the switch board and rotary converter for the underground haulage. The South room was somewhat smaller but large enough for a second pump of the same capacity as the one in the North pump room. The sump lies directly between the two pump rooms and extends to the East a distance of 160 feet. It has a capacity of 230,000 gallons. A clean cut raise from the drift 40 feet below the 10th level was extended through to the sump and holed opposite the two pump rooms. Another raise was also extended from this drift to the settling sump which is not connected in any way with the main sump. The bottom of these raises were concreted and provided with large pipes and valves through which the mud can be drawn. The drift below is at the same elevation as the top of the skips when spotted for the 10th level. This permits the loading of the material from the settling sumps into the skips without rebositing. When water was hoisted during the month of October the skips were filled with pipes which tapped the bottom of the clean cut raises leading to the sumps. By this scheme we were able to hoist our water without using the bailers; each skip having about two-thirds the capacity of a bailer.

The foundation for the North pump room was concreted in April and the pump installed in June. Nothing further could be done until the long turn elbow was received for the bottom of the water column. This arrived in September and immediately the water column was carried through to the collar of the shaft. The second delay then occurred as the gate valves, shock absorber, and other special pipe fittings were not received until October. They were installed the latter part of the month and the pump started operating November 1st. It worked perfectly until December 12th when the cast steel cross head on the West side of the pump broke. At the request of the manufacturers it was immediately sent back to Menominee and a new one is being made. The pump was idle for two days, but it is now being operated on one side to keep the mine from drowning out. It has worked satisfactorily this way to date, but now a new trouble has developed. A crack has appeared in the North water end on the East side of the pump. This leaks considerably and is gradually growing worse. A representative of the man-
Manufacturer has inspected the pump and has ordered a new water end to replace this defective section.

The pump house is located just to the East of the shaft. It is cut off from the main 10th level by means of a reinforced concrete bulkhead which is covered by a 7' boiler head door, this latter being built to stand a pressure of 200 pounds per square inch. A man hole in the center of the boiler head provides the pumpman a means of getting in and out of the pump house. A raise from the pump room to the 9th level plat has also been provided, this holed through to the 9th level in March.

The pump installed in this station is of a horizontal, plunger type, driven by a 400 horsepower motor. It was built by the Fred M. Prescott Co. of Menominee, Michigan, and has a capacity of 500 gallons per minute.

**ELECTRIC HAULAGE.**

The motor generator set was received and installed in the pump room on the 10th level in April. Previous to this time trolley wires had been strung on the 8th and 10th levels and electric haulage started in April on these two levels immediately on completion of the motor generator installation. Electric haulage started on the 4th level in August and on the 9th in October. The rotary converter has worked perfectly to date; it takes up very little room but provides current only for the underground haulage.

**CONCRETE BULKHEADS.**

As mentioned elsewhere in my report concrete bulkheads about one foot in thickness were built on the 4th and 6th levels in July and on the 10th level later in the year. These were placed within 200 feet of the shaft, the idea being to use the main drifts as temporary sumps in case of an emergency - such as a break down in our pumping equipment, no current, or an unexpected flow of water which the pumps would not be able to handle. The bulkhead on the 10th level has been used to impound water since December 12th on which date the cross head broke. This has necessarily stopped operations on this level for the time being until pumping facilities are again adequate to handle the normal flow of water.
WATER PUMPED.

The water pumped during the year varied greatly. During the early part the 100 gallon pump on the 2400' level was able to take care of the coming water. This pump delivered the water from the 2400' level to the little pump station at the bottom of the circular shaft at 1080 feet from surface. Here a pump of the same capacity discharged the water to surface. Several times throughout the year water was encountered in various developments; the first was that of the diamond drill hole from the 8th level. Here the stream filled the drill hole supplying about 100 gallons of water per minute. This was shut off by means of a valve and immediately showed a pressure of 625 lbs. per square inch. During the latter part of the year after the 500-gallon pump was installed this drill hole was opened to drain the water back of the dike.

On the 4th level development to the East toward the Corbit, a water course was encountered which carried a large volume of water. This has gradually drained until now very little is coming from this section of the mine. The drill hole on the 4th level to the South also cut a water course which gave about a 2" pipe half full. An effort was made to block this hole but the formation was broken so badly that when the hole was blocked the water broke out through the end of the drift. On the 8th level a water course was encountered in the third cross cut to the Northwest. Here a stream containing about 100 gallons per minute made drifting almost impossible. This same course was later cut by the fourth cross cut. Water is still coming from this place, however, it seems to be diminishing slightly. At the end of the year it was estimated the mine was making between 250 and 300 gallons of water per minute.

EXPLORATORY.

Five holes were drilled in the Athens mine during 1918; two horizontal holes to the North on the 8th level, one horizontal, and one vertical hole on the Bunker Hill from the 10th level and one horizontal hole to the South on the 4th level. The location of these holes and details of the drilling are as follows:
Hole #1 Athens, 6th level, coordinates S3424.33; W1342; dip 0°; direction North 36°40' West; elevation -784.45. The material diorite dike. This hole was started on June 21st, and bottomed on July 18th at a depth of 243 feet. Water under pressure here 625 lbs.

Hole #2, Athens, 8th level, coordinates S3421.52; W1336.12; dip 0°; direction North 17°21' East; elevation -784.69. The material was diorite and soft ore jasper. This hole was started on July 23rd, and bottomed on August 5th at 316 feet. Had to stop account of pressure against bit.

Hole #3, Athens, 4th level, coordinates S3495.96; W141.23; dip 2°; direction South 19°04' West; elevation 390.68. The material was paintrock, soft ore jasper, and slate and graywacke. This hole was started on November 23rd, and bottomed on December 7th at 260 feet.

Hole #1, Bunker Hill, 10th level, coordinates S3668.78; W1947.90; dip 0°; direction South 10°30' West; elevation -990.90; The material slate and graywacke. This hole was started on November 2nd, and bottomed on November 12th at 193 feet.

Hole #2, Bunker Hill, 10th level, coordinates S3432.93; W1941.82; dip 90°; elevation -993.37. The material for the first 65 feet averaged 64.15 in iron and from there on it was dike. This hole was started on November 15th and on December 31st was 161 feet deep.

SURFACE

As early as the frost was out of the ground in the spring grading around the shaft was started; the concrete mixer was first removed and the hole opposite the West side of the shaft filled with rock. At the same time the grading was started around the office and mine buildings for the lawn and roads, a fence was built to keep out the cattle and cow guards installed at the railroad tracks. A road was built from Ann Street to the engine house and a path constructed from the engine house to the office yard. The whole work was under the direction of Mr. Manning and the appearance of the surface was greatly improved.
STOCK PILE LEASE.

The only ground available for stocking purposes at the Athens is to the East and Southeast of the shaft. However, in both of these directions in order to provide sufficient room for stocking, it was necessary to secure more ground. During the latter part of the year an arrangement was made with the Lucky Star Mining Company so that a portion of their ground was leased by the Athens to give us sufficient stocking room for the time being. This lease covers a term of 25 years and is described as follows:

"Beginning at the Northwest corner of the Lucky Star property, which point is Two Hundred Eighty-Five and Ninety-One One Hundredths (285.91) ft. east of the west quarter post of Section five (5), measured along the east and west quarter line of said section; thence south Eighty-nine degrees Forty-three minutes (89°43') east Four Hundred Eighty-seven (487) ft. along the north line of the Lucky Star property; thence south no degrees Seventeen minutes (0°17') west Two Hundred Thirty ft. (230), thence north Eighty-nine degree Forty-three minutes (89°43') west Two Hundred Eighty-seven (287) ft., thence South One degree Three minutes (1°3') west Five Hundred Eighty-five (585) ft., thence north Eighty-eight degrees Fifty-seven minutes (88°57') west Two Hundred (200) ft. to a point on the west boundary line of the Lucky Star property; thence north along said west boundary line north One degree Three minutes (1°3') east Eight Hundred Fifteen (815) ft. to the point of beginning, containing Five and one-fourth acres (5 1/4) more or less, all in Section five (5), Township forty-seven (47) North, Range twenty-six (26) west; subject, however, to the railroad right of way of the Lake Superior and Ishpeming Railway Company now existing across said premises."

STOCKING GROUND AND ONE TRESTLES.

Stock pile ground to the Southeast of the shaft in the direction of the Lucky Star tail track was graded a sufficient distance to permit twenty-eight bents to be erected. In this direction the trestle extends from the steel permanent trestle 594 feet and provides sufficient room to stock 71,500 tons of ore.

ROCK TRESTLE.

The rock trestle was extended to the South a distance of 252 feet during the year, making a total length of 748 feet.

TIMBER YARD.

To the West of the Shop Building grading of the timber yard was started in the fall and early winter of 1917. This was continued in the spring of 1918.
and new provides room for docking stall timber received at the mine.

TIMBER TUNNEL.

The timber tunnel was started in 1917, but had to be discontinued on account of the winter weather. In all 600 feet have been constructed West of the road which crosses to the Change House and from the East side of this road back to the concrete tunnel 210 feet have been built. At this latter section the tunnel is made two tracks wide to permit storing empty trucks on a switch.

TRANSFER HOUSE.

At the transfer house the South engine was set up and started operating in February. This engine is of the same type as that used at the Maas having a single grooved 3' sheave lined with rubber which is operated by a motor. It operates the West ore car and the rock car. The North engine which operates the East ore car was put in commission later in the season. The transfer house is made of cement plaster over Hy-ril. It was built in the fall of 1917 too late in the season to plaster. It was covered during the winter with composition roofing, and plastered in June of this year. This makes a construction which is comparatively cheap, but which is practically fire proof.

HEADFRAME.

In September the headframe was enclosed from the landing platform to the top of the dumps. Ship lap covered with roofing being used for this construction. During the coming season we hope to spray this with the cement gun to make it as fire proof as possible. By covering the headframe in this manner it prevents the dumps from freezing and facilitates hoisting. The Negaunee headframe was covered in a similar manner last winter.

STORAGE YARD.

To the East of the rock trestle a storage yard was built enclosed by a ten foot board fence. Here are placed used materials that collect around a mine such as shaft sets, buckets, ropes, etc., which are unsightly, but which may be needed for future use.

DRAINAGE DITCH.

With the installation of the new pump a 12" pipe was placed under the
loading tracks South of the headframe and a launder provided to carry the water around the rock trestle to the West side. Here it discharges into a ditch and gradually works its way down to the South end of the property. This ditch is cutting out badly near the end of the launder and in order to provide against the possibility of its undermining the rock trestle, a spiral riveted pipe will be installed during the coming spring.

CEMENTING DIAMOND DRILL HOLES.

Stand pipes left from the surface drilling were pulled after first cementing the tops of the holes at the ledge. Holes E, F, I, K, 4, 5, 7, 10, 11, 12 and D were cemented.
The total estimate in the Superintendent's Division on E. & A. #261 - Operating and Equipping Athens Mine - as shown by the Opening Statement is $606,100.67.

To this should be added the Estimate of July 5th, 1916 to sink the shaft to 2490 feet $55,390.00

Estimate of opening 1800' level to explore Corbit Lease 24,100.00

Total Superintendent's Division $685,590.67

Total expenditures Superintendent's Division to December 31st, 1917 $960,093.32

Less credit for sale of ore 1917 150,396.29

Total net expenditures $809,697.03

Estimate 685,590.67

Balance over expenditures December 31st, 1918 $124,106.36

Over expenditures are found in practically every item under the Superintendent's Division with the exception of Sinking in Sand and Sinking in Rock. These are almost wholly explained by the great increase in labor and supplies due to war conditions of the past few years, the last two particularly and by deferring the time when the mine was put on an Operating basis to January 1st, 1919. Most of the shaft sinking was completed before the high costs from labor and supplies came into effect, which explains how this item came within the estimate figures.

The mine operated on two 8-hour shifts. Ore was encountered at about the time estimated. It was expected the mine would start operating March 15th, 1918. Ore was struck April 1st. The deposit was not shaped as anticipated, the balance of the year was spent in development. The product of 37,568 tons from this work was credited $150,396.29 on the Opening Statement - no credits appearing opposite the individual items that made up the deficit in the estimate. The explanation of expenditure under the different items follow:-

Account No. 1. GENERAL EXPENSE.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate</td>
<td>$87,487.00</td>
</tr>
<tr>
<td>Expended</td>
<td>$158,185.00</td>
</tr>
<tr>
<td></td>
<td>to Dec. 31, 1918</td>
</tr>
<tr>
<td>overrun</td>
<td>$70,688.00</td>
</tr>
</tbody>
</table>

ATHENS MINE
The mine was expected to start operating October 1917, later it was deferred to March 1918, on account of extra sinking. The mine started operating January 1st, 1919.

Overrun includes $21,600 Administration, and $16,437 Central Office on which there were no estimates. Taxes overrun $22,038 and Personal Injury $4,341. The latter due to compensation law going in effect after estimate was made. This includes payment for one fatal accident. During the last three years there have been large increases in labor charges.

ACCOUNT NO. 2. MAINTENANCE.

| Estimate   | $8,499.00 |
| Expended   | 17,435.57 to Dec. 31, 1918. |
|            | $8,936.57 overrun |

This overrun expenditure includes $4,675.18 in surface improvement on which there was no estimate. The other large charges to this account are Hoisting Machinery #2E $4,146.31 and Pumps #2G of $6,243.18. These two items alone, amount to $1,890.00, more than the whole estimate. The overrun in hoisting machinery and pumps was due to regular charges over which we had no control.

ACCOUNT NO. 3 SINKING IN SAND.

| Estimate   | $6,185.00 |
| Expended   | 4,291.48 |
| Balance    | $1,893.52 |

The sinking in sand was less expensive than estimated.

ACCOUNT NO. 4 - SINKING IN ROCK.

| Estimate - Opening Statement | $216,017.00 |
| To which should be added supplementary Estimate of sinking 430 feet to 2490 ft. | 46,870.00 |
| Total Estimate               | $262,887.00 |
| Amount expended              | 251,376.79 |
| Unexpended Balance           | $11,510.21 |
| Distance sunk in rock 2436.5 feet. Cost per foot $103.17 |
Estimated cost per foot:

1033.5 Circular shaft $109.00 per ft.
976.0 Rectangular 105.00 "
430.0 " 109.00 "
2439.5 feet $107.76 per ft.

This shows the shaft was sunk for $4.23 per foot less than the estimated price.

The annual report for 1917 went into all the details of shaft sinking including concreting.

ITEM NO. 5. - DRIFTING.

The estimate for Drifting amounts to $99,900, covering 8,410 feet made up as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Feet</th>
<th>Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Estimate</td>
<td>5,500</td>
<td>$12.00</td>
<td>$66,000.00</td>
</tr>
<tr>
<td>Hegeman-Athens Drift</td>
<td>1,020</td>
<td>11.00</td>
<td>11,220.00</td>
</tr>
<tr>
<td>Extra drifting on account of sinking to 2490 feet</td>
<td>710</td>
<td>12.00</td>
<td>8,520.00</td>
</tr>
<tr>
<td>4th level</td>
<td>1,180</td>
<td>12.00</td>
<td>14,160.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8,410</td>
<td>$11.76</td>
<td>$99,900.00</td>
</tr>
</tbody>
</table>

This item #5 on December 31st shows $244,774 or an over expenditure of $144,874. The total feet drifted was 10,857 which cost $22.55 per foot or an increased cost per foot of 92% over the estimated cost of $11.76. The drifting was all done in the last 16 months at a time when both labor and supplies were practically 100% higher than when estimate was made in 1913.

The drifting covers not only the cross cuts to the ore body and foot wall drifts, but also cross cuts in ore; the latter in most cases, being more expensive than the rock drifts.

ITEM NO. 6 - PLATES AND POCKETS.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate Opening Statement - 3 Plates &amp; Pocket</td>
<td>$21,000.00</td>
</tr>
<tr>
<td>4th Level Plat &amp; Pocket Authorized</td>
<td>7,000.00</td>
</tr>
<tr>
<td>Total Estimate</td>
<td>$28,000.00</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>62,260.46</td>
</tr>
<tr>
<td>Over expenditure</td>
<td>$34,260.46</td>
</tr>
</tbody>
</table>
The estimate contemplated 4 plates and pockets at a cost of $7,000 each. In addition there was charged to this account the plat at the bottom of the shaft to clean the skip pit.

When the estimate was made it was thought that the plates could be cut when the sinking was in progress, so that the overhead costs would be distributed between the two accounts. It was decided that if the sinking were interrupted it might hurt the organization and result in less speed. This change added extra expense on both items 4 and 5. The principal cause of the over expenditure, however, was the skip pit plat and the increase in both labor and supplies.

ITEM NO. 8. - PREPARING SITE.

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimate</th>
<th>Expended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$10,000.00</td>
<td>11,773.37</td>
</tr>
<tr>
<td>Over expenditure</td>
<td>$1,773.37</td>
<td></td>
</tr>
</tbody>
</table>

Due to increase in labor.

ITEM NO. 9 - TEMPORARY EQUIPMENT.

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimate</th>
<th>Expended</th>
<th>Over expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$6,500.00</td>
<td>23,029.73</td>
<td>$16,529.73</td>
</tr>
</tbody>
</table>

The estimate was made up as follows:-

9a Derricks & Buckets $500.00
9d Miscellaneous Buildings $1,000.00
9e Concrete Equipment $5,000.00

There was expended:-

9a Surface tracks and cars $4,638.08
9b Underground " " " $2,264.61
9f Tools in General use 250.52 on which there was no estimate.
9h Compressors & Air pipes 579.00
9i Ventilating System 4,102.54

TOTAL $11,834.75

The concrete equipment costs were $8,737.85 or $3,737.85 more than estimates. These items make up most of the deficit.
ITEM NO. 10 - PERMANENT EQUIPMENT.

Estimate $27,320.00
Expended 64,143.96
Over expenditure $36,823.96

The principal items of over expenditure are as follows:-

10a Timber tracks and cars.

Estimate $770.00
Expended 2,739.54
Over expenditure $1,969.54

Due to more track laid than estimated. More cars built and increase in cost of rail and other material, also labor.

10c Electric Haulage tracks.

Estimate $4,675.00
Expended 20,622.87
Over expenditure $15,947.87

The estimate was for 5,500 feet of drifting, while actually this covered about 10,000 feet at greatly increased cost for labor and supplies.

10d Power Drills.

Estimate $1,575.00
Expended 10,623.39
Over expenditure 9,048.39

This covers the expenditure for all drills bought to Dec. 31, 1918, while there could only have been included the original equipment for sinking.

10e Timber Tunnel.

Estimate $5,000.00
Expended 8,031.13
Over expenditures $3,031.13

Due to increase in costs for labor and material.

10g Road tunnel under railroad tracks.

No Estimate Cost $1,155.31
10h Permanent Air Lines.

No estimate Cost $6,442.30

This covers 4" and 6" air lines in main drifts.

ITEM NO. 12 & 13. - OFFICE AND LABORATORY EQUIPMENT.

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimate</th>
<th>Expended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,900.00</td>
<td>2,450.01</td>
</tr>
<tr>
<td>Over expenditure</td>
<td>$550.01</td>
<td></td>
</tr>
</tbody>
</table>

This is due to high cost of equipment. This item will show a greater over expenditure as all of the laboratory equipment has not been purchased.

ITEM NO. 14. - EXPLORATORY.

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimate</th>
<th>Expended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$97,759.67</td>
<td>103,798.34</td>
</tr>
<tr>
<td>Over expenditure</td>
<td>$6,038.67</td>
<td></td>
</tr>
</tbody>
</table>

This amount expended in 1918. Drilling in mine and concreting surface holes at ledge.

14a Testing drill hole.

No estimate Cost $8,870.65

14b Taxes 1912

No estimate Cost $7,703.91
ESTIMATE OF PROBABLE ORE IN ATHENS MINE DECEMBER 31, 1918.

Ore above 4th level 274,500 tons
" between 4th and 8th levels 2,471,600 "
" " 8th and 9th levels 559,000 "
" " 9th and 10th levels 320,750 "
Total ore in sight 3,625,850 tons.

Total ore mined to December 31, 1918 35,111 tons.
Balance left in mine December 31, 1918 3,590,739 tons.

GRADED AS FOLLOWS:-

Non-Bessemer Ore
Developed 3,590,739 tons.

Assumption: 12 cu. ft. equals one ton; 10% deduction for rock. 10% deduction for loss in mining.

Percentage of Bessemer 0.

ESTIMATED ANALYSES.

<table>
<thead>
<tr>
<th>Natural</th>
<th>IRON</th>
<th>PHOS.</th>
<th>SILICA</th>
<th>MANG.</th>
<th>ALUM</th>
<th>CA.O.</th>
<th>MAG.</th>
<th>SUL.</th>
<th>IGNITION</th>
<th>MOIST.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45.77</td>
<td>.092</td>
<td>8.70</td>
<td>0.50</td>
<td>3.44</td>
<td>0.45</td>
<td>1.40</td>
<td>.017</td>
<td>2.60</td>
<td>16.00</td>
</tr>
</tbody>
</table>
## ATHENS MINE

### AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR - 1918.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Iron</th>
<th>Phos.</th>
<th>Silica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens</td>
<td>59.46</td>
<td>.113</td>
<td>5.81</td>
</tr>
<tr>
<td>Bunker Hill</td>
<td>60.84</td>
<td>.126</td>
<td>4.90</td>
</tr>
<tr>
<td>Mitchell Lease</td>
<td>60.26</td>
<td>.124</td>
<td>5.21</td>
</tr>
<tr>
<td>Corbett Lease</td>
<td>60.39</td>
<td>.127</td>
<td>5.03</td>
</tr>
</tbody>
</table>

### AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR - 1918.

- Athens
- Bunker Hill, All Mixed
- Mitchell Lease
- Corbett Lease

### ORE STATEMENT AND SHIPMENTS FOR YEAR 1918.

<table>
<thead>
<tr>
<th></th>
<th>Athens</th>
<th>Mitchell Lease</th>
<th>Corbett Lease</th>
<th>Bunker Hill</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>On hand Jan 1st 1918</td>
<td>530</td>
<td></td>
<td></td>
<td></td>
<td>530</td>
</tr>
<tr>
<td>Output for Year</td>
<td>28,225</td>
<td>5,507</td>
<td>1,899</td>
<td>2,457</td>
<td>37,568</td>
</tr>
<tr>
<td>Total</td>
<td>28,765</td>
<td>5,507</td>
<td>1,899</td>
<td>2,457</td>
<td>39,098</td>
</tr>
<tr>
<td>Shipments</td>
<td>15,013</td>
<td>5,507</td>
<td>403</td>
<td>2,173</td>
<td>22,996</td>
</tr>
<tr>
<td>Balance on Hand</td>
<td>13,752</td>
<td>0</td>
<td>1,496</td>
<td>284</td>
<td>15,002</td>
</tr>
</tbody>
</table>

1918 = 2-3 Hour Shifts for year.

---

ATHENS MINE.