

to some extent on account of insufficient air for riveting. While the riveting job was in progress, we had considerable rainfall and the flow in the pit was so excessive and the amount of silt carried into the underground workings so great, that we were obliged to operate all our electrical pumps in the pits and also a steam pump, which we worked with air. This taxed the capacity of our compressor.

The erection work was completed on May 24th and the shovel was immediately moved onto a clean up job to the east of last year's ore cut. It was necessary to move the shovel from the place that it was erected to the east of last season's ore cut in order to get it down to the bottom of the pit. The light amount of clean up work done did not delay the moving of the shovel, as it could be cast, or loaded out, while the pitmen were moving their sections.

The three American locomotives, Nos. 104, 105 and 106, were received on April 25th. One of these locomotives was immediately put in service, pumping air for the Prescott pump in the pit.

Ore loading was begun on June 2nd, the 350-ton shovel starting westward along the south side of last year's cut. The machine continued working on this cut until August 14th, when the west limits of the pit were reached and the shovel was turned around for the second cut of the season. Ore operations were continued until August 29th, when our approach loading track was cut out by the Contractor in connection with their stripping operations. From August 29th to September 17th, while the loading approach track was out of commission, the 350-ton shovel was moved up on top of the ore and proceeded to clean and cast the material washed from the north bank, as well as the dams left from stripping operations to hold back the pit water from the cleaned ore areas. Our shovel had completed this work and was moved back into position for ore loading by the time the new approach track was constructed.

Ore operations were slowed up somewhat during the balance of the season on account of the congested condition at the west end of the pit, the Contractor being engaged in taking their last stripping cut in the proximity of our switch-back and approach tracks. The Contractor's stripping was confined to night shifts only subsequent to October 24th, as it was necessary to push our ore operations

day shifts. Our loading operations had to be discontinued on October 30th, 31st and November 1st., due to freezing conditions, which caused the Great Northern Railway Company to refuse us cars.

The past season's ore cuts were carried down to the bottom rock, with the exception of the easterly workings, where we were operating along the deep ore channel. The westerly limit of this year's ore cut was not extended as far west as last year's, as we wished to provide an adequate yard for handling our underground timber, covering boards and lagging. Except for a rather heavy capping of cretaceous material near the west end of the pit, which necessitated our doing some casting to maintain our ore grade, the westerly three-quarters of the season's ore cut produced a satisfactory shipping ore. The east one-quarter of the season's ore cut was in a lower grade material and while we sampled the bank frequently and dug and cast behind the shovel an appreciable tonnage of off-grade ore, we were still unable to secure the desired analysis in our output. The south bank of the ore cut averaged higher in iron content than the material to the north and we feel that we will be able to pick up the ore cast from this year's operations when we make our next cut. The test-pitting at the east end of the pit has shown the existence of quite a low grade ore and we will be obliged to do considerable sorting, casting and manoeuvring with our shovel in this area in order to secure even a fair grade of ore. We now figure that it will be necessary to sweeten the product from this end of the pit with underground ore, and it is doubtful then whether we will be able to forward a grade that will average 48.59% natural.

According to our plans, we will extend the present cut along the north side of the pit to the extreme easterly limits. The shovel will then be turned around and a cut will be taken from the east limits to the west limits of the pit. While the machine is digging along the east one-third of the pit, we are going to have considerable trouble in maintaining a desirable grade of ore. The material from the westerly two-thirds of next year's cut should show some improvement and we are in hopes that it will carry itself, or in other words average approximately 48.59% iron natural.

Since closing the ore season, our 350-ton shovel dug itself out of the

cut onto the top of the ore deposit, casting back the material. The shovel has been engaged off and on in clean up work at the east end of the pit during the balance of the season.

Due to the delays on account of car service, the cost of the open pit operations was increased appreciably. We could have loaded out our tonnage very nicely without working any overtime, provided our car service had been satisfactory.

The following table shows the monthly output of open pit ore and the analysis of same:

<u>MONTH</u>	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MN.</u>	<u>AL.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
June-----	62,913	55.71	.081	11.27	.60	3.71	14.15	47.83
July-----	80,256	56.86	.080	10.10	.56	3.47	14.13	48.82
August-----	67,781	56.27	.089	9.95	.57	3.94	14.14	48.31
September---	37,209	56.98	.079	9.56	.69	3.82	14.83	48.53
October-----	84,463	55.98	.076	10.06	.85	3.45	15.89	47.08
November----	<u>30,603</u>	<u>54.74</u>	<u>.083</u>	<u>9.37</u>	<u>1.08</u>	<u>4.67</u>	<u>15.29</u>	<u>46.37</u>
TOTAL-----	363,225	56.17	.081	10.25	.70	3.76	14.72	47.91

STRIPPING

The Winston-Dear Company started stripping operations for the 1923 season on March 20th. The work was conducted on single shifts until July. From July 1st. to October 24th, the Winston-Dear operations were conducted on double shift and from October 24th to the end of the year on single shift.

The following table shows the yardage handled each month by the Contractor, the monthly stripping bills and the cost per yard:

	WINSTON-DEAR	CUBIC YARDS	---COST PER YARD---	
	BILLS		FOR MONTH	FOR YEAR
Previous to Jan. 1st. 1923--	\$2,048,060.41	4,763,347	--	\$.430
January-----	11,336.93	----	--	.432
February-----	11,811.77	----	--	.435
March-----	12,856.22	7,416	\$1.734	.437
April-----	26,114.58	44,671	.585	.438
May-----	33,569.51	61,248	.548	.440
June-----	28,562.83	39,706	.719	.442
July-----	40,673.00	87,499	.465	.444
August-----	47,028.79	119,684	.393	.441
September-----	45,993.48	115,154	.399	.440
October-----	37,707.14	87,936	.429	.440
November-----	34,464.73	42,284	.815	.443
December-----	14,853.18	----	---	.4457
TOTAL FOR 1923-----	\$ 344,972.16	605,598	.5696	---
TOTAL TO JAN. 1ST. 1924-----	\$2,393,032.57	5,368,945	--	.4457

The Winston-Dear Company operated the 300 shovel and from three to five locomotives throughout the season, work with this machine starting March 20th and ending November 10th. The 300 shovel took a cut on the ore along the south side of the pit from the west to the east end and the machine was then turned around and the final stripping cut taken, extending from the east limits and progressing westward about half the length of the pit. A hog's back was left to support a loading track some 20' above the ore. When the shovel encountered the permanent approach grade, which left the ore and followed a 4% grade until the west end of the pit was reached. When the machine was turned around at the east end of the pit and started operating along the south limits, a considerable flow of water was encountered and the bank kept sloughing ahead of the shovel and was washed back and became saturated. Very slow progress was made here for several weeks and the material loaded was very soupy and in spite of the fact that the cars were

blocked and we used sawdust and other materials, there was a heavy drip from the cars and the tracks from the pit to the dump had to be cleaned from time to time. Every endeavor was made to keep the shovel cuts down to the ore, but this was found impossible on account of the water and quantity of soupy material. Further than this, the south bank kept sloughing until our approach tracks were endangered and it was finally decided to bring the shovel up 15' above the ore and dig at this elevation.

Our original estimate of stripping was based on cross sections through the drill holes. These drill holes were placed 300' apart and the information available was not sufficient to make an accurate estimate, due to the fact that the top of the ore was rather uneven in places. There was a considerable sloughing of the north bank during our 1920 and 1921 operations and this increased the yardage appreciably. During the past summer the sloughing of the south bank at the east end of the pit amounted to a considerable additional yardage over our estimates. In order to safeguard our approach tracks, two shallow cuts were taken with a Model 60 machine to the south of the original approach. The tracks were thrown into this cut. The yardage handled here was also in addition to what we had contemplated. While our original estimate called for the removal of 4,984,500 cubic yards, the Winston-Dear Company actually removed 5,368,945 yards. At the time of writing the last Annual Report, we figured that there would be an overrun of better than 300,000 yards from our original figures. We did not anticipate the sloughing of the south bank at that time. The Contractor handled 384,000 yards in excess of our original estimate.

The normal flow of water in the pit remained at approximately 1,100 gallons per minute. We encountered saturated pockets from time to time in the stripping operations and the flow would be temporarily increased. Since the pit has been entirely stripped, a slight decrease in the flow is noticeable.

The drag line from the Scranton Mine, which was used during the summer and fall of 1922 in removing the deep stripping in the center of the pit, was dismantled and returned to the Scranton Mine during the spring of 1923. While the operation of this machine was quite expensive, it was absolutely necessary on account of the saturated condition of the material in the deep pocket, near the

center of the pit. No rental was charged for the dragline.

In order to hold the shoulder for the support of our approach tracks, along a stretch of about 200', where the sloughing was very bad, a considerable quantity of Susquehanna Mine rock was dumped by the Winston-Dear Company. The regular charge of cost plus 10% was made for doing this work, the Contractor making the necessary arrangement with the Susquehanna Mine officials.

The Winston-Dear Company brought a 60 Marion shovel into the pit for the purpose of grading a track for our ore operations. This track grade extended from a point several hundred feet east of our approach switch-back down onto the top of the ore at the west end of the pit. This shovel also did some clean up work and took a cut for our permanent approach grade to the south of the tracks in use at the time. It was impossible to complete this job on account of water conditions and the work was postponed until a cut for drainage purposes was taken on the north side of the approach tracks.

It was necessary to do some clean up work along the south stripping bank, due to the heavy wash from the spring break-up. The Crosby Mine Model 60 shovel and the Hill-Trumbull locomotive No. 19 were rented for this work. The equipment was brought from Marble the latter part of June and the work was undertaken in July. Progress was quite slow, as the only equipment available was this one locomotive and eight 12-yard cars, the latter being purchased from the Hill-Trumbull Mine last spring.

During the time that the Winston-Dear Company had cut out our ore loading approach track, our 350-ton shovel was moved out of its cut onto the top of the ore body and spent some time cleaning up and casting material that had washed into the pit and the old dirt dams, which were built to divert the water to our 4" casing pipes leading to the underground workings.

When the Contractor completed the grade for our switch back tracks down into the pit, the Crosby Model 60 shovel was utilized in completing the work on our permanent main approach tracks. In order to handle the water, it was necessary to cut across from the approach tracks to the outer edge of the track bench. The yardage involved here was small, but it took some time to handle it on account of the congested conditions and the necessity of operating with very

shallow cuts.

To clean up the surface material along the south bank at the east end of the pit, our track gang leveled a grade to the top of the ore from a point several hundred feet east of the approach switch-back. During the latter part of the season our 350-ton shovel cut down to the ore and loaded out the surface material along the south bank at the east end of the pit. This material was left by the Contract on account of its saturated condition and the bad sloughing which occurred when their machine was digging here.

The Winston-Dear Company's dumps gave them very little trouble during the past year and this phase of the job was quite satisfactory. As the muskeg area had been pretty well filled, the Contractor had no further trouble on this score.

Quite a little difficulty was encountered in dumping the wet sticky material from the east end of the pit. It was necessary to cable the cars onto the rails when dumping, but in spite of this precaution, several cars went over the dump, due to broken rails.

The area on top of the dump to the east of the highway bridge, which was set aside for the accommodation of a lean ore stockpile, took care of all of that material we encountered during the season. We figure that there is sufficient space here for all of the lean ore that we will be called upon to handle at the Boeing Mine.

Upon the completion of stripping operations, the Winston-Dear Company started dismantling the 300-ton shovel. This work was completed and all parts of the shovel had been taken to the shops for repairs by the end of the year. The Contractor will thoroughly repair the shovel, but it will not be re-erected, as there is no further use for the machine in the vicinity of the Boeing Mine. The repair work will be continued for at least two months into 1924.

All but three of the Winston-Dear locomotives had been put through the shops by the end of the ore season and two of the remaining machines had been overhauled by December 31st. The locomotives are torn down and are given a complete overhauling. This work consumes some time and is quite expensive. The last locomotive should be put through the shops during January.

The repairs to the 20-yard cars had not been undertaken by the end of the year, other than maintenance repairs from time to time during the season. We used a number of the Winston-Dear 20-yard cars in connection with our clean up operations during the latter part of the season. These cars have now all been returned to the Contractor.

The service on the cars and locomotives at the Boeing job has been unusually severe. The steep grades in the pit have taxed the locomotives and the repairs on this equipment would be heavier than on the ordinary job. The 20-yard cars have been put to unusually severe service on the Boeing job. Stripping operations have been carried on when there was frost in the ground and a large amount of soupy sticky material has resulted in numerous derailments and in several instances the cars have gone over the dump. A number of the cars have been badly strained and the forms bent. The cost of repairing these cars will be quite high.

ACCIDENTS

Following is a list of the accidents which occurred at the Boeing Mine during 1923 and were of a nature serious enough to be reported:

ARTHUR KOSKI

Injured-----January 8th, 1923.
Occupation-----Miner.
Nationality-----Finnish.
Time Lost-----84 Days.
Compensation Paid-----\$211.72.

Remarks: Koski was hoisting a 12' leg up a transfer by means of a rope and block. The lift was apparently too much and resulted in a rupture on the right side. The nature of the injury was right inguinal hernia.

FRED PORTINI

Injured-----January 2nd, 1923.
Occupation-----Miner.
Nationality-----Austrian.
Time Lost-----28½ Days.
Compensation Paid-----\$71.92.

Remarks: Portini was dumping a car of ore at a chute. The car rocked, catching his left hand between a post and the car. The nature of the injury consisted of a severe sprain of left wrist, also bruise of ventral surface of left hand.

MARKO BUELUSH

Injured-----February 28th, 1923.
Occupation-----Miner.
Nationality-----Montenegrin.
Time Lost-----27 Days.
Compensation Paid-----\$81.00.

Remarks: Buelush was pushing a car of dirt around a curve with his shoulder to the car, when the car left the track. Buelush's head was jammed between the car and a post, lacerating his right ear. He also sustained a severe bruise of his head. The X-Ray shows no fracture of head. Buelush complained of dizziness and said he had bled from the mouth, but there was no bleeding from inside of ear.

JALMER WIREN

Injured-----March 12th, 1923.
Occupation-----Miner.
Nationality-----Finnish.
Time Lost-----80½ Days.
Compensation Paid-----\$240.00.

Remarks: Wiren was starting down a ladder between the 1370' and 1380' sub-levels to get some timber. The first ladder rung was made of iron and fastened on either end with a nut. The nut on one side of the ladder apparently became loose, and fell off and the ladder rung slipped out of its place. When Wiren stepped on same, he dropped to the next rung, causing right inguinal hernia.

CHARLES CHILLMEN

Injured-----March 24th, 1923.
Occupation-----Dumpman, Underground.
Nationality-----American.
Time Lost-----44 Days.
Compensation Paid-----\$89.60.

Remarks: Chillmen had turned the rotary dump over. Upon reversing the air to return the dump to its proper position, the dump failed to operate, presumably on account of insufficient air. He then proceeded to return the dump by hand, by pulling on the cable. His glove caught on a sliver on the cable and his hand was pulled upwards as the dump fell back into position and was drawn in between the cable and the pulley. The end of his left index finger was torn off, and the nail and soft tissue were almost completely torn off from the end of the bone.

MATT SILTA

Injured-----February 26th, 1923.
Occupation-----Miner.
Nationality-----Finnish.
Time Lost-----Quit.
Compensation Paid-----\$90.00.

Remarks: Silta was barring down some loose dirt from the back of his working place. A chunk of rock came down, striking the bar with which he was working and sprained his back.

JOHN FREDERICKSON

Injured-----April 14th, 1923.
Occupation-----Pipeman.
Nationality-----Swedish.
Time Lost-----None.
Compensation Paid-----None.

Remarks: Frederickson at the request of miners started the power in the machine shop that miners might grind their axes. Meanwhile, he was curious to see the operation of the power hack-saw. Upon starting up this machine, he caught his fingers in the frame of this machine, squeezing the 4th, and 5th fingers of his left hand. Second and third phalanges third finger, skin squeezed off.

JOHN ANDERSON

Injured-----April 13th, 1923.
Occupation-----Steam Shovel Erecter.
Nationality-----Swedish.
Time Lost-----Quit.
Compensation Paid-----\$27.50.

Remarks: Track jack fell on his toe, causing fracture on end of left great toe.

CARL NOVAK

Injured-----April 27th, 1923.
Occupation-----Miner.
Nationality-----Austrian.
Time Lost-----25 Days.
Compensation Paid-----\$51.00.

Remarks: Novak was setting up timber close to the breast. He caught his finger between the ore and timber when putting up a cap. The nail was torn off from his right ring finger, and also an abrasion of nail on the right third finger.

JACK BRUSTER

Injured-----April 28th, 1923.
Occupation-----Timber Trammer.
Nationality-----American.
Time Lost-----Quit.
Compensation Paid-----\$10.67.

Remarks: Bruster was putting a truck back onto the timber cage. He caught his arm between the truck and shaft timber, suffering a sprain of his left wrist.

FRANK B. GALLI

Injured-----June 25th, 1923.
Occupation-----Miner.
Nationality-----Italian.
Time Lost-----7 Days.
Compensation Paid-----\$6.00.

Remarks: Galli had put in one head pole, and was trimming down back for additional poles, when small chunk fell from the back, striking him on the head, inflicting a scalp cut, also a hard bruise and abrasion of face.

NICK CIUK

Injured-----July 24th, 1923.
Occupation-----Miner.
Nationality-----Jugo-Slav.
Time Lost-----Deceased.
Compensation Paid-----Funeral Expenses Only.

Remarks: Nick Ciuk and his partner, Nick Drobac, had raised up to the cretaceous, sandy ore, to make room for a lining set, preparatory to taking a new slice. Nick Drobac was in the previous slice, cutting blocking, and handing it to Ciuk, who was blocking the back after putting up the new set of timber. Without warning, about five motor cars of sandy ore came down from a small area in the back, catching Ciuk. His death was due to suffocation.

NICK DROBAC

Injured-----July 24th, 1923.
Occupation-----Miner.
Nationality-----Jugo-Slav.
Time Lost-----Never Returned to Work.
Compensation Paid-----\$296.00.

Remarks: Nick Drobac and his partner, Nick Ciuk, had raised up to the cretaceous, sandy ore, to make room for a lining set, preparatory to taking a new slice. Nick Drobac was in the previous slice, cutting blocking and handing it to Ciuk, who was blocking the back after putting up the new set of timber. Without warning, about five motor cars of sandy ore came down from a small area in the back, catching Ciuk. The caving ground did not fill the old slice and Drobac was rescued at 7:00 P. M. There was no evidence of injury, although Drobac suffered a slight nervous shock and has not returned to work at the end of the year.

TONY GUELLTO

Injured-----July 17th, 1923.
Occupation-----Miner.
Nationality-----Italian.
Time Lost-----3 Days.
Compensation Paid-----None.

Remarks: Guellto was shovelling ore in his place when he struck his elbow against a post, and cut it slightly. Infection resulted.

TONY GUELLTO

Injured-----August 5th, 1923.
Occupation-----Miner.
Nationality-----Italian.
Time Lost-----13 Days.
Compensation Paid-----\$6.00.

Remarks: Guellto was lifting a cap to put it in place. It slipped and Guellto's right wrist was sprained.

HERBERT DOWER

Injured-----August 6th, 1923.
Occupation-----Miner.
Nationality-----American.
Time Lost-----3 Days.
Compensation Paid-----None.

Remarks: Dower was cleaning up in front of his loader. His partner accidentally moved a lever and caused the arms of the loader to strike Dower in the abdomen. Dower sustained a bruise over the left lower abdomen, and a small swelling on the left groin.

VICTOR PARVI

Injured-----August 14th, 1923.
Occupation-----Track Cleaner.
Nationality-----Finnish.
Time Lost-----14 Days.
Compensation Paid-----\$20.07.

Remarks: Parvi was cleaning sand on the side of the tracks, and throwing same into motor cars. He struck his right hand against the corner of the motor car, and knocked some skin off the little finger of his right hand. This wound became infected.

CHARLES PIIRONEN

Injured-----September 4th, 1923.
Occupation-----Miner.
Nationality-----Finnish.
Time Lost-----Still off - 1/1/24.
Compensation Paid-----\$303.00 To Dec. 31st.

Remarks: Piironen was making a wedge and cut the back of his left hand. A tendon was severed and an operation was necessary.

MILO RASKOVICH

Injured-----August 28th, 1923.
Occupation-----Underground Motorman.
Nationality-----Montenegrin.
Time Lost-----3 Days.
Compensation Paid-----None.

Remarks: Raskovich and his helper had lifted a carbide drum of grease, weighing approximately 100 pounds, from the cage, and in doing so, he sprained his back.

NAZARENO VALERI

Injured-----September 13th, 1923.
Occupation-----Timber Trammer.
Nationality-----Italian.
Time Lost-----1 Day.
Compensation Paid-----None.

Remarks: Valeri was going down the shaft ladderway, returning to his work underground. He slipped and fell a distance of about 18'. He sustained bruises and abrasions of right and left arms, also right thigh.

JOHN DIKKI

Injured-----September 1, 1923.
Occupation-----Miner.
Nationality-----Finnish.
Time Lost-----18 Days.
Compensation Paid-----\$36.00.

Remarks: Dikki was fixing lagging in the back of his drift. A piece of lagging fell, striking and inflicting a cut on his right wrist.

FRED MANNILA

Injured-----September 28th, 1923.
Occupation-----Locomotive Brakeman.
Nationality-----Finnish.
Time Lost-----Still off - 12/31/23.
Compensation Paid-----\$240.00 to 12/31/23.

Remarks: Finger caught between grab iron and locomotive tender floor while going around a sharp curve. He had his right finger cut off between distal and middle joints.

ANDREW SOCH

Injured-----October 11th, 1923.
Occupation-----Miner.
Nationality-----Montenegrin.
Time Lost-----2 Days.
Compensation Paid-----None.

Remarks: Soch was returning to work after his dinner hour, and in some manner, he missed his hold and fell the length of the first ladder, approximately 18', spraining his right shoulder and bruising his left arm. X-Ray showed no fracture.

PAUL DAVICH

Injured-----October 30th, 1923.
Occupation-----Miner.
Nationality-----Austrian.
Time Lost-----4 Days.
Compensation Paid-----None.

Remarks: Davich was carrying timber to his working place and in some way strained his back.

JOHN HOMER

Injured-----November 14th, 1923.
Occupation-----Miner.
Nationality-----Austrian.
Time Lost-----Still Off - 12/31/23.
Compensation Paid-----\$133.33 to 12/31/23.

Remarks: Homer was dumping a car at the chute, and caught his finger between car and dump guard rail. Almost the entire palmer surface was torn from last phalanx, and the skin ripped from the second phalanx.

ANDREW MARKIN

Injured-----November 20th, 1923.
Occupation-----Miner.
Nationality-----Finnish.
Time Lost-----Still Off - 12/31/23.
Compensation Paid-----\$116.66 to 12/31/23.

Remarks: Markin was making a wedge with an axe and a piece of lagging from the side of the drift dropped out, and struck the axe handle, causing him to cut his left hand. The tendon in his left thumb was severed and a fragment of the bone chipped loose.

ANDREW ISAACSON

Injured-----November 15th, 1923.
Occupation-----Test-Pitter.
Nationality-----Swedish.
Time Lost-----Still Off 12/31/23.
Compensation Paid-----\$130.00 to 12/31/23.

Remarks: Isaacson was test-pitting and struck his foot with a pick, cutting the dorsum of left foot, and fracturing the navicular bone.

LAWRENCE KINGSBURY

Injured-----December 2nd, 1923.
Occupation-----Trackman.
Nationality-----American.
Time Lost-----Still Off - 12/31/23.
Compensation Paid-----\$51.80 to 12/31/23.

Remarks: Kingsbury was working with the track gang, lining the pit tracks. His foot was caught under the track when dropped by the track jack. He sustained a severe bruise of right instep.

CHARLES BISSONNETTE

Injured-----December 7th, 1923.
Occupation-----Timber Framer.
Nationality-----French.
Time Lost-----Still Off - 12/31/23.
Compensation Paid-----\$39.87 to 12/31/23.

Remarks: Bissonnette was rolling timber on skidway. One end of a piece of timber rolled off the skid, dropping onto his left foot. He sustained a fracture of terminal phalangeal bone of second left toe.

JOHN SAARI

Injured-----December 13th, 1923.
Occupation-----Pit Laborer.
Nationality-----Finnish.
Time Lost-----Still Off - 12/31/23.
Compensation Paid-----\$25.20 to 12/31/23.

Remarks: Saari was walking to work around the south end of the Boeing location, following the south bank of the pit, when he slipped on the icy path and fractured his knee cap.

GEORGE VUKICH

Injured-----December 21st., 1923.
Occupation-----Laborer.
Nationality-----Austrian.
Time Lost-----Still Off - 12/31/23.
Compensation Paid-----\$4.20, to 12/31/23.

Remarks: Vukich was unloading a car of mining timber. His cant hook slipped, and he lost his balance, falling headlong to the ground, a distance of approximately 10 feet. He sustained a cut over the right eye, which was quite deep, and bruised his right elbow, forearm and wrist.

SHIPMENTS

Following are the cargoes of Boeing ore shipped during the 1923 season and the analysis of same as obtained at the Mine and by the Lower Lake Chemists:

<u>PONTIAC</u> - - - - - 5/9/23 - - - - - 5,781 Tons.							
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>ALU.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>	
Mine-----	56.99	.085	9.07	3.37	13.77	-----	
Cremer & Case-----	57.00	---	---	---	14.23	48.89	
<u>MICHIGAN</u> - - - - - 5/10/23- - - - - 9,646 Tons.							
Mine-----	57.05	.084	8.83	3.36	13.78	-----	
Oscar Textor-----	57.02	---	---	---	14.18	48.94	
<u>PETER WHITE</u> - - - - - 5/12/23- - - - - 8,820 Tons.							
Mine-----	57.25	.082	8.98	3.51	13.80	-----	
Hughes & Guentzler----	57.45	---	---	---	13.82	49.51	
<u>A.E.R.SCHNEIDER</u> - - - - - 5/23/23- - - - - 3,079 Tons.							
Mine-----	57.38	.081	8.58	3.46	12.65	-----	
Oscar Textor-----	57.15	---	---	---	13.71	49.31	
<u>PONTIAC</u> - - - - - 6/7/23- - - - - 5,992 Tons.							
Mine-----	57.30	.086	9.01	3.72	13.43	-----	
Oscar Textor-----	56.15	---	---	---	14.09	48.24	
<u>PIONEER</u> - - - - - 6/11/23- - - - - 5,045 Tons.							
Mine-----	56.90	.083	9.22	3.96	14.26	-----	
Crowell & Murray-----	56.93	---	---	---	12.99	49.53	
<u>PONTIAC</u> - - - - - 6/16/23- - - - - 11,537 Tons.							
Mine-----	55.94	.083	10.77	3.78	15.73	-----	
Oscar Textor-----	56.35	---	---	---	13.91	48.51	
<u>ISHPEMING</u> - - - - - 6/19/23- - - - - 9,925 Tons.							
Mine-----	56.00	.079	10.98	3.85	14.04	-----	
Hughes & Guentzler----	55.95	---	---	---	13.35	48.48	
<u>W.G.MATHER</u> - - - - - 6/23/23- - - - - 10,399 Tons.							
Mine-----	56.56	.077	10.54	3.63	13.96	-----	
Crowell & Murray-----	56.41	---	---	---	14.95	47.98	
<u>MUNISING</u> - - - - - 6/25/23- - - - - 6,248 Tons.							
Mine-----	56.46	.079	10.82	3.60	15.18	-----	
Hughes & Guentzler----	56.97	---	---	---	14.53	48.69	
<u>PIONEER</u> - - - - - 6/26/23- - - - - 9,338 Tons.							
Mine-----	56.32	.077	11.86	3.49	13.98	-----	
Oscar Textor-----	56.30	---	---	---	13.97	48.43	

BOEING MINE.

<u>ANGELINE</u>	-6/28/23-						6,836 Tons.
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>ALU.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>	
Mine-----	56.66	.077	11.13	3.04	13.82	-----	
Cremer & Case-----	56.40	---	-----	----	13.48	48.80	
<u>PONTIAC</u>	-7/1/23-						5,866 Tons.
Mine-----	56.04	.080	11.96	3.39	13.14	-----	
Crowell & Murray----	55.65	---	-----	----	14.13	47.79	
<u>SHEADLE</u>	-7/3/23-						3,937 Tons.
Mine-----	55.91	.079	12.02	3.62	13.73	-----	
Hughes & Guentzler--	56.35	---	-----	----	13.69	48.64	
<u>MICHIGAN</u>	-7/6/23-						10,126 Tons.
Mine-----	55.85	.077	11.96	3.57	13.85	-----	
Cremer & Case-----	55.20	---	-----	----	13.63	47.68	
<u>NEGAUNEE</u>	-7/12/23-						5,765 Tons.
Mine-----	56.48	.073	10.77	3.37	14.33	-----	
Crowell & Murray----	56.25	---	-----	----	14.27	48.22	
<u>W. G. MATHER</u>	-7/13/23-						9,158 Tons.
Mine-----	56.48	.082	10.14	3.60	14.24	-----	
Hughes & Guentzler--	56.70	---	-----	----	14.10	48.71	
<u>PONTIAC</u>	-7/15/23-						8,635 Tons.
Mine-----	56.44	.082	10.67	3.47	14.51	-----	
Oscar Textor-----	56.00	---	-----	----	12.96	48.74	
<u>MUNISING</u>	-7/15/23-						4,644 Tons.
Mine-----	57.26	.077	9.54	3.21	14.46	-----	
Hughes & Guentzler--	58.15	---	-----	----	11.14	51.67	
<u>GRAND ISLAND</u>	-7/19/23-						5,028 Tons.
Mine-----	57.18	.081	9.54	3.20	13.83	-----	
Oscar Textor-----	56.75	---	-----	----	12.13	49.87	
<u>PIONEER</u>	-7/20/23-						6,043 Tons.
Mine-----	56.84	.079	10.07	3.40	14.12	-----	
Oscar Textor-----	55.60	---	-----	----	13.00	48.37	
<u>PENOBSCOT</u>	-7/21/23-						3,273 Tons.
Mine-----	57.68	.076	9.33	3.28	12.75	-----	
Oscar Textor-----	55.60	---	-----	----	13.63	48.02	
<u>FRONTENANC</u>	-7/24/23-						11,861 Tons.
Mine-----	56.82	.080	10.14	3.55	13.59	-----	
Cremer & Case-----	56.50	---	-----	----	14.03	48.57	

<u>GRAND ISLAND</u>			-7/27/23-				4,968 Tons.
	FE.	PHOS	SIL.	ALU.	MOIS.	FE.NAT.	
Mine	56.93	.081	9.86	3.54	13.83	-----	
Cremer & Case	57.00	---	----	----	13.54	49.28	
<u>FRONTENAC</u>			-8/1/23-				-11,697 Tons.
Mine	57.04	.079	9.00	3.51	13.77	-----	
Crowell & Murray	56.70	---	----	----	13.73	48.92	
<u>PETER WHITE</u>			-8/1/23-				5,754 Tons.
Mine	56.95	.086	8.90	3.86	14.27	-----	
Crowell & Murray	57.05	---	----	----	13.79	49.18	
<u>ISHPEMING</u>			-8/4/23-				6,736 Tons.
Mine	56.63	.090	9.60	4.07	13.80	-----	
Crowell & Murray	56.80	---	----	----	13.74	49.00	
<u>PIONEER</u>			-8/5/23-				6,189 Tons.
Mine	57.22	.090	8.75	4.01	13.91	-----	
Oscar Textor	57.05	---	----	----	13.48	49.36	
<u>E.N.SAUNDERS</u>			-8/9/23-				6,784 Tons.
Mine	56.55	.091	9.15	3.91	13.39	-----	
Hughes-Guentzler	56.50	---	----	----	12.90	49.21	
<u>PETER WHITE</u>			-8/11/23-				3,182 Tons.
Mine	56.27	.095	9.56	3.94	13.47	-----	
Cremer & Case	55.50	---	----	----	12.83	48.38	
<u>FRONTENAC</u>			-8/13/23-				5,694 Tons.
Mine	56.58	.092	9.24	3.96	13.56	-----	
Cremer & Case	56.50	---	----	----	12.81	49.35	
<u>PONTIAC</u>			-8/16/23-				3,033 Tons.
Mine	55.77	.093	9.99	4.24	13.59	-----	
Crowell & Murray	55.80	---	----	----	13.65	48.18	
<u>ISHPEMING</u>			-8/20/23-				10,345 Tons.
Mine	56.09	.093	9.60	4.36	13.55	-----	
Crowell & Murray	55.60	---	----	----	13.53	48.08	
<u>PIONEER</u>			-8/22/23-				3,384 Tons.
Mine	55.70	.092	10.37	4.26	13.71	-----	
Hughes & Guentzler	56.55	---	----	----	12.50	49.48	
<u>CHRISTOPHER</u>			-8/24/23-				6,251 Tons.
Mine	57.04	.078	9.52	3.28	14.32	-----	
Oscar Textor	57.35	---	----	----	13.79	49.44	
Hughes & Guentzler	57.35	---	----	----	13.26	49.76	
<u>MICHIGAN</u>			-8/27/23-				10,359 Tons.
Mine	56.43	.086	9.99	3.66	14.57	-----	
Oscar Textor	56.30	---	----	----	13.36	48.78	

BOEING MINE.

<u>PETER WHITE</u> - - - - - 8/27/23 - - - - - 6,160 Tons.						
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>ALU.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
Mine-----	56.77	.077	9.75	3.45	14.62	-----
Crowell & Murray-----	56.15	---	---	---	12.73	49.00
<u>GRAND ISLAND</u> - - - - - 8/30/23 - - - - - 4,952 Tons.						
Mine-----	56.15	.082	10.10	3.56	14.87	-----
Crowell & Murray-----	56.58	---	---	---	13.67	48.85
<u>PONTIAC</u> - - - - - 9/2/23 - - - - - 11,438 Tons.						
Mine-----	57.29	.081	9.04	3.38	14.23	-----
Hughes & Guentzler-----	57.25	---	---	---	13.51	49.52
<u>PONTIAC</u> - - - - - 9/11/23 - - - - - 11,288 Tons.						
Mine-----	56.69	.082	9.61	3.56	13.77	-----
Oscar Textor-----	56.15	---	---	---	13.44	48.60
<u>NEGAUNEE</u> - - - - - 9/15/23 - - - - - 5,762 Tons.						
Mine-----	56.75	.083	9.21	3.72	14.65	-----
Oscar Textor-----	56.15	---	---	---	13.15	48.77
<u>WM. G. MATHER</u> - - - - - 9/21/23 - - - - - 6,927 Tons.						
Mine-----	57.15	.083	9.18	3.69	14.67	-----
Hughes & Guentzler-----	57.55	---	---	---	14.15	49.41
<u>W. E. FITZGERALD</u> - - - - - 9/22/23 - - - - - 6,935 Tons.						
Mine-----	57.25	.084	9.08	3.78	15.27	-----
Cremer & Case-----	57.50	---	---	---	13.29	49.86
<u>JAS. H. DUNHAM</u> - - - - - 9/25/23 - - - - - 6,849 Tons.						
Mine-----	58.15	.083	8.55	3.61	13.42	-----
Hughes & Guentzler-----	58.25	---	---	---	13.43	50.43
<u>GRAND ISLAND</u> - - - - - 9/27/23 - - - - - 8,272 Tons.						
Mine-----	56.97	.079	9.68	3.94	14.71	-----
Crowell & Murray-----	57.50	---	---	---	14.45	49.19
<u>PETER WHITE</u> - - - - - 9/29/23 - - - - - 8,621 Tons.						
Mine-----	56.80	.076	9.66	4.17	14.06	-----
Oscar Textor-----	58.00	---	---	---	14.09	49.83
<u>A. E. CORNELIUS</u> - - - - - 10/3/23 - - - - - 6,905 Tons.						
Mine-----	56.66	.078	9.79	3.66	14.61	-----
Cremer & Case-----	56.90	---	---	---	14.54	48.63
<u>W. T. ROBERTS</u> - - - - - 10/6/23 - - - - - 8,817 Tons.						
Mine-----	56.84	.078	9.50	3.62	14.92	-----
Cremer & Case-----	56.90	---	---	---	14.46	48.67
<u>E.N.SAUNDERS, JR.</u> - - - - - 10/7/23 - - - - - 7,226 Tons.						
Mine-----	56.42	.075	9.45	3.75	14.46	-----
Crowell & Murray-----	56.60	---	---	---	14.15	48.59

BOEING MINE.

<u>E. L. FORD</u> -----		-10/10/23-					7,461 Tons.
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>ALU.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>	
Mine-----	56.50	.074	10.09	3.74	16.17	-----	
Hughes & Guentzler-----	56.10	---	-----	-----	15.52	47.39	
<u>NEGAUNEE</u> -----		-10/13/23-					5,651 Tons.
Mine-----	56.54	.074	9.77	3.48	15.67	-----	
Cremer & Case-----	56.10	---	-----	-----	14.62	47.90	
<u>W. E. FITZGERALD</u> -----		-10/15/23-					6,993 Tons.
Mine-----	56.44	.076	9.78	3.53	16.00	-----	
Hughes & Guentzler-----	56.70	---	-----	-----	14.50	48.48	
<u>FRONTENAC</u> -----		-10/17/23-					3,377 Tons.
Mine-----	56.24	.077	10.30	3.67	15.82	-----	
Crowell & Murray-----	56.45	---	-----	-----	14.38	48.33	
<u>PONTIAC</u> -----		-10/18/23-					2,611 Tons.
Mine-----	56.22	.080	9.83	3.77	16.38	-----	
Oscar Textor-----	55.80	---	-----	-----	15.17	47.33	
<u>WM. G. MATHER</u> -----		-10/19/23-					8,751 Tons.
Mine-----	55.88	.075	10.92	3.51	16.02	-----	
Crowell & Murray-----	56.40	-----	-----	-----	14.25	48.36	
<u>MIDVALE</u> -----		-10/22/23-					7,111 Tons.
Mine-----	55.78	.073	11.16	3.48	15.35	-----	
Oscar Textor-----	56.50	---	-----	-----	15.17	47.93	
<u>MARQUETTE</u> -----		-10/22/23-					4,629 Tons.
Mine-----	55.62	.079	11.46	3.34	16.42	-----	
Oscar Textor-----	55.55	---	-----	-----	14.93	47.26	
<u>ANGELINE</u> -----		-10/25/23-					6,568 Tons.
Mine-----	55.95	.074	10.10	3.41	15.56	-----	
Crowell & Murray-----	56.43	---	-----	-----	14.50	48.25	
<u>PIONEER</u> -----		-10/27/23-					8,730 Tons.
Mine-----	55.96	.076	9.36	3.80	16.50	-----	
Hughes & Guentzler-----	56.02	---	-----	-----	15.66	47.25	
<u>MIDVALE</u> -----		-10/30/23-					7,457 Tons.
Mine-----	56.51	.080	8.55	3.77	15.41	-----	
Hughes & Guentzler-----	56.10	---	-----	-----	15.30	47.52	
<u>J. J. TURNER</u> -----		-11/2/23-					9,976 Tons.
Mine-----	56.50	.081	8.53	3.74	14.97	-----	
Oscar Textor-----	56.10	---	-----	-----	15.16	47.60	
<u>J. J. BOLAND</u> -----		-11/3/23-					3,677 Tons.
Mine-----	55.77	.085	8.68	3.82	16.10	-----	
Cremer & Case-----	56.10	---	-----	-----	14.73	47.84	

BOEING MINE.

<u>PONTIAC</u>	<u>-11/5/23-</u>						5,875 Tons.
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>ALU.</u>	<u>MOIST.</u>	<u>FE.NAT.</u>	
Mine-----	55.54	.086	8.73	3.67	15.61	-----	
Oscar Textor-----	54.90	---	---	---	15.44	46.42	
<u>ANGELINE</u>	<u>-11/5/23-</u>						-3,465 Tons.
Mine-----	55.58	.084	9.10	4.40	14.90	-----	
Cremer & Case-----	55.60	---	---	---	15.40	47.04	
<u>PETER WHITE</u>	<u>-11/8/23-</u>						9,092 Tons.
Mine-----	54.78	.085	9.42	4.83	15.00	-----	
Oscar Textor-----	54.80	---	---	---	15.74	46.17	
<u>LaBELLE</u>	<u>-11/11/23-</u>						4,452 Tons.
Mine-----	54.71	.083	9.77	4.74	13.91	-----	
Oscar Textor-----	54.80	---	---	---	16.26	45.89	
<u>JOSEPH WOOD</u>	<u>-11/13/23-</u>						2,229 Tons.
Mine-----	54.31	.081	9.90	4.90	14.55	-----	
Hughes & Guentzler---	55.00	---	---	---	15.50	46.48	
<u>W. D. CRAWFORD</u>	<u>-11/15/23-</u>						2,512 Tons.
Mine-----	54.35	.079	9.63	5.05	15.10	-----	
Cremer & Case-----	54.60	---	---	---	16.15	45.78	
<u>ANGELINE</u>	<u>-11/22/23-</u>						4,393 Tons.
Mine-----	54.92	.078	9.89	4.43	14.60	-----	
Crowell & Murray-----	55.25	---	---	---	14.61	47.18	

In addition to the above cargoes, 33,608 tons of Boeing ore was shipped as Upson Grade, which is made up of a mixture of 60% Hill-Trumbull and 40% Boeing ore. The Upson cargoes are listed in the Hill-Trumbull Mine report.

A comparison of the Mine and Lower Lake analysis on the cargoes of straight Boeing ore follows:

	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>ALU.</u>	<u>SIL.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>
Mine Analysis-----	56.49	.081	.77	3.71	9.84	14.48	48.31
Lower Lake Analysis--	56.45	---	--	--	--	14.03	48.52

A composite analysis of the season's shipments follows:

	<u>TONS.</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>ALU.</u>	<u>LIME</u>	<u>MAG.</u>	<u>SUL.</u>	<u>LOSS</u>
Lerch Brothers-----	500,127	56.43	.082	.80	9.63	3.55	.18	.17	.010	4.59

BOEING MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1923.

GRADE	IRON	PHOS.	SILICA	MANG.	ALUM.	MOIST.
Boeing Merch.,	56.60	.081	9.71	.76	-	-
Boeing Lean,	(No Production)					

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1923.

GRADE	IRON	PHOS.	Mine			MOIST.	Lake Erie	
			SILICA	MANG.	ALUM.		IRON	MOIST.
Boeing Merch.,	56.49	.081	9.84	.76	3.70	14.47	56.23	13.72

ORE STATEMENT - DECEMBER 31ST, 1923.

	PIT		SHAFT		TOTAL	TOTAL	LAST	YEAR
	BOEING	PIT	BOEING	SHAFT				
	MERCHANT.	BOEING	MERCHANT.	BOEING	LEAN ORE	TOTAL		
	ORE	LEAN ORE	ORE	LEAN ORE				
On Hand Jan. 1, 1923,	-	33,417	8,754	5,144	47,315	29,478		
Output for Year,	363,225	-	140,450	213	503,888	268,311		
Total,	363,225	33,417	149,204	5,357	551,203	297,789		
Shipments,	363,225	-	131,545	5,357	500,127	250,474		
Balance on Hand,	-	33,417	17,659	-	51,076	47,315		
Increase in Output,					235,577			
Increase in Ore on Hand,					3,761			

- 1923 -- 2-8 Hour Shifts, Jan. 1st to Apr. 15th, 1923.
 1-8 Hour Shift, Apr. 15th to Dec. 31st, 1923.
 Pit operations began June 2nd, and ceased Nov. 9th, 1923.
- 1922 -- Mine Idle Jan. 1st to Nov. 16th, 1922.
 2-8 Hour Shifts Underground, 6 days per week, Nov. 16th to Dec. 31st, 1922.
 Pit operations began Aug. 11th, and ceased Nov. 4th, 1922.

BOEING MINE
SHIPMENTS FOR YEAR-1923

GRADE	PIT	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Pit, Boeing Merchantable Ore,	363,225	-	-	363,225	-
Pit, Boeing Lean Ore,	-	-	-	-	-
Shaft, Boeing Merchant. Ore,	-	87,074	44,471	131,545	248,067
Shaft, Boeing Lean Ore,	-	-	5,357	5,357	2,407
Total,	363,225	87,074	49,828	500,127	250,474
Total Last Year,				250,474	
Increase,				249,653	

BOEING MINE

COMPARATIVE MINING COST FOR YEAR

	1923	1922	INCREASE	DECREASE
Open Pit Product	363,225	257,550	105,675	
Shaft Product	140,663	10,761	129,902	
Total Product	503,888	268,311	235,577	
OPEN PIT COSTS				
Operating Accounts	.189	.029	.160	
General Accounts	.024	.019	.005	
Contract Mining		.292		.292
Winter Expense	.009		.009	
Stripping Amortization	1.142	.800	3.42	
Total Open Pit Costs	1.364	1.140	.224	
SHAFT COSTS				
Underground Costs	1.613	1.841		.228
Surface Costs	.209	.432		.223
General Mine Accounts	.195	.028	.167	
Loading & Shipping	.050	.197		.147
Total Shaft Costs	2.067	2.498		.431
Depreciation	.427	.350	.077	
Occupation Tax	.053		.053	
Taxes	.083	.042	.041	
Central Office	.010	.019		.009
Idle Expense		.040		.040
Cost Adjustments	.002	.001	.001	
Misc. Debits & Credits	.115	.651		.536
Total Cost on Cars	2.250	2.325		.075
No. Days Operating - Pit	124)			
No. Shifts & Hours "	1-10)	See Note.		
Avg. Daily Product	2,929)			
No. Days Operating - Shaft	308	37	271	
No. Shifts & Hours "	2-8:1-8	2-8		
Avg. Daily Product	457	291	166	

Note: Open Pit mining in 1922 was contract work.

BOEING MINE

TIMBER STATEMENT FOR THE YEAR ENDING DECEMBER 31, 1923

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT 1923	AMOUNT 1922
6" to 8" Timber	158,359	.10	15,835.90	939.00
8" to 10" "	79,180	.10	7,918.00	402.40
Total Timber - 1923	237,539	.10	23,753.90	
Total Timber - 1922	13,414	.10		1,341.40
	LINEAL FEET	PER 100'		
6' Lagging	512,910	.691	3,544.50	565.25
Poles	157,625	1.56	2,470.43	145.16
Covering Boards	445,896	1.369	6,105.28	831.75
#4 Boards				150.00
Total - 1923	1,116,431	1.085	12,120.21	
Product		(1)	140,450	8,754
Feet of timber per ton of ore			1.691	1,532
" lagging "			3.651	9,343
" boards "			3.174	6,171
" poles "			1.122	1,105
" lagging per foot of timber			2.159	6,097
Cost per ton for timber			.169	.153
" " " " lagging			.025	.065
" " " " poles			.017	.017
" " " " boards			.043	.112
" " " " timber, lagging, poles & boards			.254	.347
Equivalent of stull timber to bd. measure			366,603	17,438
Feet of board measure per ton of ore			2.61	1.992

NOTE: (1) Includes over run.

BOEING MINE

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE

KIND	QUANTITY	AVERAGE PRICE	AMOUNT 1923	AMOUNT 1922
40% Powder	39,250	12.88	5,056.07	375.13
Total Powder	39,250	12.88	5,056.07	375.13
Fuse	102,600	.624	640.32	66.73
Caps	27,900	1.151	321.16	44.19
Total Fuse, Etc.			961.48	110.92
Total All Explosives			6,017.55	486.05
Product			140,450	8,754
Pounds powder per ton of ore			.279	.302
Cost per ton for Powder			.036	.042
" Fuse, Etc.			.007	.013
" All Explosives			.043	.055
Average price per pound for powder			.1288	.1415

WADE AND HELMER MINES

ANNUAL REPORT FOR 1923.

With the exception of some stockpile loading, the Wade-Helmer Mines were idle during the year. The usual force of six men was employed regularly, consisting of the captain, clerk, three pumpmen and night watchman.

It will be necessary to load out the ore on hand before stocking operations could be resumed. The Wade trestle was partly dismantled during the stockpile loading operations the past summer and it would be very difficult and expensive to provide facilities for any stocking until the balance of the pile has been cleaned up and a new trestle erected.

At the Helmer Mine, the available space for stocking was about filled, and as only a small tonnage was moved from here during the 1923 season, it would not be practical to do any stockpiling here until the balance of the ore is removed.

STOCKPILE LOADING

The tonnage and average analysis of the ore in stock at the Wade and Helmer Mines on January 1st., 1923, follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>
Wade Ore in Stock January 1st., 1923----	77,271	57.22	.064	1.27	7.50
Helmer Ore in Stock January 1st., 1923--	<u>20,354</u>	<u>56.48</u>	<u>.066</u>	<u>1.35</u>	<u>10.03</u>
TOTAL AND AVERAGES- - - - -	97,625	57.07	.064	1.29	8.03

Orders were issued to load out 10,000 tons of Wade stockpile ore prior to May 1st. A small crew was hired and the Model 60 Marion shovel was set up and loading was started on the 20th of April. Between April 20th and 27th, 10,507 tons of ore were loaded. No further ore was desired until the latter part of May, a 10,000 ton cargo being prepared between May 26th and June 2nd.

From April 27th to May 26th the crew were engaged on several surface jobs. After the second cargo was loaded out, the steam shovel force was taken into the Helmer pit for a clean up job around the Helmer stockpile. Considerable sand had washed down onto the stockpile from the north and west banks of the pit

and the Model 36 revolving shovel took a clean up casting cut around the pile. This job had about been completed when orders were received to prepare a third cargo. We loaded out 3,670 tons of Helmer ore, but the grade was so low that we were obliged to move the crew onto the Wade pile in order to secure a cargo of satisfactory iron content.

We received orders on June 29th to discontinue forwarding Wade ore for the season. The crew was employed on several jobs about surface until August 11th, when they were discharged. There was some question about further loading at the Wade and Helmer Mines and the definite decision was not made until the forepart of August.

Following is the tonnage and average analysis of the stockpile ore shipped during the 1923 season from the Wade and Helmer properties:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>MOIST.</u>
Wade Ore Shipped for Season 1923----	35,379	57.07	.067	1.40	7.51	12.59
Helmer Ore Shipped for Season 1923--	3,670	54.72	.069	1.57	9.63	11.73
TOTAL AND AVERAGES- - - - -	39,049	56.85	.067	1.42	7.71	12.51

The tonnage and analysis of the ore in stockpile on January 1st., 1924, is as follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS.</u>	<u>MN.</u>	<u>SIL.</u>	<u>MOIST.</u>
Wade Ore in Stock Jan. 1st., 1924---	41,892	57.22	.064	1.27	7.50	---
Helmer Ore in Stock Jan.1st., 1924--	16,684	56.48	.066	1.33	10.03	---
TOTAL AND AVERAGES- - - - -	58,576	57.01	.065	1.29	8.22	---

The analysis of the Wade ore shipped during 1923 was slightly lower than the average for the pile. The analysis of the ore in the balance of the pile should show some improvement and check the grade obtained in making.

The small tonnage of Helmer ore shipped ran 1.76% lower in iron than the average for the pile. Several check samples were taken along the fresh cut and these showed an average grade of 56% iron. The balance of the pile should check very closely with the grade obtained when the ore was stocked. The ore from the Helmer underground workings is of a very fine structure and contains some paint-rock. This ore hangs up in the loading chute and requires considerable barring in filling the railroad cars. As a result the ore on top of the cars contains more fines than the average and the sampling is not representative, being lower in iron. When loading operations are resumed here, this situation will be watched very closely in an endeavor to get a fair sample.

WADE MINE ORE ESTIMATE OF JANUARY 1ST. 1924

No ore was mined from any of the Wade deposits during the past two years, nor was any exploratory work undertaken; the estimates, therefore, remaining the same as of January 1st., 1922. The ore estimates are based on a factor of 13 cubic feet per ton, with a 10% deduction to cover mining loss in the case of underground ore.

The tonnage and average grade of ore in the several Wade deposits on January 1st., 1924, follows:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>MOIS.</u>
West Deposit-----	1,365,000	57.90	.074	1.05	6.79	13.25
East Deposit-----	1,515,000	56.91	.075	1.83	7.44	13.50
Deacon Deposit---	80,000	56.65	.045	1.16	8.04	12.50
" " ---	95,000	55.77	.053	.42	8.43	12.50

Following are the tonnages and grades of ore in the West Deposit above and below the main haulageway:

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>
Above Main Level--	1,179,000	57.85	.074	1.33	6.40
Below Main Level--	186,000	58.11	.073	.74	7.03

The total ore by forty acre tracts as of January 1st., 1924, is as follows:

SE $\frac{1}{4}$ of SW $\frac{1}{4}$ of Section 12, 58-19-----	305,000 Non-Bessemer.
NE $\frac{1}{4}$ of NW $\frac{1}{4}$ of " 13, 58-19-----	1,305,000 " "
NE $\frac{1}{4}$ of NW $\frac{1}{4}$ of " 13, 58-19-----	80,000 Bessemer.
NW $\frac{1}{4}$ of NW $\frac{1}{4}$ of " 13, 58-19-----	1,365,000 Non-Bessemer.

HELMER MINE ORE ESTIMATE OF JANUARY 1ST. 1924

No mining or exploratory operations were conducted at the Helmer Mine during the past two years and the tonnage estimates are the same as on January 1st. 1922. These estimates are based on a factor of 13 cubic feet per ton, with a 10% deduction for mining loss in the case of underground ore, 20% deduction for rock in the open pit and 25% deduction for rock in the scam ore.

The Helmer tonnage in sight January 1st., 1924, follows:

	<u>TONS</u>
Open Pit-----	15,000
Scram Ore-----	26,000
Underground Ore-----	<u>68,000</u>
TOTAL- - - - -	109,000

There is no indication that any additional ore will be developed in the Helmer, in fact, due to the low grade and restricted mining conditions underground, we are apprehensive that this total tonnage cannot be mined at a profit.

The average analysis of the ore in sight January 1st., 1924, follows:

<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>MOIS.</u>
109,000	56.00	.070	1.35	9.50	12.50

Of the ore remaining in the Wade-Helmer Mines, 576,000 tons will be mined by the open pit method, 26,000 tons by scam to pit and 2,562,000 tons from underground operations.

ESTIMATE OF PRODUCTION FOR 1924

The estimate of production at the Wade Mine for 1924, is based on the assumption that opening and repairing work underground will be started April 1st., and that we do not enter into an agreement with the Oliver Iron Mining Company for the operation of the property south of the Helmer and Wade pits. The period of production considered is from April 1st. to November 15th.

	<u>TONS</u>	<u>FE.</u>	<u>PHOS</u>	<u>MN.</u>	<u>SIL.</u>	<u>MOIS.</u>
Wade Open Pit Ore-----	100,000	58.50	.060	.75	7.00	12.50
Wade Underground Ore---	61,000	57.50	.061	.95	8.13	12.50
Helmer Ore-----	<u>10,000</u>	<u>56.00</u>	<u>.070</u>	<u>1.30</u>	<u>10.25</u>	<u>12.50</u>
TOTAL AND AVERAGES-----	171,000	58.00	.061	.85	7.59	12.50

In the event that we should operate the property south of the Wade and Helmer pits, we would be engaged in stripping during the entire season of navigation and we would not be able to handle any Wade open pit, or any Helmer ore, otherwise than through the Wade shaft. If we were not to operate either the Wade pit or underground, we no doubt could get permission to handle Helmer ore through the Wade shaft. It is quite important that we move the Helmer tonnage available next season, on account of the situation as to the minimums.

Both the Wade and Helmer stockpiles are somewhat off grade and if no sweetening ore is taken from the Wade pit, our 1924 shipments would only run about 57% in iron content.

GENERAL SURFACE

The Wade and Helmer premises have been patrolled by day and night watchmen during the past year. The captain has acted in the capacity of day watchman. No irregularities have been reported.

From the middle of April until August 11th, the stockpile crew was engaged on various jobs when not actually employed on stockpile work.

During the early part of the summer the scrap iron was collected and loaded out and the Wade stocking trestle was dismantled. Later the mine and location premises were cleaned of the winter's accumulation of rubbish and the weeds were cut in the immediate vicinity and some brushing was done for fire protection. Some of the location houses chimneys were repaired and in a number of instances a concrete cap was placed on top of the chimneys.

During July some of the force was employed in cleaning up the spill from stockpile loading and also in brushing out and removing the stumps from a strip of land 30' wide by 600' in length along the north side of the loading track. When this land is graded, there will be ample room for a winter's output. Our old stocking grounds were not adequate for the maximum production during the winter months.

On August 11th the stockpile crew was discharged and since then only the six regular men have been carried on the Wade payroll.

ACCIDENTS

Only one accident occurred at the Wade Mine during the past year, a description of which follows:

JOHN VAINIO

Injured-----	August 1st., 1923.
Occupation-----	Pitman.
Nationality-----	Finnish.
Time Lost-----	17 Days.
Compensation Paid-----	\$30.00.

Remarks: Vainio and several others were piling trestle timber and a spike, in one of the pieces, caught into John Vainio's clothing, resulting in a rupture of blood vessel (intoscrotum).

UNDERGROUND OPERATIONS

Three pumpmen have been employed on 8-hour shifts during the past year. With the exception of some flood water during the heavy rains of July, pumping conditions were normal throughout 1923. The snow and ice in the pit melted very gradually and there was no perceptible increase in the volume of water pumped. The ice and snow had disappeared by May 1st. During the heavy rains of July, it was necessary to operate the centrifugal pump for a few hours at a stretch upon several occasions.

A coil in the centrifugal pump motor was burned out and had to be shipped to the Ishpeming shops for rewinding. While the repair work was being done, a spare motor from the Boeing Mine was installed, to take care of any emergency. Except for rebabbiting several bearings on the pole pump, only minor repairs were made during 1923.

Very thorough monthly inspections were made of the underground workings of the Wade Mine during the year. The sub-level drifts were retimbered in places during 1922 and while some of the lagging and a few caps broke during 1923, it was not necessary to do any repairing. The main level opening into the Helmer pit is blocked with ice every winter and this cuts off the circulation of air through the Wade workings. The fungus growth makes considerable progress each winter while the air circulation is cut off and the timber throughout the mine is showing considerable evidence of dry rot. When the mine is reopened, it will be necessary to replace a considerable amount of the timber.

During the last few months of the year, the raise cribbing, ladders and sollars showed signs of dry rot. Quite a little repair work will be necessary here when underground operations are resumed. It is estimated that it will require practically a month with a fair size crew to put the tramways and sub-level drifts in shape for mining activities.

If underground operations are not resumed at the Wade Mine during 1924, it will still be advisable to do rather extensive repair work throughout the underground workings.

SHIPMENTS

Following are the cargoes of Wade-Helmer ore shipped during the past season and the analysis of same as obtained at the Mine and by the Lower Lake Chemists:

<u>PONTIAC</u> - - - - -	- - - - -	- 5/9/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	5,092 Tons.
	<u>FE.</u>	<u>PHOS</u>	<u>SIL.</u>	<u>MN.</u>	<u>MOIS.</u>	<u>FE.NAT.</u>		
Mine-----	57.82	.066	7.33	1.19	12.83	-----		
Cremer & Case-----	57.80	---	----	----	12.87	50.36		
<u>ISHPEMING</u> - - - - -	- - - - -	- 5/27/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	5,328 Tons.
Mine-----	57.71	.066	7.39	1.21	12.43	-----		
Crowell & Murray-----	57.61	---	----	----	12.96	50.14		
<u>MARQUETTE</u> - - - - -	- - - - -	- 6/2/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	7,198 Tons.
Mine-----	56.86	.067	7.40	1.39	11.52	-----		
Oscar Textor-----	57.03	---	----	----	12.18	50.08		
<u>NEGAUNEE</u> - - - - -	- - - - -	- 6/11/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	3,420 Tons.
Mine-----	56.55	.068	7.30	1.56	11.80	-----		
Hughes-Guentzler-----	56.25	---	----	----	12.02	49.49		
<u>PONTIAC</u> - - - - -	- - - - -	- 6/23/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	5,278 Tons.
Mine-----	55.95	.067	7.68	1.53	13.60	-----		
Cremer & Case-----	56.50	---	----	----	13.43	48.91		
<u>PONTIAC</u> - - - - -	- - - - -	- 7/1/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	5,310 Tons.
Mine-----	56.25	.068	8.34	1.60	12.55	-----		
Crowell & Murray-----	56.77	---	----	----	13.32	49.21		
<u>NEGAUNEE</u> - - - - -	- - - - -	- 7/2/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	6,086 Tons.
Mine-----	56.48	.069	8.30	1.52	12.37	-----		
Oscar Textor-----	56.20	---	----	----	13.65	48.53		
<u>W. G. MATHER</u> - - - - -	- - - - -	- 7/13/23 -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	1,337 Tons.
Mine-----	56.93	.066	7.77	1.52	13.54	-----		
Hughes & Guentzler-----	57.53	---	----	----	14.14	49.40		

Following is the average analysis of the Wade Grade shipped during the 1923 season, as obtained from Mine and Lower Lake Chemists' sampling:

	<u>Tons</u>	<u>Fe.</u>	<u>Phos</u>	<u>Sil.</u>	<u>Mn.</u>	<u>Mois.</u>	<u>FE.NAT.</u>
Mine-----	39,049	56.85	.067	7.71	1.42	12.51	49.74
Lower Lake-----	39,049	56.92	---	----	----	12.98	49.53

Of the above ore, 35,379 tons came from the Wade stockpile and 3,670 tons from the Helmer stockpile.

HELMER-WADE MINE

AVERAGE MINE ANALYSIS ON OUTPUT FOR YEAR 1923.

GRADE	IRON	PHOS.	SILICA	MANG.	MOIST.
Helmer,					(No Production)
Wade,					(No Production)

AVERAGE ANALYSIS ON STRAIGHT CARGOES FOR YEAR 1923.

GRADE	IRON	PHOS.	Mine SILICA	MANG.	MOIST.	Lake Erie IRON	MOIST.
Helmer,							(No Shipments)
Wade,	56.81	.067	7.70	1.42	12.46	56.91	12.98

ORE STATEMENT - DECEMBER 31ST, 1923.

	HELMER	WADE	TOTAL	TOTAL LAST YEAR
On hand January 1, 1923,	20,354	77,271	97,625	97,625
Output for Year,	-	-	-	-
Total,	20,354	77,271	97,625	97,625
Shipments,	3,670	35,379	39,049	-
Balance on Hand,	16,684	41,892	58,576	97,625
Decrease in Ore on Hand,			39,049	

1923 --- Mine Idle during Year.

1922 --- Mine Idle during Year.

HELMER-WADE MINE

SHIPMENTS FOR YEAR-1923.

	GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Helmer,		-	3,670	3,670	-
Wade,		-	35,379	35,379	-
Total,		-	39,049	39,049	-
Total Last Year,		-	-	-	-
Increase,				39,049	

WADE-HELMER MINE

COMPARATIVE WAGES AND PRODUCT

	1 9 2 3	1 9 2 2	INCREASE	DECREASE
PRODUCT	-	-		
No. Hours & Shifts				
AVG. NO. MEN WORKING				
Surface	4	2	2	
Underground	4	5		1
Total	8	7	1	
AVG. WAGES PER DAY				
Surface	5.30	5.15	.15	
Underground	4.84	4.19	.65	
Total	5.08	4.50	.58	
WAGES PER MO. OF 25 DAYS				
Surface	132.50	128.75	3.75	
Underground	121.00	104.75	16.25	
Total	127.00	112.50	15.50	
PRODUCT PER MAN PER DAY				
Surface				
Underground				
Total				
LABOR COST PER TON				
Surface				
Underground				
Total				
AVG. PRODUCT BRK'G & TRM'G				
" WAGES CONTRACT MINERS				
" " " TRAMMERS				
TOTAL No. of DAYS				
Surface	1,564	762 $\frac{1}{4}$	801- $\frac{3}{4}$	
Underground	1,400	1,622 $\frac{1}{2}$		222 $\frac{1}{2}$
Total	2,965	2,384- $\frac{3}{4}$	579 $\frac{1}{4}$	
AMOUNT FOR LABOR				
Surface	8285.97	3927.90	4358.07	
Underground	6780.51	6796.32		15.81
Total	15066.48	10724.22	4342.26	

Proportion of Surface to Underground Men:

- 1923 - 1 to 1
- 1922 - 1 to 2.50
- 1921 - 1 to 3.92
- 1920 - 1 to 2.84
- 1919 - 1 to 3.14

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31, 1923.

Ishpeming, Michigan,

January 16, 1924.

ENGINEERING DEPARTMENT.

Mr. M. M. Duncan,
Vice Pres. & Gen. Mgr.,
Building.

Dear Sir:-

The following report of the Engineering Department is herewith handed to you. The photographic maps and views which form part of this report have been bound and the books labeled as follows:

LIST OF ANNUAL REPORT MAP BOOKS FOR 1923.

Cleveland-Cliffs Iron Company,
Ishpeming and North Lake Districts.

Cleveland-Cliffs Iron Company,
Negaunee, Iron River & Republic Districts,
& Hydro Electric System.

Cleveland-Cliffs Iron Company,
Mesabi District.

Cleveland-Cliffs Iron Company,
Gwinn District.

These books contain the maps of the Company's mines; two sets of them have been prepared, one for the Cleveland office, which is handed to you, and the other, which is to be kept in the vault in this office.

Special books have been prepared for the other companies which are interested in the Cleveland-Cliffs Iron Company's mines and also books and loose prints have been given to the superintendents of the various districts as follows:

BOOKS - OR LOOSE LEAVES.	DISTRICT.	FOR WHOM.
Loose leaves	Ishpeming	L. Eaton
Book	North Lake	J. M. Bush
"	Negaunee	G. R. Jackson
"	Iron River & Republic	C. J. Stakel
Loose leaves	Hydro-Electric System	O. D. McClure
Book	Mesabi	M. H. Barber
Loose leaves	Boeing	C. Brewer
" "	Hill-Trumbull	H. C. Bolthouse
Book	Gwinn	W. W. Graff
"	Negaunee	Bethlehem Iron & Steel Corporation
2 Books	Wade, Boeing, Hill-Trumbull	Arthur Iron Mining Company
5 "	Boeing and Hill-Trumbull	Mesaba-Cliffs Iron Mining Company
Book	Athens Mine	Pickands, Mather & Company
"	Boeing Mine	Col J. B. Cavanaugh

The address of Colonel J. B. Cavanaugh is Royal Mineral Association, Hibbing, Minnesota.

Maps of the Athens Mine have been sent monthly to the Cleveland office for Pickands, Mather & Company. No mining operations were conducted in 1923 upon the portions known as the Mitchell and Corbit, consequently no maps were sent to the fee owners.

For the Oliver Iron Mining Company's Adams strip lying between the Maas and Negaunee Mines, maps have been prepared as usual.

No maps of the Barnes-Hecker or Moore and Chase properties have been requested during 1923. Mr. P. P. Chase made several visits to the office and was informed as to the progress of mining operations.

Fourteen sets of maps have been prepared for the Negaunee Mine fee owners.

Monthly maps have been sent out to Mr. R. S. Archibald, the Engineer in charge of the Roman Catholic Cemetery property at Negaunee.

Stephenson Mine maps have been furnished to Mr. L. J. Coman, that Company's Engineer.

Exploration maps of the Virgil have been sent out in accordance with the lease.

Mr. R. J. Chenneour, Assistant Engineer, has written the following pages covering the report of work done by the force employed in the Engineering office.

Following the above, I have added a few remarks on the Abstract Department and on various subjects.

Yours truly, *J. E. Jopling*
Chief Engineer.

JEJ:LTD.

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1923.

AND A BRIEF OUTLINE OF THEIR WORK.

BY REGINALD J. CHENNEOUR, ASSISTANT CHIEF ENGINEER.

THE FORCE.

The following table shows the personnel of the Department during the year, arranged in order of entrance:

NAME.	POSITION.	ENTERED.
R. J. Chenneour	Asst. Chief Engineer	Entire year.
H. O. Moulton	Engineer	" "
J. E. Hayden	"	" "
A. Rock	Helper	" "
J. T. Trosvig	Engineer	" "
T. A. Miller	"	" "
S. Malmgren	Helper	" "
C. W. Nicolson	Engineer	" "
K. C. Pellow	"	" "
A. Minnear	Helper	" "

The following table shows the days worked, days sickness, percentage of days worked, etc., for all men in the Department. The vacation column shows time granted for regular vacations. Eight hours constitutes a working day. There was no work Saturday afternoons during the year.

The total days as shown in the table are actual working days:

NAME.	DAYS WORKED.	DAYS VACATION.	DAYS SICK.	TOTAL DAYS.	PERCENTAGE DAYS WORKED.
R. J. Chenneour	269 $\frac{1}{2}$	6	0	275 $\frac{1}{2}$	98%
H. O. Moulton	265	9 $\frac{1}{2}$	1	275 $\frac{1}{2}$	96
J. E. Hayden	223	52 $\frac{1}{2}$	0	275 $\frac{1}{2}$	81
C. W. Nicolson	274 $\frac{1}{2}$	1	0	275 $\frac{1}{2}$	100
T. A. Miller	268	7 $\frac{1}{2}$	0	275 $\frac{1}{2}$	97
K. C. Pellow	259	9 $\frac{1}{2}$	7	275 $\frac{1}{2}$	94
J. Trosvig	284	0	0	275 $\frac{1}{2}$	103
A. Rock	269	$\frac{1}{2}$	6 $\frac{1}{2}$	275 $\frac{1}{2}$	98
A. Minnear	269 $\frac{1}{2}$	4	2	275 $\frac{1}{2}$	98
S. Malmgren	288 $\frac{1}{2}$	0	0	275 $\frac{1}{2}$	105

The following table shows the number of working days lost because of sickness and vacation by men in the Department for the last five years:

	1919.		1920.		1921.		1922.		1923.	
	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.	VACATION.	SICK.
R. J. Chenneour	2 $\frac{1}{2}$	0	25	10	17	3	11	0	6	0
H. O. Moulton	27	5	2 $\frac{1}{2}$	0	4 $\frac{1}{2}$	0	23	2	9 $\frac{1}{2}$	1
J. E. Hayden	0	0	23	4 $\frac{1}{2}$	19	0	12	4	52 $\frac{1}{2}$	0
C. W. Nicolson	0	0	0	1	24	0	10 $\frac{1}{2}$	0	1	0
T. A. Miller	18 $\frac{1}{2}$	1 $\frac{1}{2}$	16 $\frac{1}{2}$	0	3 $\frac{1}{2}$	0	23	0	7 $\frac{1}{2}$	0
K. C. Pellow	13	15 $\frac{1}{2}$	22 $\frac{1}{2}$	1 $\frac{1}{2}$	13 $\frac{1}{2}$	49 $\frac{1}{2}$	11	7 $\frac{1}{2}$	9 $\frac{1}{2}$	7
J. Trosvig	6 $\frac{1}{2}$	1 $\frac{1}{2}$	26 $\frac{1}{2}$	1	11 $\frac{1}{2}$	8	10	5	0	0
A. Rock	4 $\frac{1}{2}$	2 $\frac{1}{2}$	14 $\frac{1}{2}$	0	4 $\frac{1}{2}$	0	6 $\frac{1}{2}$	4	1 $\frac{1}{2}$	6 $\frac{1}{2}$
A. Minnear	9	8 $\frac{1}{2}$	18	1	0	0	0	0	4	2
S. Malmgren	0	0	8	1 $\frac{1}{2}$	0	0	0	0	0	0

The following table gives the names of the men employed in the Department during the last five years, arranged in order of entrance, showing the months worked and the average number of men for the year:

	1919.	1920.	1921.	1922.	1923.
C. Brewer	3	0	0	0	0
R. J. Chenneour	12	12	12	12	12
H. O. Moulton	12	12	12	12	12
J. K. Osborne	12	1	0	0	0
A. Rock	12	12	12	12	12
J. Trosvig	12	12	12	12	12
J. E. Hayden	0	12	12	12	12
T. A. Miller	11	12	12	12	12
J. J. Heilala	10	0	0	0	0
S. Malmgren	12	12	6	0	12
C. W. Nicolson	0	11	12	12	12
W. F. H. Janzen	12	1	0	0	0
C. Nicholls	3 $\frac{1}{2}$	0	0	0	0
A. Alanen	8 $\frac{1}{2}$	0	0	0	0
A. Minnear	12	12	6	3 $\frac{1}{2}$	12
K. C. Pellow	12	12	12	12	12
P. Denn	8	9	5	0	0
A. Ham	8	1	0	0	0
F. A. Olson	2	12	6	0	0
C. C. Taylor	0	12	6	0	0
A. E. Carlson	0	12 $\frac{1}{2}$	6	0	0
J. D. McCarthy	0	6	6	0	0
Average number of men	13 $\frac{1}{2}$	14 1/3	11 5/12	8 $\frac{1}{4}$	10

The work performed by each man in the Department is described briefly as follows:

REGINALD J. CHENNEOUR, as Assistant Chief Engineer, has had charge of the office during the year, supervising the office work, field and underground surveys. He assisted with the Barnes-Hecker and Spies shafts plumbing jobs and Cliffs Shaft, Holmes and Republic Mines surface surveys.

He spent some time in the field and office in connection with the change of roads across the Dead River Storage Basin and surveys for additional storage at the Carp River Basin No.2.

In the office, he prepared maps for insurance purposes and checked them over in the field with Mr. Ramsdell, of the Accounting Department.

He took monthly photographs of construction at the Dead River Storage Dam.

In the office, in addition to the regular routine work, he assembled the annual report and Tax Commission maps of all mines and had them photographed, printed and bound in books.

He prepared a report on the advisability of raising No.2 Carp River Storage Basin two feet, showing the increased storage to be expected, lands to be acquired and length of road that would have to be raised or changed.

HENRY O. MOULTON, Engineer, has been in charge of the engineering work at the Negaunee and South Jackson Mines for the entire year.

At the Negaunee Mine, he made the regular surveys and noted and posted all geology, gave lines for sinking No.3 shaft, made tests to show the direction of air currents and made maps of the same.

On the surface, he laid out 176' of wooden stocking trestle, supervised the guniting of the shaft house, made an estimate of ore and coal in stock and measured the Mining Department houses in Negaunee for painting.

In the office, he made a plan for surface men's change house, prepared a fire protection map, made the annual tax estimate and

maps and prepared the annual report maps.

While Mr. J. E. Hayden was away on a two months leave of absence, Mr. Moulton did the work at the Maas Mine in addition to his Negaunee Mine work.

At the Jackson Mine, he did the necessary survey work, which was mainly in connection with the Tax Commission estimate.

Below is a table showing the percentage of his time spent on Negaunee Mine and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Negaunee Mine,	19%	13%	35%	67%
Miscellaneous,	4	10	19	33
Total,	23%	23%	54%	100%

J. ELLZEY HAYDEN, did the engineering work at the Maas Mine, with the exception of two months, for the entire year. At this mine, he made the regular surveys, noting and posting all geology, designing a sump clean-out for the 3rd level pump house, made drawings of and gave lines for the new trench system of mining which is being used at this mine and made air tests to show direction of flow and quality.

In the office, besides his regular work for the mine, he prepared the annual report maps and made the Tax Commission estimate and maps. He also prepared a fire map of the Maas Mine in accordance with the rules laid down by the Central Safety Committee.

On the surface, he made surveys of parts of the Dead River road and an estimate of the cost of constructing a new road in the vicinity of Boyce's Creek. He also made surveys to determine the approximate position of the 1390' contour on the Carp River Storage Basin No.2 and prepared a report of the same showing the estimated increased storage that could be expected and lands that would have to be acquired.

He assembled blue prints of the various mines, locations, etc., showing the water mains, hydrants and location of insured property for fire insurance purposes.

He was away from the office on a leave of absence for two months.

Below is a table showing the percentage of his time spent at the Maas Mine and on other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Maas Mine	15%	5%	38%	58%
Miscellaneous,	1	8	33	42
Total,	16%	13%	71%	100%

CLYDE W. NICOLSON had charge of the engineering work at the Athens Mine for the entire year. At this mine he made the surveys and noted and posted geology. He made air tests to show volume, quality and direction of air currents and made a detailed report on the same with recommendations for improving it. He supervised the installation of a large fan on the bottom level. After this fan had been in operation for a time, he made other air tests and prepared another report on the air tests. He supervised the installation of booster fans and fan pipe in various parts of the mine.

He supervised the guniting of the wooden partition between the skip and cage compartments.

On the surface, he made estimates of ore and coal in stock, supervised the concreting of the permanent steel trestle and laid out the foundation for a cooling pond.

In the office, he posted the Athens abstracts to date, made the Tax Commission estimate and maps and prepared the annual report.

He did some work preparing tables to show factors to be used in making hydro electric computations.

He made a joint estimate of the Cleveland-Cliffs Iron Company's ore in stock at the Algoma Steel Plant at the Canadian Soo, together with their engineers.

Below is a table showing the percentage of his time spent on Athens Mine and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine	17%	33%	44%	94%
Miscellaneous	1	1	4	6
Total,	18%	34%	48%	100%

TOM A. MILLER did the engineering work at the Cliffs Shaft and Holmes Mines.

At the Cliffs Shaft Mine, he made the regular monthly surveys and located all diamond drill holes. He also ran a number of check surveys on the various levels and has started to check the elevations at various points on all levels.

On the surface, he made surveys for construction of new re-crushing plant, made estimates of crushed and lump ore piles and laid out additional stocking trestle.

In the office, he posted the Tax Commission maps, prepared the annual report maps, made fire maps to show location of fire hydrants, fire extinguishers, etc, and made maps of all levels showing the direction of air currents.

At the Holmes Mine, he made the regular surveys and frequently surveyed the contracts along the Section 16 Mine boundaries.

On the surface, he made an estimate of ore and coal in stock and also estimated the lagging piles. He surveyed the cracks caused by caving ground and the changes which had to be made in the railway tracks.

In the office, he prepared the Tax Commission and annual report maps, made fire maps and other maps to show the direction of air currents on all levels.

Below is a table showing the percentage of his time spent on the Cliffs Shaft and Holmes Mines and on other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Cliffs Shaft Mine,	22%	5%	36%	63%
Holmes Mine,	10	2	24	36
Miscellaneous,			1	1
Total,	32%	7%	61%	100%

KENNETH C. PELLOW did the engineering work for the Republic, Barnes-Hecker and Spies-Virgil Mines.

At the Republic Mine, he made monthly surveys and located all diamond drill holes.

On the surface, he made an estimate of ore in stock and measured

ENGINEERING DEPARTMENT.

the Company houses which were to be painted.

At the Barnes-Hecker Mine, he made regular surveys and assisted the Geologist in noting the geology. He also plumbed the 3rd level to check the old surveys.

At the Spies-Virgil Mine, he made surveys for new construction, checked the old surface surveys and plumbed the shaft from the surface to the 3rd level and from there to the 4th to establish surveys on the 4th level.

In the office, he made the Tax Commission estimate of the Barnes-Hecker and prepared the maps for the same and made the annual report maps. For the Republic Mine he made the Tax Commission and annual report maps. For the Spies-Virgil Mine he prepared the annual report maps and also made drawings of the old Lake pulley stands adapting them for use at this mine. He also made a drawing of the proposed pump house lay out for the 5th level.

He prepared fire maps and air current maps for all of the above mines.

Below is a table showing the percentage of his time spent on Republic, Barnes-Hecker and Spies-Virgil Mines and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Republic Mine,	11%	3%	24%	38%
Barnes-Hecker Mine,	9	0	28	37
Spies-Virgil Mine,	4	6	13	23
Miscellaneous,			2	2
Total,	24%	9%	67%	100%

JOHN TROSVIG did the engineering work at the Morris-Lloyd Mine for the entire year. At this mine he made the regular surveys, located diamond drill holes and assisted the Geologist in his surveys.

On the surface, he made an estimate of available stocking room, measured the North Lake houses for painting, gave lines for concrete curbs and sidewalks and supervised the laying of the same.

In the office, he made fire and air current maps, made the Tax Commission estimate and maps and prepared the annual report maps.

He also made an estimate of the cost of guniting the Morris-Lloyd shafts.

Below is a table showing the percentage of his time spent on Morris and Lloyd Mines and other miscellaneous work:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Morris Mine,	28%	7%	29%	64%
Lloyd Mine,	7	5	16	28
Miscellaneous,	2	1	5	8
Total,	37%	13%	50%	100%

ALBERT ROCK, helper, assisted the engineers with their surface and underground surveys and drove the Dodge truck. For about $2\frac{1}{2}$ months in each year, his entire time is devoted to making ~~type~~ the annual report prints.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
6%	46%	48%	100%

ARCHIBALD MINNEAR, draftsman and helper, assisted the engineers with their underground and field surveys and office work.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
32%	12%	56%	100%

SEXTUS MALMGREN, helper, assisted the engineers with their underground and surface surveys, cleaned tapes, made blue prints and assisted in making the annual report prints.

Below is a table showing the percentage of his time spent underground, in the field and in the office:

UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
33%	14%	53%	100%

The following table shows the percentage of time spent underground, in the field and in the office for engineering work for mines in this district:

	UNDERGROUND.	FIELD.	OFFICE.	TOTAL.
Athens Mine,	15%	36%	49%	100%
Barnes-Hecker Mine,	29	5	66	100
Cliffs Shaft Mine,	38	10	52	100
Holmes Mine,	28	12	60	100
Lloyd Mine,	27	20	53	100
Maas Mine,	24	13	63	100
Morris Mine,	37	14	49	100
Negaunee Mine,	23	24	53	100
Republic Mine,	28	14	58	100
Spies-Virgil Mine,	27	31	42	100
Average,	28%	18%	54%	100%

The next table shows the distribution of time and the cost for the various mines and other work for the last three years:

ENGINEERING DEPARTMENT.

DISTRIBUTION OF ENGINEERING LABOR FOR YEARS 1921, 1922 and 1923.

	1921.			1922.			1923.			PERCENT INCREASE.	PERCENT DECREASE.
	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.	LABOR.	TIME IN DAYS.	PER CENT.		
Angelina, Athens, Bunker Hill)	\$408.28	58½	2.06	3.26	0	0	\$3712.44	377	15.42		.89
Barnes-Hecker	2291.62	273½	9.76	3064.80	365½	16.31	1557.24	195½	6.47		.99
Cliffs Shaft	138.07	17	0.60	1146.28	167	7.46	2601.51	338½	10.81	6.12	
Holmes	1245.63	171½	6.06	797.99	105	4.69	1483.78	185½	6.17		4.82
No.3 Incline	1900.09	265	9.48	1762.03	245½	10.99	0	0	0		
Lake	1.81	¼	0	0	0	0	0	0	0		
Lloyd	528.22	77	2.73	0	0	0	1306.27	169	5.43	.40	
Maas	977.71	132½	4.69	850.18	112½	5.03	2660.75	274½	11.06		2.00
Morris	3191.92	346½	12.45	2809.29	292	13.06	2556.13	342½	10.62		1.71
Negunee	1886.87	266	9.50	1958.66	276½	12.33	2944.76	280½	12.24	.44	
Republic	2233.63	232½	8.24	2488.71	264	11.80	1534.23	178	6.38		1.65
Salisbury	1422.41	183	6.50	1410.13	179½	8.03	23.79	3½	.10		.17
South Jackson	190.77	28	1.00	43.28	6	.27	24.01	2½	.10		.02
Spies	18.69	2½	0.07	24.97	2½	.12	415.92	44½	1.73	.62	
Vivip	469.89	61	2.16	179.30	25	1.11	602.53	78	2.51	2.31	
Total Ishpeming, Negunee, Republic & Iron River,	\$16932.72	2120½	75.40	\$16567.87	2046	91.40	\$21423.36	2469½	89.04		2.36
<u>GWINN DISTRICT MINES.</u>											
Austin	0	0	0	9.69	1	.04	60.12	9	.24	.20	
Francis	27.66	3	0.10	37.03	5	.22	85.70	12	.35	.13	
Gwinn	42.93	6	0.20	23.92	3 3/8	.15					.15
Mackinaw-Gardner	69.67	9	0.30	2.50	3/8	.02					.02
Princeton	45.12	5½	0.20	28.30	3½	.17					.17
Stephenson	47.47	5	0.20	83.08	10½	.47	73.45	10½	.30		.17
Total Gwinn District,	\$232.85	28½	1.00	\$184.52	24	1.07	\$219.27	31½	.89	.18	
<u>MESABI DISTRICT MINES.</u>											
Boeing	29.75	3½	0.10	33.32	5	.23	77.02	11½	.32	.09	
Crosby	36.17	5	0.20	23.46	3½	.15					.15
Hill-Trumbull	44.56	6	0.22	33.35	5	.22	78.84	11½	.33	.11	
Meadow-Fowler	24.89	3½	0.12	16.30	2½	.11					.11
Wade-Helmer	41.67	5½	0.21	21.09	2½	.12					.12
Total Mesabi District,	\$177.04	24	0.85	\$127.52	18½	.83	\$155.86	23	.65		.18
<u>WATER POWER.</u>											
Dead River Stor. Dam E&A 414				621.33	65½	2.93	1049.97	99	4.36	1.43	
Operating Elec. Power Plants	0	0	0	158.17	18	.80	650.23	72½	2.70	1.90	
Carp River	97.33	11	0.39	0	0	0					
Transmission Line	11.57	1	0	0	0	0					
Dead River Storage Dam	293.01	34½	1.21	0	0	0					
Total	\$401.91	46½	1.60	\$779.50	83½	3.73	\$1700.20	171½	7.06	3.33	
<u>SURVEYS AND CONTOURS.</u>											
Section 3, 47-27 Expl.	16.99	2½	0.08	0	0	0					
" 1, " Contours	23.35	4	0.15	0	0	0					
" 2, "	9.66	2½	0.08	0	0	0					
" 3, "	29.05	5	0.20	0	0	0					
" 4, "	4.39	1	0.03	0	0	0					
" 6, "	6.07	1½	0.04	0	0	0					
" 10, "				92.46	14½	.65					.65
" 11, #	1369.80	164½	5.80	124.82	12½	.56					.56
" 12, "	54.93	7½	0.27	21.83	2½	.11					.11
" 13, "	5.54	1½	0.04	0	0	0					
" 14, "	975.64	136	4.83	62.70	6½	.29					.29
" 15, "	27.80	7	0.25	0	0	0					
" 21, "	15.41	4	0.18	0	0	0					
" 22, "	199.83	23½	0.82	0	0	0	18.62	3½	.08	.08	
" 23, "	18.83	5	0.20	0	0	0					
" 24, "	0	0	0	0	0	0	5.56	1	.02	.02	
" 26, "	19.33	6	0.22	0	0	0	0	0			
" 27, "	4.84	1½	0.03	0	0	0	10.64	2	.05	.05	
Neely Exploration	13.22	1½	0.03	0	0	0					
Total,	\$2794.68	374½	13.25	\$ 301.81	36	1.61	34.82	6½	.15		1.46
<u>MISCELLANEOUS.</u>											
American-Boston	28.93	2½	0.08	0	0	0					
Hoisting Plant	2.72	3½	0.10	0	0	0					
Abstracts	297.86	39½	1.40	145.02	17	.76	177.00	15	.73		.03
Oper. Hydro Elec. Plants											
Carp Basin No. 2,							118.09	11½	.49	.49	
New Hard Ore Warehouse	6.79	1	0.03	0	0	0					
Division of Smith's Bay	105.27	15½	0.53	0	0	0					
Diversion Ditch, Barnes-Hecker	920.25	136	4.87	0	0	0					
Miscellaneous	157.03	25	0.89	98.65	13½	.60	256.45	22½	.99	.39	
Total	\$1538.92	223	7.90	\$243.67	30½	1.36	\$531.54	49	2.21	.85	
Grand Total,	\$22078.12	2817	100.00	\$18204.89	2238½	100.00	\$24065.05	2750½	100.00		

OFFICE EXPENSE.

Below is a comparative table of office expense for three years:

	1921.	1922.	1923.
Traveling expense and livery,	\$ 252.88	\$ 266.86	\$ 295.27
Supplies (see below), - -	2910.19	1503.47	2453.41
Operating automobiles, - -	1877.24	990.27	1261.85
Office expense, - - - -	107.93	38.21	306.18
Insurance, - - - -	221.25	231.26	231.25
Taxes, - - - -	43.63	41.68	42.78
Total,	\$5413.12	\$3071.75	\$4590.74
Total salaries general office, Engineers # - - -	22078.12	18204.89	24065.05
Total charges to Eng. Dept.	\$27491.24	\$21276.64	\$28655.79
# Does not include salary of Chief Engineer and Stenographer.			

The following table shows extraordinary charges for supplies in the above for the year 1923:

Keuffel & Esser Company, - - - -	\$ 53.28
Denn Brothers, - - - -	66.79
Childs Art Gallery, - - - -	395.66
Stenglein Bindery, - - - -	75.50
George A. Newett, - - - -	49.17
Winter & Suess, - - - -	121.84
American Blue Print Paper Company, -	24.05
E. G. Soltman, Inc., - - - -	132.33
C. L. Berger & Sons, - - - -	49.33
Frederick Post Company, - - - -	13.37
C. F. Pease Company, - - - -	323.33
American Blue Print Paper Company, -	88.47
C. F. Pease Company, - - - -	54.00
American Blue Print Paper Company, -	18.44
Stenglein Bindery, - - - -	11.47
American Blue Print Paper Company, -	19.44
Keuffel & Esser, - - - -	18.51
George A. Newett, - - - -	18.17
Underwood Typewriter Company, - -	47.95
Stenglein Bindery, - - - -	33.57
American Blue Print Paper Company, -	15.59
Childs Art Gallery, - - - -	445.74
Keuffel & Esser, - - - -	49.92
Depreciation (Dodge truck 1923), - -	249.38
Depreciation (Dodge touring car 1923),	337.75

AUTOMOBILES.

The Dodge truck and touring car were put in operation in April and were run continuously for the balance of the year.

Below is a comparative statement of auto and livery expense for three years. NOTE: Year 1921 using Ford truck and touring car; Dodges in 1922 and 1923:

	1921.	1922.	1923.
Company horses,	\$ 251.18	\$ 255.84	\$ 289.14
Company automobiles;			
Salaries,	601.31	0	0
Expense,	1275.93	990.27	1261.85
Traveling expense,	1.70	11.02	6.13
Total,	\$2130.12	\$1257.13	\$1557.12
COST OF OPERATING AUTOMOBILES.			
Chauffeur's salary,	601.31	0	0
Gasoline, oil, etc,	246.39	208.34	169.97
Tires and tools,	207.84	70.35	206.41
Repairs,	292.75	70.90	116.35
Miscellaneous,	77.58	87.21	77.18
Insurance,	113.08	123.36	104.81
Depreciation,	338.29	430.11	587.13
Total,	\$1877.24	\$ 990.27	\$1261.85

M I N E S.

ATHENS MINE.

Regular surveys were made and all geology posted.

Air tests were made at various times and two reports written showing the conditions and suggestions were offered to improve the quality and quantity.

Guniting the shaft dividing between the skip and cage compartments was supervised.

An estimate of ore and coal in stock was made.

A cooling pond was designed and the foundations for the same laid out on surface adjacent to the engine house. This work was done with a cement gun.

The abstracts of this mine were brought up to date.

BARNES-HECKER MINE.

Regular surveys were made and geology noted and mapped.

The 3rd level was plumbed to check the old surveys. The working places at this mine had to be surveyed frequently in as much as most of the work being done is to develop and determine the size and position of the ore body.

CLIFFS SHAFT MINE.

Regular monthly surveys were made and all diamond drill holes located.

Check surveys and elevations were run on a number of levels.

On the surface, surveys were made for new construction at the re-crushing plant.

Additional stocking trestle was laid out and estimates were made of lump and fine ore piles.

HOLMES MINE.

Regular monthly surveys were made.

All working places along the Section 16 boundary lines were surveyed frequently to avoid trespasses.

On the surface, the outline of the caving ground was surveyed.

ore and coal piles were estimated and an estimate made of the lagging on hand.

MAAS MINE.

Regular surveys were made and geology noted and posted.

A sump clean-out was designed for the 3rd level pump room.

The trench system of mining is being tried at this mine and takes a great deal of the engineer's time.

On the surface, additional stocking trestle was laid out.

MORRIS-LLOYD MINE.

Monthly surveys were made and all geology noted and posted.

Diamond drill hole locations were surveyed.

On the surface, surveys were made to determine the stocking room available.

A new stocking trestle was also laid out.

NEGAUNEE MINE.

Surveys were made and geology noted and posted.

Special surveys were run to continue the sinking of No3. shaft.

On the surface, 176' of double wooden trestle was laid out on the East end of the present permanent trestle.

An estimate was made of ore and coal in stock.

Surface men's change house was designed and located.

REPUBLIC MINE.

Monthly surveys were made and all diamond drill holes located.

On the surface, an estimate of ore in stock was made.

The Company houses were measured for painting.

SOUTH JACKSON MINE.

There was very little work done at this mine during the year, most of it being in connection with the annual Tax Commission estimate.

SPIES-VIRGIL MINE.

Surface surveys were made in connection with the construction of the new engine house and the location for placing old Lake pulley stands which had been changed to meet conditions at this mine.

The old surface surveys were checked, preparatory to transferring to the new 4th level underground.

The new 4th level was plumbed to transfer the surveys to this level.

ALL MINES.

Fire maps were made to show the location of fire hydrants, fire hose, fire extinguishers and giving instructions to be followed in case of fire, and maps were prepared to show the direction of air currents for all mines.

MISCELLANEOUS.

NORTH LAKE DISTRICT.

Curbs and sidewalks were laid out and the construction of the same supervised.

REPAIRS TO RENTED HOUSES.

The houses in Negaunee and Republic were measured for painting.

ESTIMATE OF ORE IN STOCK AT ALGOMA STEEL PLANT AT SAULT STE. MARIE, ONTARIO.

A joint estimate of the Cleveland-Cliffs Iron Company's ores in stock at their plant was made by our and their engineers.

ABSTRACTS.

The Athens Mine abstracts were brought up to date.

The Cleveland office copy of Water Power Abstracts was posted to date and returned to them.

DEAD RIVER STORAGE DAM E & A NO. 414.

Photographs were taken monthly to show progress of construction.

Mr. Charles Cummings of Marquette was employed to survey the proposed location for a new road and to re-locate missing land corners. The new road was to provide a crossing further up the river. The present road would be under water. A great deal of work was done by engineers in this office in connection with the changes of roads.

CARP RIVER STORAGE BASIN NO. 2.

Surveys were run to determine the approximate position of the 1390' contour, which is 10' above the present elevation of the basin. Reports were made showing the increased storage to be expected, lands

that would have to be acquired and the probable length of road that would have to be elevated or changed.

INSURANCE MAPS.

Insurance maps were prepared for the Cleveland office showing the size of water mains and the location of insured property.

OFFICE EQUIPMENT.

A new electric blue print dryer was purchased for drying blue prints. This machine is used for prints that we wish to get out at once and for drying the annual report maps. The purchase of this machine has speeded up the annual report printing at least 25%.

REPORT ON THE ABSTRACT DEPARTMENT FOR THE YEAR 1923.

Documents received have been recorded and copies made when necessary. The abstract of the Minnesota mines and the water power lands are still incomplete.

OPTIONS FOR MINING LEASES.

Two options were accepted by this Company upon lands in Crow Wing County, Minnesota, consisting of six forty acre tracts in Section 12, T. 138 N. R. 25 W. owned by Mr. Joseph H. Winter of Negaunee and others. The lands are some fifteen miles North of the mines on the Cuyuna Range. Explorations were concluded without discovery of ore.

MINING LEASES.

No mining leases were taken out during the year and none were surrendered. In May, there was received from the Cleveland office a cloth bound book entitled "MINING LEASES", which contains a summary of the mining leases arranged alphabetically and also shows the contract numbers.

DOCUMENTS RECORDED.

The following is a list of documents placed in the files during the year:

	<u>NO. RECEIVED.</u>	<u>LAST FILE NO.</u>
Land offers, - - -	68	1422
Authorizations, - - -	0	117
Deeds and Miscellaneous,	42	819
Easements, - - - -	0	145
Rights of Way, - - -	6	194
Water rights, - - -	2	32
Surface leases, - -	90	2097
Applications for Sale, -	9	77
Sales, - - - - -	48	378
Tax Histories, - - -	7	524
Legal Opinions, - -	8	178

LAND OFFERS.

The land offers for the greater part consisted of houses and lots in Negaunee, more particularly in the area West of the Maas Mine where this Company has already made several purchases.

There were a number of offers of land situated on the Cuyuna Range and Mesabi Ranges and also on the Michigan iron ranges. A few came from

other states and also from Canada.

AUTHORIZATIONS.

There were no authorizations for exploring recorded during the year.

DEEDS AND MISCELLANEOUS DOCUMENTS.

About half the number recorded were deeds and other documents granting additional rights in Minnesota; most of the rest were deeds of Negaunee lots. The last deed is from the I. Stephenson Company conveying the property upon which is situated the Cataract Falls on the Escanaba River near Gwinn.

EASEMENTS.

No easements for transmissions were secured.

RIGHTS OF WAY.

Four rights of way for highways were granted in Marquette County and two railway rights of way in Minnesota were recorded.

WATER RIGHTS.

A further agreement as to discharge mine waters from the Spies was obtained. One was also granted the City of Negaunee for the right to discharge storm sewer water in Partridge Brook.

SURFACE LEASES.

All the leases recorded were from the Cleveland-Cliffs Iron Company. Most of them were in the Gwinn District and the rest consisting of farms, gardens and house lot leases in the neighborhood of the mines.

APPLICATIONS FOR SALE.

The applications for sale which were recorded were those sent from the Land Department for approval by this Department.

SALES.

These were land contracts or deeds issued by the Land Department. Most of them were from the Cleveland-Cliffs Iron Company, the rest were from Mr. W. G. Mather and consisted of portions of his Michigamme property.

TAX HISTORIES.

Most of these tax histories refer to lands in the proposed Dead
ENGINEERING DEPARTMENT.

River Storage Basin.

LEGAL OPINIONS.

Most of the legal opinions also relate to the storage lands on Dead River.

LAND OFFER PLAT BOOKS.

The land offer plat books have been posted as to land offers and outside explorations; also a number of old options and leases granted by, as well as to, the Company have been entered. The old correspondence has been examined to obtain much of this information, which relates to a period some twenty or thirty years ago.

OUTSIDE EXPLORATIONS.

A few outside explorations have been listed and entered.

ABSTRACTS OF TITLE.

The few abstracts entered in the records relate to the lands acquired for the proposed Dead River Storage. Mr. Carl Brewer informs me that he has nearly finished the Minnesota abstracts but he has not yet sent the copy of the book to this office. The Cleveland office and the Land Department returned to this Department last summer the copies of the books entitled Hydro Electric Abstracts and Hydr1 Electric Maps. These books were posted and returned to the Cleveland office and the Land Department.

FARM AND LOT LEASE BOOK OF MAPS.

A book of maps showing farm and lot leases was received during the year from the Land Department. This book shows most of the areas and the lots under lease to various parties in the neighborhood of the mines.

MICHIGAN STATE TAX COMMISSION.

The maps and estimates of tonnages in the various mines were sent to the T ax Commission at the end of January. Mr. L. P. Barrett, Appraiser of Mines, visited the district in March and April. A new form prepared in this office is now in use to tabulate the estimates. It is 14" x 17" in size, being the same as that of the maps. Upon it also is shown the analyses of the ore in the mines.

FORCE OF ENGINEERS.

The personnel of the force remains the same as last year.

ENGINEERING DEPARTMENT.

DEAD RIVER WATER POWER.

A few additional purchases of land in the Dead River Storage Basin have been entered. During the construction of the storage dam at the hoist, a number of visits were made chiefly on land questions. For the changes in highways, several excursions were made and maps prepared.

PARTRIDGE BROOK, NEGAUNEE.

Further excavation has been made by the City of Negaunee in the bed of Partridge Brook to provide room for additional water from the new storm sewer.

IRON ORE INDICATIONS.

A second excursion was made with Mr. R. A. Brotherton on October 26th and a report written concerning iron ore indications in Section 2, 44-28, which he had noted many years ago.

HOMER MINE.

A suit was begun by the fee owners against the Buffalo Iron Mining Company (Wickwire Mining Company) who operate the Homer Mine at Iron River to recover damages for ore lost in mining. Messrs. F. A. Bell and M. J. Sherwood, Counsel for the defense, requested me to examine the workings, which was done in company with Mr. J. M. Bush on May 17th. Preparations were made to answer questions as a witness in this case. A hearing was attended June 5th to 7th at Iron Mountain.

ASHLAND MINE.

with
In June, Mr. J. M. Bush, an underground inspection was made at the Ashland Mine, Ironwood, to note the ore deposit opened in the neighborhood of the ore discovered by this Company just before the lease was surrendered. A report was made.

ROCK QUARRIES NEAR EAGLE MILLS.

A report was made in July on the condition of the Advance Industrial Quarry and that of the Beaver Board Company near Eagle Mills.

EMPIRE MINE.

In September, a report was made of the Empire Mine which had been operated for a short time by M. A. Hanna & Company.

ENGINEERING DEPARTMENT.

LOW GRADE ORE ON CASCADE RANGE.

An examination and report were made in November on the low grade ores upon Company lands on the Cascade Range.

CATARACT FALLS AT GWINN.

Investigations of the water power at the Cataract Falls on the Escanaba River, West of Gwinn, were followed by a survey made by the engineers of that district.

THE CLEVELAND-CLIFFS IRON COMPANY.

REPORT OF THE GEOLOGIST FOR THE YEAR ENDING DECEMBER 31, 1923.

STAFF.

The staff of the Geological Department in 1923 is shown in Table I below. There were no changes in the personnel during the year:

TABLE I.

<u>NAME.</u>	<u>OCCUPATION.</u>	<u>DURATION OF EM- PLOYMENT IN 1923.</u>	<u>DAYS LOST. SICKNESS, VACATION.</u>	<u>% OF WORKING DAYS WORKED.</u>
E. L. Derby, Jr.	Geologist in charge of Department.	Entire year	1½	98.9
E. A. Allen	Assisting Geologist, testing diamond drill holes, collecting & labeling samples, etc.	Entire year	0	95.6
Gustav Afuhs	Draftsman.	Entire year	2¼	98.8

The year was divided into the factors as shown in Table II below:

TABLE II.

Total days of eight hours worked,	- -	275½ days.
Sundays,	- - - - -	52 "
Days resulting from Saturday afternoons,		26 "
Holidays,	- - - - -	<u>11½ "</u>
Total,		365 days.

Table III, below, shows the average number of men regularly employed on the staff of the Geological Department during the last five years:

TABLE III.

<u>YEAR.</u>	<u>AVERAGE NUMBER OF MEN.</u>
1919	5.44
1920	4.06
1921	3.56
1922	3.00
1923	3.00

DIVISION OF WORK AMONG THE MEMBERS OF THE DEPARTMENT.

H. L. Smyth. The work of the Geological Department continued under the direction of Mr. H. L. Smyth as Consulting Geologist.

E. L. Derby, Jr. I continued to have direct charge of the Department. The larger portion of my time, as in other years, was taken up with the general oversight and supervision of the work of the Department. This has included, besides the usual routine office work, surface drilling explorations in the Ishpeming, Gwinn and Iron River Districts, and the Cuyuna Range; underground drilling in the Cliffs Shaft, Morris, Republic and Stephenson Mines; and the geological surveys in the Athens, Austin, Barnes-Hecker, Cliffs Shaft, Francis, Holmes, Maas, Morris-Lloyd, Negaunee, Republic and Stephenson Mines. I, personally, made the underground geological surveys of all new development work in these mines.

My time, not taken up with these duties, was spent chiefly as follows:

In January, I made an examination of the Section 16 Mine workings in company with Messrs. Cronk and Hulst, Oliver Company engineers, and convinced them that a large portion of the hard ore which they had been classifying as Castleford or siliceous grade was in reality high grade ore. This agreement was important in establishing the value of our 1/4 interest in this property in connection with the joint estimates we made relating to a possible transfer of interests in the Race Course and Right of Way strip at Negaunee, and the Lake Superior Iron Company's holdings.

In February, I examined the Company's marble property in the vicinity of the Ropes Gold Mine and Michigan Verde Antique Marble Quarry in company with Messrs. Jopling and Hayden, relative to the granting of a lease on a portion of it to the latter.

In May, I visited the Ford Motor Company's drilling exploration at Taleen's Spur, near Michigamme Mountain in the Mansfield District of Iron County, with Mr. J. R. Reigart, formerly of this Company but now in charge of the Mining Department of the Ford Motor Company.

In June, I again visited the Ford exploration at Taleen's Spur with Mr. Reigart and reviewed the results of the work to date. I have made complete reports of this work for our files.

In July, I made an examination and reported on the quarries of the Advance Industrial Company and the Beaver Board Company near Morgan Heights in company with Mr. Jopling. These properties are under lease from us.

In August, I again visited the Ford exploration at Taleen's Spur with Mr. Reigart, the drilling being practically completed at this time. No ore discoveries were made.

In September, I made an examination of the Company's Ethel Mine at Ethel, West Virginia, with Mr. G. R. Jackson. We made a joint report of our findings with recommendations for the future development of the property.

In November, I accompanied Mr. Elliott to Hurley, Wisconsin, where we examined Pickands, Mather & Company's Carey Mine and made estimates of its value. We were called as Pickands, Mather & Company's witnesses at a hearing being conducted in Hurley at this time before a Board of Review appointed by the Wisconsin State Tax Commission in Pickands, Mather & Company's attempt to have the local Assessor's valuation materially reduced. I understand that they were completely successful. I also visited the Ford Motor Company's drilling explorations in Section 19, 46-30, Southwest of Republic, known as the Pumpelly Mine, and in Section 35, 47-29, Northwest of Republic at the old Riverside Mine in company with Messrs. Reigart and Kronquist. The latter is Geologist for the Ford Company.

In December, I examined the old rock and lean ore dumps at the Fitch Mine with Messrs. Jopling and J. H. Quinn. Mr. Quinn was contemplating an arrangement with the Company to pick out and recover the high grade ore which he thought might exist. I believe he is now convinced that this would not be an economical undertaking. I also went underground at the Imperial Mine with Messrs. Jopling and Kron-

quist and examined the drill results which the Ford Company, now the operating owners of this property, have obtained since they reopened the property. On the East end of the 4th level and on a sub-level above they have exposed a North-South fault heretofore unknown, which undoubtedly has an important bearing on the extension of ore in this locality. The Ford Company is negotiating for an exploring option on the four forties lying just East and South of the Imperial owned by Mr. Mather.

E. A. Allen. Mr. Allen continued as an assistant in the Department throughout the year. About one seventh of his time, however, was spent assisting in the Engineering Department in the capacity of a truck driver and in assisting several of the engineers with their surveys. The major part of his time in the Geological Department was employed in collecting, sampling and filing diamond drill samples from the current explorations and in making Maas Compass surveys of all the deep holes. He took complete samples of the drill water at the last Virgil drill hole while ore was being encountered in order that we might get a sample of the soluble sulphur content of the ore. He occasionally assisted me in the underground geological surveys and accompanied me in nearly all of my trips into the field. He made the regular monthly carbon report and the annual inventory of diamond drill equipment and did some map work in the office. He also visited several outside explorations during the year in which I did not participate.

Gustav Afuhs. Mr. Afuhs continued as draftsman throughout the year. His work, as in the past, has consisted chiefly in preparing cross-sections of drilling and in posting the current extensions on the underground geological maps and cross-sections of all the Company's operating mines on the Michigan ranges, making new maps and cross-sections as they became necessary. He spent considerable time on the large number of Canadian land offers in our files, correlating the information spread through the various records and plotting the locations and numbers on a series of maps as a permanent record which

can be easily referred to. He posted the Tax Commission's set of geological cross-sections of the Athens, Morris-Lloyd and Negaunee Mines and made a number of new sections covering the new extensions during the year. He colored all the annual report sheets of the Company's drilling for the year and the legend sheets to accompany them. He also made copies of drill results for our outside exploration files of all the important land offers that were received and spent the rest of his time on the routine work of the office.

SURFACE GEOLOGICAL SURVEYS.

No surface geological work of any magnitude was done during the year on account of the reduced number of our staff which has been maintained since the depression period of 1921. We have gotten along without an assistant geologist by confining our attention only to the more pressing duties of the Department.

UNDERGROUND GEOLOGICAL SURVEYS.

Having no assistant geologist, I have continued to depend on the several engineers for a large amount of current underground geological data in our operating mines, more particularly in the areas previously developed. I have personally made geological surveys of the new development work in all the mines, except those on the Mesabi Range.

ATHENS MINE.

The Athens Mine was worked steadily throughout the year. Except for a small extension on the 6th level, which I surveyed, the work in the property was practically confined to mining. Both the geological maps and cross-sections were posted regularly from the information furnished us by Mr. Nicolson, Engineer at the property and formerly an assistant geologist.

AUSTIN MINE.

This mine operated until December. The work continued to be confined principally to scrambling on the various levels in the area having triangular cross-sections made by the footwall and the old nearly vertical limits of the slices caved, and to the pillars around the old

main shaft. The geological maps and cross-sections were posted regularly from my frequent surveys of the workings and from data supplied by Mr. Tillson, Engineer.

BARNES-HECKER MINE.

This mine was operated throughout the year but is still in the development stage, although mining was done on several of the top sub-levels. A total of about 400' of drifting was done from the two Easternmost headings on the 1st level, extending them farther East and Southeast. Raises were put up from these drifts to explore the ore encountered in surface drill hole No.25, which showed a good footage. These developments have been encouraging as far as they have gone. The main 3rd level drift was extended nearly 400' East and encountered a nice body of ore. A raise in this ore, which is still going ahead in ore, indicates that this body may connect with the ore in No.25 drill hole mentioned above in connection with the 1st level development. A connection was made with the Morris Mine through a raise put up from the West end of the 6th level Morris to the East end of the 3rd level. The difference in elevation is about 190'.

In driving ~~the~~ West on the 6th level Morris Mine to make this raise connection, the main North Lake fault was cut near the raise location. This has been very helpful in studying the structure formed by it and in planning the explorations by drift and drill of the resulting fault crotch on Barnes-Hecker ~~px~~ territory. Conditions now appear very favorable for the development of a large body of high grade ore in this crotch below the 3rd level with a probable connection between it and the ore cut during the past year on the 3rd.

I have paid particular attention to the geology of this mine, making frequent surveys and keeping the geological maps and cross-sections posted. At no time in its development have the conditions for the discovery of a good sized ore body been as encouraging as at present.

CLIFFS SHAFT MINE.

This mine has been a steady producer during the year. For a number of years past very little detailed geological work has been done, principally because of our reduced force and the continued accessibility of the mine workings. Geological surveys were resumed, however, late in the year. We hope to keep up with all current extensions and gradually survey the old work and bring it up to date. Another reason for the delay in resuming this work has been the lack of elevations and check surveys by the Engineering Department in several parts of the mine, which affect materially the accurate construction of the cross-sections.

FRANCIS MINE.

The Francis Mine continued to produce throughout the year. I have made regular geological surveys here and posted the maps and cross-sections. The new development for the year was practically confined to a short extension on the 6th level to provide additional room for raises to mine the ore below the 5th level and for raises to reach the South limb of the basin above the 4th and 5th levels. A small amount of mining was done between the 5th and 6th levels. The development work is practically complete, the ore on the North side and central part of the basin mined down to the 5th level, and most of the remaining ore will be removed during the coming year.

HOLMES MINE.

This property also produced continuously in 1923, the work all being confined simply to mining. Regular geological surveys were made and the geological maps and cross-sections posted.

MAAS MINE.

The Maas Mine operated steadily throughout the year. The geological maps and cross-sections were posted regularly from data furnished us by Mr. Hayden, Engineer at the property. No new developments, geologically, were made, the work being entirely confined to mining.

MORRIS-LLOYD MINE.

This property also operated continuously and a considerable amount of development work was done in the Morris. Work in the Lloyd and Lloyd

East was confined principally to mining. In the Morris, both the 6th and 7th levels were extended a considerable distance West and a number of new development subs opened between the two levels. In most cases these have explored ore bodies encountered on both the 6th and 7th levels and found to be continuous between them.

The 6th level, as already mentioned, cut the main fault extending under North Lake near the West end of the level and a raise was put up from here to the 3rd level Barnes-Hecker Mine. I have recommended that the 6th level be continued on Barnes-Hecker ~~area~~ territory to explore the fault crotch. It is quite probable that a considerable body of ore will be found at this elevation and below it.

I have made frequent geological surveys of all this new development work and have used data furnished by Mr. Trosvig, Engineer at the property, for posting the geological maps and cross-sections of the areas where only mining is being done.

NEGAUNEE MINE.

The Negaunee Mine continued to be one of the largest producers on the Range. The shaft, which formerly bot tomed at the 12th level, was sunk 113' during the year. The last 30' of ground was in good ore except that it is high in sulphur content. This good ore is not altogether a surprise as the iron formation from the 10th level^{down} is very rich so that it was realized that ore might be encountered as the slate foot-wall was approached in sinking. It is quite possible that this ore connects with that encountered in surface drill hole No.17 in Section 5, under the D. S. S. & A. Railway right of way and in front of Captain Haggerton's house. The latter is about 1000' East of the shaft. There is a rather steep and narrow synclinal structure indicated as connecting these two points and may account for quite an appreciable amount of ore.

Aside from the shaft sinking, all work in the mine was confined to mining. I have made a survey of the shaft development and the geological maps and cross-sections have been posted regularly from data supplied to us by Mr. Moulton, Engineer at the property.

REPUBLIC MINE.

This property produced continuously throughout the year, the ore all coming from the Pascoe Shaft workings. The main ore body on the -2570' level was discovered and completely developed on the -2670' level during the year. New ore was also developed on the South side of the -1570' level. It is now planned to drift across to and raise No.9 shaft on the -2670' level and completely explore the formation in this vicinity. Geological surveys, which for several years past have been made only at irregular intervals, have been resumed on a regular schedule and most of the old work caught up. I have made these surveys and posted the geological maps personally.

SPIES-VIRGIL MINE.

During the year the Spies shaft was bot tomed at a point 850' below the 3rd level, sinking having been started 50' below the 3rd level during the summer of 1922. Two new levels have been cut,- the 4th level, 550' below the 3rd and the 5th level, 250' below the 4th. Drifting on these levels to open up the Virgil ore body will be commenced early in 1924. A record of the material passed through in the shaft has been kept and mapped. It was all footwall slate, principally gray slate with cherty seams.

STEPHENSON MINE.

The Stephenson Mine operated continuously throughout the year. The only new development work done was an exploration crosscut into the hanging wall on the 6th level in Section 29, cutting about 35' of ore, from which some diamond drilling was done, and the sinking of a winze from the Southeast side of the 6th level for the purpose of developing and mining the ore below it. Regular geological surveys were made and the geological maps and cross-sections posted to date.

EXPLORATIONS.

Drilling explorations were carried on during 1923 in the following districts and mines:

FROM SURFACE.

<u>DISTRICT.</u>	<u>RANGE.</u>
Ishpeming	Marquette
Gwim	Swanzy
Iron River	Menominee
Aitkin	Cuyuna

FROM UNDERGROUND.

<u>MINE.</u>	<u>DISTRICT.</u>
Cliffs Shaft	Ishpeming
Morris	North Lake
Republic	Republic
Stephenson	Gwim

Two options were acquired during the year as follows:

No. 108 from Joseph H. Winter et al covering the NW $\frac{1}{4}$ of Section 12, 138-25, Crow Wing County, Cuyuna Range, Minnesota.

No. 109 from Frank Hense and wife covering the N $\frac{1}{2}$ of the SW $\frac{1}{4}$ of the same section.

These options together cover the so-called Winter-Johnson exploration and I understand have been relinquished.

No mining leases were acquired or surrendered during the year.

Table IV, which follows, gives the footage drilled, the ore encountered and the cost per foot of drilling for both surface and underground explorations. It will be noted that the average cost of surface drilling was \$3.83 per foot, excluding certain items which are not actually drilling expense but which are charged to the explorations. By including these items, the average cost was \$4.25 per foot. The average cost of underground drilling in the same way was \$5.20 per foot and \$3.40 per foot, respectively. The average cost of all drilling was \$3.38 per foot and \$3.65 per foot, respectively.

The cost of surface drilling was about 10% higher than in 1922 due principally to the relatively small footage drilled, - 2596' as against 4648' in 1922. There was also a 10% wage increase on May 1, 1923. The

cost of underground drilling on the other hand was over 7% less than in 1922 due to a larger footage, - 6495' as against 2986' in 1922. The cost of all drilling was a little less than 2% under the 1922 cost in spite of the wage increase.

Table V, also shown below, gives a comparative cost per foot of total drilling for the last five years:

TABLE IV.

SUMMARY OF DRILLING FOR 1923.

EXPLORATION.	DESCRIPTION. SEC. T. R.	STAND- PIPING FT.	CHURN DRILLING FT.	DIAMOND DRILLING FT.	TOTAL FT.	FIRST CLASS ORE FT.	SECOND CLASS ORE FT.	LEAN ORE FT.	TOTAL COST	COST PER FT.	TOTAL COST	COST PER FT.
									"A".	"A".	"B".	"B".
<u>SURFACE DRILLING.</u>												
Salisbury,	15 47 27	12		116	128	0	0	0	\$ 823.83	\$6.44	\$ 803.21	\$6.28
Austin,	20 45 25			66	66	0	0	0	198.43	3.01	198.43	3.01
Virgil,	24 43 35	75	12	1515	1602	50	45	25	7179.48	4.48	6414.51	4.00
Winter-Johnson (Minn.)	12 138 25	537	153	110	800	0	0	0	2826.67	3.53	2533.62	3.17
Total Surface Drilling,		624	165	1807	2596	50	45	25	\$11028.41	\$4.25	\$9949.77	\$3.83
<u>UNDERGROUND DRILLING.</u>												
Cliffs Shaft Mine,	9 & 10 47 27			679	679	55	40	44	\$2175.26	\$3.20	\$1969.16	\$2.93
Morris Mine,	1 & 2 47 28			1285	1285	25	25	217	4087.38	3.18	3805.53	2.96
Republic Mine,	7 46 29			4343	4343	516	83	188	15182.42	3.50	14416.56	3.32
Stephenson Mine,	29 45 25			188	188	60	5	10	664.74	3.54	590.72	3.14
Total Underground Drilling,				6495	6495	656	153	459	\$22109.80	\$3.40	\$20801.97	\$3.20
Grand Total Drilling,		624	165	8302	9091	706	198	484	\$33138.21	\$3.65	\$30751.74	\$3.38

NOTE: Cost "A" includes taxes, office expense, engineering, analysis, legal and personal injury.
 " " "B" excludes " " " " " " " " " " " " " " (to compare with contract price).

The contract drilling for the year comprises the surface drilling on the Winter-Johnson exploration and was done by S. E. Atkins Company.

TABLE V.

SUMMARY OF FOOTAGE DRILLED AND COST PER FOOT OF DRILLING FOR PAST FIVE YEARS.

YEAR.	TOTAL FEET DRILLED.	COST PER FOOT	
		"A".	"B".
1919	42,844	\$4.49	\$4.31
1920	26,658	5.41	4.81
1921	16,011	5.14	4.37
1922	7,634	3.79	3.44
1923	9,091	3.65	3.38

SURFACE EXPLORATIONS.

MARQUETTE RANGE.

ISHEMING DISTRICT.

SECTION 15, 47-27, SALISBURY MINE SURFACE.

A short drilling campaign was started on the surface of the Salisbury Mine early in December. The object of this work is to test two relatively shallow areas of iron formation lying in depressions on the irregular top of the uppermost greenstone sheet.

The first area to be explored is about 300' Southeast of the old shaft No.13 and a similar distance Northeast of the center of the section.

The first hole, No.70, is located at approximately 12650 S. and 17950 W. and is being drilled vertically. It ledged in greenstone at a depth of 9' and was still in it at a depth of 128' on the last of the year. This greenstone is probably the main sheet which outcrops a short distance to the South. It is faulted in this locality, however, and the hole will be continued until we have eliminated the possibility of cutting through the faulted edge into iron formation or possibly ore. If no ore is found, one or two additional shallow holes will prove up the area.

The second area to be tested is that lying beneath Grass Lake, near the center of the SE $\frac{1}{4}$ of the section.

SWANZEY RANGE.

GWINN DISTRICT.

SECTION 20, 45-25, AUSTIN MINE SURFACE.

One shallow hole, No."D", was sunk in August on the site of the new stocking ground to be sure that no ore existed beneath before commencing to stock ore. It was located at approximately 330 S. and 1965 E. and was drilled vertically. It ledged in footwall slate at 25' and was bottomed in the same material without change at 66'.

MENOMINEE RANGE.

IRON RIVER DISTRICT.

SECTION 24, 43-35, VIRGIL MINE SURFACE.

During 1922 a series of four drill holes, Nos. 50 to 53 inclusive, were drilled on the West side of the Virgil Mine forty to confirm the drilling done by the Wickwire Mining Company and to develop enough additional ore to warrant, if possible, the immediate development of the property. The results were entirely successful and the fifth hole, No. 54, the most Northeasterly hole of the series, was standpiping at a depth of 10' on the first of the year.

The rocks are steeply folded in this vicinity and apparently hole No. 54 followed along very closely to the nearly vertical and irregular contact between the iron formation and footwall slate, being first in one and then the other. A 50' run of good ore was encountered from 1460' to 1510' averaging 57.71% iron, .834% phosphorus and .912% sulphur. The hole was finally bottomed in footwall slate at 1612' early in April.

This is the first instance in the Virgil drilling where sulphur in any quantity has been found in the ore. This is hardly surprising, however, since the footwall slate carries considerable pyrite in places and it is quite likely that the sulphur in reality exists in seams of slate mixed with the ore on the contact. The high phosphorus content also points to this conclusion. This completed the drilling on the Virgil for the present.

CUYUNA RANGE.

AITKIN DISTRICT.

SECTION 12, 138-25, WINTER-JOHNSON EXPLORATION.

On July 6, 1923, options were acquired on the NW $\frac{1}{4}$ and the N $\frac{1}{2}$ of the SW $\frac{1}{4}$ of the above description, which lies about sixteen miles North and a little West of Aitkin, Minnesota, on the Cuyuna Range. Drilling was early commenced in September, the work being done by the S. E. Atkins Company of Duluth, under contract.

Two holes were drilled in September and October and both encountered nothing but light gray decomposed slate, after ledge was finally reached in one case at 263' and in the other at 274'. No additional drilling was deemed advisable and I understand the options have been relinquished.

UNDERGROUND EXPLORATIONS

CLIFFS SHAFT MINE.

Diamond drilling was resumed in the Cliffs Shaft Mine at the end of September. The first hole to be drilled, No.325, was located at the West end of the 15th level "B" Shaft. It was drilled horizontally and N. 57°28'W. to explore for the downward extension of the main vein in contact with the quartzite hanging wall. Two runs of good ore were encountered,- one of 41' from 169' to 210' averaging 62.45% iron and .210% phosphorus and the other of 9' from 243' to 252' averaging 60.84% iron and .099% phosphorus. These results are very encouraging.

Hole No.326 was then drilled horizontally and S. 5°04' E. from the same level but about 250' East of the West end to explore for the downward extension of the fault vein ore above. The vein formation was encountered between 260' and 283' but it only averaged 51.45% iron and .152% phosphorus at this point. A drift will have to be driven for some distance into this vein, however, in order to mine out the floor of the stope above and this will enable us to more thoroughly explore the locality for this ore.

The drill was moved to the South drift of the 11th level "A" shaft for hole No.327. It is being drilled horizontally and due South from approximately 748 S. and 2100 E. to explore for the main South vein which is being mined on the 10th level. The hole was 49' deep at the end of the year and all in greenstone.

MORRIS MINE.

Drilling was resumed in this mine the last of August and a series of five horizontal holes, Nos.71 to 75 inclusive, was drilled from the

Western end of the 7th level. Holes Nos.71, 73 and 75 were drilled due South into the jasper hanging wall. The distance between Nos.71 and 73 was about 280' and between Nos.73 and 75 about 200'. Holes Nos.72 and 74 were drilled due North as far as the slate footwall and directly opposite Nos.71 and 73, respectively.

Holes Nos.71, 73 and 75 going South found no ore but Nos.72 and 74 both cut good ore. In hole No.72 it was only a 5' seam but in No.74, 20' of good ore was encountered from 20' to 40' and averaged 65.02% iron and .148% phosphorus. It is quite likely that these two runs connect and that the ore extends Easterly and joins the ore cut on the North side of the level 50' distant. These latter results are very encouraging as this ore body is entirely distinct from any known ore body on the level above.

Hole No.76 was drilled horizontally and due North from approximately S. 3276 and 2200 W. on the 6th level. This location is below and a little to the West of the main sub-level stope. The object here was to explore for the possible downward continuation of a body of ore some distance above the level and, where being mined, more or less separate from the ore in the big stope. Rich formation, averaging from 47% to 50% iron, was encountered between 40' and 80' but no good ore and the hole was bottomed in footwall slate at a depth of 103'.

Hole No.77 is being drilled from the same locality on the 6th level with a dip of -40° and N.25° W. from approximately S. 3450 and 2165 W. in order to determine the trend of the main sub-level stope ore body on its pitch below the 6th level. The hole was 95' deep and all in rich jasper at the end of the year but had not reached the expected location of this ore extension.

REPUBLIC MINE.

The diamond drill operated continuously in the Republic Mine. A total of 4343' was drilled, distributed in the deepening of old hole No.468 from 32' to 252', in completing hole No.510, which was drilled at a depth of 379' on the first of the year, drilling holes Nos. 511 to 539 inclusive, and hole No.540 to a depth of 29', which was the

position of the drill at the end of the year.

All but five of these holes were drilled horizontally and all of them from current working levels in the Pascoe Shaft according to the plan of systematic exploration that has been followed here for several years. In the first place, an attempt is made on all new levels to locate the downward extension of known ore lenses immediately above where they are not found by drifting along the quartzite hanging contact but presumably have dropped back into the jasper footwall. Secondly, the hanging contact zone is explored for new ore bodies by drilling in cases where rock drifting is unwarranted until a discovery of ore is made. Lastly, a systematic exploration of the jasper formation is made back to a horizon 100' to 200' from the hanging contact, it being the experience in this mine to find all the important ore bodies within this zone.

Hole No.468, located on the South side of the -1710' level, was drilled to a depth of 32' in 1921 and was deepened to 252' during 1923. It encountered ore from 190' to 199' and from 214' to 224' but as yet this has not been developed by drifting into it.

Holes Nos.510 and 524 to 527 inclusive were drilled from the -2470' level. No.510 explored the jasper footwall to a depth of 407' without finding ore. No.524 also drilled into the footwall and was blank. Holes Nos.525 and 526 drilled to the hanging contact and were blank. Hole No.527 encountered 13' of ore close to the West side of the shaft plat. It proved to be of small extent and has since been mined out.

Hole No.511 was drilled from the footwall of the main stope on the -2370' level with a dip of $-13^{\circ}12'$ to test the floor of the stope. It encountered ore at 25' and was still in it at 93' when bottomed.

Holes Nos.512, 528 and 529 were drilled from the -2570' level. No.512 encountered good ore from 32' to 57', with the exception of a 3' seam of soaprock from 46' to 49'. This ore proved to be a Southwesterly continuation of the ore in the main stope lying just under the foot of the Pascoe Shaft. No.528 was drilled Southwesterly from

GEOLOGICAL DEPARTMENT.

the shaft plat and was blank. No.529 was drilled Northwesterly also from the shaft plat and encountered ore from 26' to 38' in contact with the quartzite hanging.

Holes Nos.513, 514 and 515 were drilled from the extreme South end of the -2070' level. Holes Nos.513 and 514 were drilled up at +37° to determine if possible the bottom of the ore in the stope on the level above, which we have been unable to find with horizontal holes on the -2070' level. Both holes were blank. No.515 was drilled horizontally to the Southeast and was also blank.

Holes Nos.516, 517, 522, 523, 532, 533, 534, 538 and 540 were drilled from the -1710' level. No.516 was drilled up at +24°33' and Northwesterly from the South end of the level to explore the ground above the large stope at this point, the back of which was all in rock. Twenty three feet of good ore was encountered from 86' to 109'. The remaining holes were drilled horizontally from various points on the level on the systematic plan outlined above. No.517 encountered good ore from 76' to 86'6", 91' to 93', 117' to 119' and 174' to 179'; No.522 from 7' to 18' and 79' to 82'; No.523 from 111'4" to 112' and 118' to 125'; No.532 from 55' to 60'; No.533 from 88' to 90' and 96' to 99'; No.534 from 59' to 62'; No.538 from 0 to 2'. No.540 was being drilled on the last of the year and was 29' deep and blank at that time.

Holes Nos.518, 519, 520 and 535 were drilled from the -2670' level. No.518, which was drilled Southeasterly from the footwall of the shaft, started in ore at the shaft and continued in it to a depth of 52'. No.519 was drilled in the opposite direction to the quartzite hanging contact and cut ore from 0 to 35' where the quartzite was encountered. Nos.520 and 535 were drilled Northeasterly, both from the shaft plat. No.520 cut ore from 56' to 65' and No.535 from 0 to 2', 25' to 50', 58' to 59' and 63' to 76'.

Hole No.521 was drilled Southwesterly from the Southwest side of the -1570' level with a dip of -10° in order to carry it under the floor of an old open stope and explore the ground beyond and between old holes Nos.508 and 509. Good ore was encountered from 1' to 5', 18' to 25',

83' to 103', 146' to 150', 157' to 175', 177' to 181' and 194' to 206'.

Holes Nos. 530 and 531 were drilled from the stub drift going Southwest from the shaft plat on the -2170' level. Hole No. 530 was drilled Northwesterly and encountered good ore from 21' to 31', 96' to 98', 172' to 177' and 183' to 185'. No. 531 was drilled Southwesterly and encountered good ore from 107' to 110', 111' to 114', 115' to 117', 119' to 121' and 126' to 127'.

Holes Nos. 536 and 537 were drilled from the Southwest corner of the large stope 25' below the South side of the -1850' level. No. 536 was drilled due South and encountered ore from 0 to 47'. No. 537 was drilled Southeasterly and encountered good ore from 0 to 10' and 192' to 103'.

Hole No. 539 was drilled Southwesterly from a point on the -1850' level a short distance West of the shaft to explore for a continuation of the several seams of good ore encountered in old holes Nos. 282 and 283 drilled by the old Republic Company. Ore was cut from 6' to 8', 28' to 30', 36' to 37' and 48' to 54', no seam being of mineable width.

STEPHENSON MINE.

Two holes, Nos. 7 and 8, were drilled in this mine during the year. As previously mentioned, an exploration drift was driven a distance of about 150' due East from the North-South crosscut ~~into~~ in which are located raises 43, 45 and 48. Both these holes were drilled from the breast of this crosscut to explore the main ore horizon down to the elevation of the proposed 7th level and facilitate its lay out. No. 7 was drilled vertically and encountered good ore from 35' to 45' and from 50' to 75'. No. 8 was drilled Northeasterly with a dip of -36° and encountered good ore from 70' to 95'.

EXPLORATIONS BY OTHER COMPANIES.

Mr. Allen and myself have made occasional visits to explorations of other companies in Upper Michigan.

The principal work going on during the year was the drilling by the Ford Motor Company. They drilled 11 holes on their property in

Section 3, 43-31 at Taleen's Spur in the Michigamme Mountain area near Mansfield and found no ore. They also drilled one hole on the Mitchell farm at Three Lakes, which was blank. I understand this exploration was only temporarily stopped. They are now drilling in Section 19, 46-30, Southwest of the Republic on what was known as the Pumpelly Mine property and in Section 35, 47-29, Northwest of Republic at the old Riverside Mine. They also have one drill exploring from surface at the Imperial Mine. No ore has been found at the Pumpelly and Riverside thus far. The Imperial drilling is being conducted to more definitely outline the Imperial ore body and to determine the enclosing structure, as well as the geological features adjacent to it.

Mr. Afuhs has continued to copy for our files all outside exploration results of any importance which have come to this office in the form of land offers, etc.

EXAMINATIONS OF MINERAL LAND OFFERS.

land

No mineral offers were examined during the year but we made tonnage or valuation estimates on the three following offers:

Offer No. 1351, Bovey-DeLaittre-Vanderlip properties in 55 and 56-25, Minnesota.

No. 1385, $W\frac{1}{2}$ of the $SE\frac{1}{4}$ and the $E\frac{1}{2}$ of the $SW\frac{1}{4}$ of Section 22, 47-29, Minnesota.

No. 1403, $SE\frac{1}{4}$ of the $NE\frac{1}{4}$ and $NE\frac{1}{4}$ of the $SE\frac{1}{4}$ of Section 14, 58-19, Minnesota.

No. 1403 lies immediately South of the Company's Helmer Mine.

As far as I have been advised, none of these offers were accepted.

EXPENSE STATEMENTS.

Tables VI and VII, which follow, show a detailed statement of charges to geological expense for the year and a comparative statement of these charges for the last three years. They are self-explanatory:

TABLE VI.

DETAILED STATEMENT OF CHARGES TO GEOLOGICAL EXPENSE FOR YEAR 1923.

GEOLOGICAL DEPARTMENT.

Salaries, - - -	\$16,295.25
Travel, - - -	220.98
Operating Automobiles,	657.20
Supplies, - - -	1,325.19
Office Expenses, -	<u>115.00</u>
Total	\$18,613.62

EXPENSES OF H. L. SMYTH.

Travel, - - - -	\$208.66
Supplies, - - - -	199.73
Miscellaneous, - - -	<u>120.00</u>
Total,	\$528.39

SUMMARY.

Expenses of Geological Department, -	\$18,613.62
" " H. L. Smyth, - - -	<u>528.39</u>
Grand total,	\$19,142.01

DETAIL OF TRAVELING EXPENSES. B - 1.

Traveling expenses, geological surveys, etc,	\$50.87
Company horses, - - - - -	155.43
Traveling expenses, outside explorations,	<u>14.68</u>
Total,	\$220.98

DETAIL OF COST OF OPERATING AUTOMOBILES.

<u>ITEMS.</u>	<u>STUDEBAKER.</u>	<u>1/3 PROP. DODGE TRUCK.</u>
Gasoline, oil & grease	\$98.08	\$36.27
Tires	12.45	28.19
Tools,	0.81	None
Repairs,	1.12	14.52
Miscellaneous,	50.35	12.26
Insurance,	87.84	18.55
Depreciation,	<u>213.64</u>	<u>83.12</u>
Total,	\$464.29	\$192.91

THE MORE IMPORTANT CHARGES TO SUPPLIES.

Electric Drying Machine, 1/3 proportion,	\$161.67
Annual Report, " "	527.89
Blue print paper, " "	92.25
Drawing paper, " "	66.17
Tracing cloth, " "	27.00
Repairs to transit, " "	24.67
Typewriter, " "	23.97
Rental of Maas Compass, - - - -	50.00

TABLE VII.

COMPARATIVE STATEMENT OF CHARGES TO THE GEOLOGICAL DEPARTMENT FOR LAST THREE YEARS.

	<u>1923.</u>	<u>1922.</u>	<u>1921.</u>
Salaries, - - - -	\$16,295.25	\$12,279.80	\$16,643.16
Travel, - - - -	220.98	312.64	552.25
Operating automobiles, -	657.20	860.72	1,075.18
Supplies, - - - -	1,325.19	881.01	1,190.29
Office expenses, - -	115.00	19.52	45.91
Total,	\$18,613.62	\$14,353.69	\$19,506.79
Expenses of H. L. Smyth, i.e., Travel, Supplies, and Miscellaneous,	528.39	196.88	773.56
Grand total,	\$19,142.01	\$14,550.57	\$20,280.35

CLIFFS SHAFT MINE

The installation of the Re-crushing Plant, which was started in 1922, was completed and plant placed in operation on April 16th.

A new flexible coupling was installed on Prescott underground pump #1, as the old coupling was very badly worn.

The underground haulage set formerly used at the Lake Mine was moved to this mine and placed in operation in May. Considerable trouble was experienced with underground haulage motor-generator set #1 in June. This machine has been repaired and is now in good condition.

"Lilly" Hoist Controls were installed on both hoists. These are operating very nicely.

All other mechanical equipment operated with very little trouble or delays.

Three Goodman storage battery locomotives were purchased and put in service the latter part of the year. While some trouble has developed with these, it appears that the application is suitable and justified.

HOLMES MINE

"Lilly" hoist controls were installed on the skip and cage hoists at this mine in November. Their operation has been very satisfactory.

There have been no other changes to the mechanical equipment and its operation has been very satisfactory.

The exciter on Allis-Chalmers compressor motor burned out and was sent to factory for repairs. Pending return of this, our spare exciter set has been in use and operating satisfactorily.

LAKE MINE

The underground haulage motor-generator set was taken out in May and sent to the Cliffs Shaft Mine.

SALISBURY MINE

During the latter part of the year this mine was put in shape for operation again.

The pumping equipment operated throughout the year without any trouble or delays.

ATHENS MINE

On June the 18th we had an overwind on the skip hoist, but it did not cause much delay. There is so little headroom above the skip dump that it is impossible for the brake to act soon enough to stop the hoist before the skip hits the sheave. We are going to try out a different head on the control of this hoist, which should take care of this condition.

We had a little trouble with the Ingersoll-Rand compressor burning out a bearing. This was repaired and is now in good condition.

A new spray cooling pond was built for the compressor and flywheel set as the old tower was in very poor condition.

We have had some trouble with the water cylinders on the underground Prescott pumps. An order has been placed for two new cylinders, which will be installed as soon as possible after they are received.

All other mechanical equipment operated satisfactory.

The "Lilly" overwind device on skip hoist has not been fully perfected, and while we have average protection we are working out detail improvements which should increase the accuracy and reliability of the outfit.

MAAS MINE

The steam turbine was put in operation on March the 1st and shut down April 18th. It was in operation five days in July and three days in August. It was placed in operation again on September 5th and operated almost continuously until December 3rd.

It was necessary to do a lot of repair work on the boiler furnaces as they were in very poor condition. Three of the furnaces have been repaired and are now in good condition.

All mechanical equipment operated in a satisfactory manner.

MAAS CRUSHING PLANT

This plant operated from May 15th to the middle of November without giving us much trouble. The only trouble was a broken tooth in the driving pinion on the crusher. This caused a delay of one day while repairs were being made. A new pinion was ordered to replace the one broken.

NEGAUNEE MINE

On February 5th we had a few coils burn out on the skip hoist generator, which caused a delay of about three days. Generator was repaired and has been operating satisfactory since that time.

On the skip hoist it was necessary to lengthen the drum 8" to make room for 200 ft. more rope in order to get to the next level which they have started to sink.

The pump discharge line in the shaft gave us a little trouble. It was necessary to replace the top 200 ft. because it was very badly rusted out.

A broken pinion on the north top tram plant caused a little trouble. This was repaired temporarily and will be put in good condition as soon as the new pinion is received.

All other mechanical equipment operated satisfactorily during the year.

SOUTH JACKSON CRUSHING PLANT

Not in operation.

SOUTH JACKSON MINE

There was a little loading done at this mine. All equipment operated satisfactorily.

BARNES-HECKER MINE

Considerable trouble was experienced with the belt drive on the Aldrich underground plunger pump. This was changed to gear drive and is now operating nicely.

"Lilly" hoist controls were installed on both hoists in October. These are operating satisfactorily.

LLOYD MINE

There were no changes at this mine during the year. All mechanical equipment has been in continuous operation without any trouble or delays.

MORRIS MINE

All mechanical equipment operated in a satisfactory manner during the year.

The switchboard controlling all electric power service at the Morris-Lloyd Mines, which is located in the Morris Mine engine room, was practically destroyed by fire on November 16th. This caused a delay of $2\frac{1}{2}$ days in mining operations while temporary repairs were made. All necessary material has been ordered for permanent repairs and should be received and installed early in 1924.

SECTION 6 SHAFT

The mechanical equipment at this shaft operated in a satisfactory manner throughout the year.

GWINN DISTRICT

In the Gwinn District the Francis and Stephenson mines and the Central Pumping Station only have operated throughout the entire year. The Austin Mine, Central Power Plant and District Crusher Plant were operated a part of the time. The Gwinn, Gardner, Mackinaw and Princeton mines were idle the entire year.

No new equipment was added at any of these properties. The only change made was at the Austin Mine, where the hoisting engine was re-located so that operations might be carried on through a new shaft and the old one discarded and eventually caved.

The mechanical operation has been routine and on the whole satisfactory, a detailed account of which follows:

AUSTIN MINE

In February a new engine house was started to house the hoisting engine which will have to be re-located when operations are started through the new shaft.

On March 13th the skip bucket tipped over during a hoist and caught in the shaft timbers. The hoisting rope being stronger than the drum fastenings, the drum was torn from the hoist, with other minor damages resulting. The repairs were rushed and hoisting was resumed at noon on March 15th.

Early in May a tram plant was transferred from the Princeton Mine and installed at the Austin Mine to haul the ore from the old shaft to the new loading pocket for shipping. This plant was located and installed so that it can be used to transfer the ore from the new inclined shaft to the stocking trestle and to the loading pocket when so desired in the future.

Later in the month the installation of the old Princeton #2 hoist, which had also been transferred to the Austin for hoisting from the new inclined shaft, was completed, after which all hoisting was done through the new shaft and the old one sealed up.

FRANCIS MINE

In March for some unexplainable reason the right hand main bearing on the Ingerspill-Rand air compressor heated up, and before the compressor could be stopped the bearing was badly burned and the shaft scored. While repairs were being made air was furnished from the Central Power Plant compressor, so that there was no delay in mining operations.

On August 24th one of the skip ropes broke just above the ball as the loaded skip was entering the dump, resulting in the loaded skip dropping to the bottom of the shaft, tearing out a number of the steel shaft sets and completely wrecking itself. A new skip and hoisting rope were installed, repairs were made in the shaft and hoisting resumed on August 27th.

This hoisting rope had been oiled at regular intervals and 50 ft. cut from the end next to the skip every six months. Everything had been made ready

FRANCIS MINE (Cont'd)

to replace the rope with a new one on the following Sunday, the 26th, but due to crystallization the rope did not last that long.

In September "Lilly" Hoist Controls were installed on the hoists, so that the operation of both the skips and cage are much more dependable with the extra safety features provided by these controls.

In November, as a result of caving ground, a considerable increase in the mine water took place. However, the pumping capacity is still much more than the incoming water.

GWINN MINE

Since the Gwinn Mine has been closed down all of 1923 there is nothing to report concerning this property, except that the mine pumping for keeping the mine unwatered has been carried on throughout the year.

GWINN CRUSHING PLANT

Before the start of the 1923 shipping season some general repairs were made to this plant, after which it operated throughout the season in a most satisfactory manner.

After the close of the shipping season some repairs were made to the plant to have it in good condition for 1924. These repairs include a new pinion at the upper end of the steel pan conveyor for driving it, and new concaves in the crusher.

GARDNER-MACKINAW MINES

The Gardner and Mackinaw mines not having been operated since November, 1920, and it being unlikely that their operation would start before some distant future date, it was decided in November to pull out all of the underground equipment, except the main 10" pump column in the Mackinaw shaft and a 5 $\frac{1}{2}$ "x12" 200 G.P.M. Aldrich plunger pump on the 1,000 ft. level of the Mackinaw Mine, and allow these two mines to fill with water. This work was all completed early in December.

It will not be a long or expensive operation to unwater these shafts in case it is desired to resume operations at any future date.

PRINCETON MINE

Nothing in a mechanical way has been done at this mine except pumping to keep the mine unwatered, there being no mining operations carried on at this property during the year 1923.

PRINCETON CENTRAL POWER PLANT

In the latter part of January the high pressure air cylinder of the Allis-Chalmers compressor developed a crack on its upper and outer surface, probably due to casting defects. It was patched and kept in service until it was replaced by a new cylinder in March.

On February the 1st the boiler plant was cooled down, drained and laid up, it being thought that the hydro-electric plants would be able to furnish sufficient power until the break-up. However, due to a shortage of power, it was necessary to put the turbine in operation again on March 29th. It was kept running until April 18th, when it was again closed down.

During the month of May extensive repairs were made to the Murphy stoker settings on boilers #1, 3 and 4. New front arches were built in each; also a back arch in #4. In #2 furnace only temporary repairs were made.

On account of low water in the storage basins it was necessary to put the steam turbine in operation again on June 21st. It was kept in operation almost continuously the remainder of the year.

In October a number of coils burned out in the motor of the underground haulage set, necessitating its shutting down for repairs. A temporary repair was made and new coils are to be installed later.

In November 50 new tubes were installed in boiler #4. The lower ends of these tubes had become crystallized and broken off back of the outer edge of the mud drum. When the plant is closed down again it will be necessary to replace quite a number of such defective tubes in boilers #1, 2 and 3.

The operation of the Central Power Plant as a whole has been very satisfactory and dependable throughout the year, with no long or serious delays to affect the mining operations.

PRINCETON PUMP STATION

The operation of this plant has been very satisfactory. It has rendered practically continuous service throughout the year.

Some repairs have been made to the steam pumps and their condensers. A new smoke stack was erected for the boilers and all new flues were put in the large Kewanee boiler. The whole plant is now in the best of condition for either steam or electric operation.

STEPHENSON MINE

There were no changes or additions to the mechanical equipment at this mine. There were no delays and operation was satisfactory throughout the entire year.

BOEING MINE

After the third General Electric 150 K.V.A. transformer was received and installed in January the Substation gave no more trouble for the year, with the exception of two insulators being broken on lightning arrester.

Some carbon trouble and valve breakage was experienced on compressor. By cutting the oil feed to the minimum some carbon has been eliminated. On the motor of this machine, the coils in upper half of stator became loose and had to be wedged to place. The babbitt in crank pin brasses wore oblong, but after re-babbiting in August with #1 quality no further trouble developed.

The only repairs placed on skip hoist was a set of brake blocks in April. A close watch is being kept of motor pinion reported in bad condition last year, but it seems to be good for some months yet, and will not be replaced until absolutely necessary.

We were fortunate in having a 50 H.P. top tram motor that could be spared from the Wade Mine to replace the cage hoist motor when it was wrecked by overspeeding in May. This motor was repaired at the Hard Ore Shops and was put back in service in October. The wooden cage attached to this hoist was of weak construction and was replaced in November with a steel cage built in the shops. A car for cleaning skip pit was also built for this cage, that would

BOEING MINE (Cont'd)

operate in rotary dump.

Some changes were made in shaft house in the fall to improve operations of top tram. After these improvements were made all tramping was done on day shift, the top tram engine handling two cars. The chutes beneath the dump plates in shaft house were rebuilt so that the south skip dumps into south tram car and the north skip into north car. The system has now operated close to two months with very little trouble. A tram car was built at the Hill-Trumbull shops to replace one in poor condition.

Considerable trouble was experienced with underground pumps due to cretacious sand from pit. It was necessary to replace the seats and valves in the plunger pump about every three months. The impellers and bushings in the underground centrifugal ^{pumps} were cut out and had to be rebuilt almost as often. In April the water and sand conditions got so bad it was necessary to install a steam pump in the Pit, as no other was available, and cut off the water from underground as the sump would fill with sand in less than 24 hours and no miners could be secured to remove it.

The pump station located in east end of Pit was shifted near the center in May, and an 8" discharge line secured from the Crosby Mine was installed. In November it was necessary to change this station again to east end. Only one pump was installed as the Winston-Dear Company removed their pump from the pit. This leaves us at present with only one pump in pit.

In order to eliminate any future sand trouble an 800 G.P.M. centrifugal pump should be purchased, duplicating the one now in underground pump station so that repair parts will be interchangeable and repairs made quickly. This should be installed in pit for such emergencies as come during the spring break-up.

A very heavy rain on August 31st made it necessary, for the first time, to close cast iron door isolating pump house from rest of mine. Water rose to over two feet on the main level, but was cleaned out and hoisting resumed the next morning.

The rotary dump installed on main level seems to be too weak for the

BOEING MINE (Cont'd)

service expected and after operating for six months the rivets loosen and have to be replaced. A heavier construction would eliminate this trouble. Some minor parts of dump wore out and were replaced. The 4" diameter cylinders operating butterfly under dump proved to be too small and were replaced with 5" diameter cylinders.

All of new equipment was purchased for the open pit. This consisted of three 9-60 switching locomotives, a Model 350 Marion steam shovel, eight 12-yard second hand dump cars and a second hand flat car.

The locomotives were purchased from the American Locomotive Company and are duplicates of those bought for the Hill-Trumbull Mine in 1920. They were received on April 25th. When testing these out trouble was experienced with #106, this being due to a loose bolt left in steam pipe when assembling. This bolt came over into valve chamber with steam and wrecked the valve and mechanism. The wreck was made good by the locomotive company, but the engine was out of commission for a week. Operating these three locomotives has shown a weakness in the flues. These are charcoal iron quality and have a strong tendency to leak. It has been necessary to roll the flues to make them hold out for the season, and before starting next season's work they will have to be re-tipped. With the poor tracks and excessive grades in pit, a coal test on these machines showed consumption of 6.5 lbs. of coal per ton of ore hauled from loading shovel to railroad yard.

The Model 350 Marion shovel was put in commission on May 22nd. It required 45 working days to assemble it. The general dimensions of this machine are as follows:

Length of boom,	80 ft.
" " dipper handle,	52 ft.
Capacity of dipper,	6 yds.
Hoisting engine cylinders,	14" x 16"
Crowding " "	10" x 11"
Rotating " "	10" x 11"
Approx. working weight with ballast,	360 tons.

It operated all season with only short delays. Two teeth broke out of rotating pinion on October 12th, due to flaw in material. This was replaced the same day with pinion secured from the Oliver Iron Mining Co. On December 7th the crane

BOEING MINE (Cont'd)

shoved the dipper stick out too far and broke two $3\frac{1}{4}$ " bolts holding yoke block. New ones were secured from the Oliver Company and installed the same day. In October a representative of the Marion Steam Shovel Co. installed some reinforcing plates at a point on bridge truss that had proven too weak. Only one hoisting rope and one set of brake blocks were worn out during the season. It was first planned to coal the shovel with a steel chute leading from shovel to locomotive tender on upper bench, but the shovel came with a coal hoist equipment and the chute plan was discarded. The steel chute on hand was purchased for \$275.00 and sold to the Winston-Dear Company in the fall for \$400.00. A duplicate chute, built in their shop a year ago, cost us \$1,160.00, which shows their repair costs are high. A coal test was made while shovel loaded ore on a 40 ft. bank, giving a consumption of $4\frac{1}{2}$ lbs. of coal per ton of ore hoisted and dumped into cars.

All of the pit cleanup work could not be handled with the #28 shovel, so the #22 shovel and #19 locomotive were shipped over from the Hill-Trumbull.

CROSBY MINE

With the exception of removing equipment, no work was done at this mine. In January over 100 tons of scrap iron were sold and shipped. In March the power was shut off and the washing plant turned over to M. A. Hanna Co. As the 50 H.P. motor driving plunger pump for washing plant had been shipped to Ishpeming with compressor last fall, it was necessary to install the duplicate 50 H.P. motor from underground pump to replace it. In June the shaft house was dismantled and sold. In September the wheel press was shipped to Morris-Lloyd Mine. During October and November all other machinery and supplies stored in shops were removed by truck and stored in big warehouse at Hill-Trumbull Mine.

The M. A. Hanna Company made several changes at Washing Plant. The receiving pocket was changed to accommodate 20 yd. side dump cars, and the discharge openings to pan conveyor were enlarged from 18" x 18" to 18" x 36". The tail track on receiving pocket was lengthened an additional 50 ft. A

CROSBY MINE (Cont'd)

weightometer was added to belt conveyor; also two rock picking chutes with pockets beneath. The 40 H.P. motor driving belt conveyor was replaced with a 50 H.P., and the 40 H.P. used on the 25 ft. log washer in place of the 20 H.P. An additional 18 ft. turbo was installed, and the 20 HP. motor removed from 25 ft. log washer was used to drive this turbo and also a bucket conveyor put in to elevate and dewater the table concentrates. Additional grading and fill increased length of tail track for concentrate ore cars. Our Substation was disconnected and the Washing Plant served by transmission line run to Larue Mine Substation.

HILL--TRUMBULL MINE

Before the Washing Plant was started for the season it was necessary to rebuild belt of 8 ft. pan conveyor as the round head rivets holding links had worn badly and were loose. These were replaced with countersunk head rivets, which should correct the trouble.

The post brake on belt conveyor was shifted to motor shaft, where it works much better than on intermediate shaft and holds the load without slipping. New linings were placed in screen pocket, and the oil filtered in the three 150 K.V.A. transformers in Substation. New poles were put in plunger pump to replace those cracked by frost. A new 36" belt was put on conveyor.

The Washing Plant was started up on May 5th and shut down October 3rd, operating day shift only and washing 255,636 tons of concentrates. The 14" pipe laid to dispose of tailings worked satisfactory for four months, then the basin got too full and it was necessary to assist the flow with high pressure water from tank. The tailings basin is now filled flush with end of concrete launder from mill and next season it will be necessary to dispose of tailings by pumping.

The various shovels and locomotives were put through the shops and gave little trouble during the season. On #27 shovel the flues were removed, cleaned and re-tipped. A patented feed water heater inside the boiler was discarded as it was found completely blocked with scale, with no chance of

HILL-TRUMBULL MINE (Cont'd)

cleaning it. A new hoisting drum was necessary on shovel #26. No. 19 locomotive required a new cab to replace the one torn off at Boeing Mine chute.

No. 19 shovel started on track work April 16th, while #27 started on clean-up work April 18th. During shipping season three steam shovels and five locomotives were used in Pit, not in continuous operation, but as needed in various locations.

The only new work during the summer was building up the dyke around the tailing basin and adding a small 6"x6" belt driven compressor to washing plant to operate rock pocket chute closers.

While cleaning up the Washing Plant after shipping season it was found that the bearings on pan conveyor drive shaft were in bad shape. It is planned to bore these out for brass shells so that repairs can be easily made on these bearings in the future.

WADE-HELMER MINE

With exception of underground pumping and stockpile loading, no work was done during the year.

In order to eliminate taxes after May 1st, stockpile loading was started April 20th with #23 shovel and this work continued with some delays during July and July. During May #24 shovel in Helmer pit started clean-up work around stockpile and then part of the Helmer pit stockpile was shipped in June.

The 100 H.P. General Electric motor on Platt underground centrifugal pump was in bad shape due to moisture. It was shipped to Ishpeming in July for repairs and was returned in August. In the meantime a 125 H.P. motor from the Boeing underground Prescott pump was installed on the Platt pump to be prepared for emergency. In September a new thrust bearing was put in Platt pump, which completed repairs for the year on this machine. The only repairs on plunger pump consisted in rebabbiting the two pinion shaft bearings. The equipment is now in good condition.

The wood Location water supply pipe caused trouble due to bad leaks where the band wire had been eaten away by acid water. These sections were repaired with iron clamps around pipe and should now last as long as the pipe.

REPUBLIC MINE

The mechanical equipment at this mine operated in a satisfactory manner throughout the year. No new equipment was installed.

SPIES MINE

The installation of the new Lake Shore Engine Works hoist and General Electric motor, ordered in 1922, was completed and the hoist put in operation on October 20th

Two 6 $\frac{1}{2}$ " x 10" Prescott Single Acting Vertical Triplex pumps were ordered in March and received in September. They have a capacity of 300 G.P.M. against 1200 ft. head and will be driven by 150 H.P. General Electric motors, which were received in August. This equipment will be installed early in the coming year.

The three steel pulley stands at the Lake Mine were taken down, shipped to Iron River and re-erected at the Spies Mine by the Worden-Allen Company.

The 100 K.W. General Electric motor-generator set formerly used at the Crosby Mine, and which had been stored at the General Storehouse in Ishpeming, was shipped to this mine to furnish current for the underground haulage. This has not yet been installed.

Eight 36 cu. ft. rocker dump cars were bought from the Lake Shore Engine Works for the underground haulage system.

DEAD RIVER STORAGE DAM

The attached map shows the location and topography of the damsite and sufficient other detail to clearly visualize the project as a whole.

Construction operations were carried on during the entire year.

The preliminary work, such as the building of camps, roads, repair of the old Hoist branch of the L. S. & I. Ry.; the purchase, assembly and erection of the required construction plant; and stripping and opening up of a gravel pit was practically completed previous to 1923.

The first concrete placed in the dam proper was poured on January

DEAD RIVER STORAGE DAM (Cont'd)

3rd; the last on the 17th of December. A total of 41,387 cubic yards of concrete was placed.

The building of the earth dam at the west end of the concrete section was started on the 21st of August. From this date till the end of the year 87,145 cubic yards were placed.

RAILROAD OPERATION.

Previous to January, 1923, the old Hoist Branch of the L. S. & I. Ry. had been rehabilitated and a spur line extended to the mixing plant. A locomotive was rented from the L. S. & I. and operated by us. This locomotive was used in delivering freight such as gravel, cement, lumber and other miscellaneous carload lot shipments from Whitman to the dam. During the year, 1894 cars of gravel, 215 cars of cement, four cars of lumber, 40 cars of coal, 25 cars of miscellaneous freight, such as structural steel, ties, rails, etc., and 73 cars of logs for Wm. Hogan, were handled.

For the operation of this locomotive three men were employed regularly, namely, an engineer, a fireman and a brakeman. Besides these three a section gang of five men were employed during the winter months and up until the middle of May, after which date no regular section gang was employed. The track was inspected from time to time and any repairs needed were made by an extra gang who ordinarily were otherwise employed.

GRAVEL PIT OPERATION

Explorations and tests previously made had indicated the unsuitability for concrete aggregate, without washing, of the gravel found near the proposed damsite. As nearly half of the total concrete to be placed would be poured during freezing weather, it was impractical to wash the aggregate. Consequently, the only alternative was to find a source of gravel which did not require washing. Such a supply was found alongside of the L. S. & I. Ry. tracks near Marquette on land belonging to the Longyear Estate. Accordingly a pit was opened up here and a spur track laid from the L. S. & I. main line.

For loading the gravel a 3/4 yard Erie steam shovel, equipped with caterpillar traction, was used. Previous to the beginning of concreting this