PRINCETON MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	12 mos. 1910 AMOUNT	13 mos. 1909 AMOUNT
40% Powder	19,600	9.25	1815.00	2632.75
50% "	150	10.25	15.37	841.91
60% "	100	11.25	11.25	
80% "	10,500	13.25	1390.69	1221.26
Fuse	89,400	3.78	339.84	445.82
Caps	19,900	6.11	121.12	175.00
Connecting wire	5	35	1.65	
Total			3694.92	5316.74
Product			115,782	144,882
Pounds powder per ton of ore			.262	.316
Cost per ton for explosives			.032	.036

The ore body was encountered on the 1st, 2nd and 3rd levels and 644 tons was hoisted and placed on the stockpile.

WORK FOR DECEMBER

The shaft was sunk 13' and work was continued on 6th level plat pocket.

WORK FOR THE YEAR

The 1st level cross-cut was extended by No. 3 contract 605' to the North. No. 2 Contract extended its drift on 2nd level 640' to the North. This level passed through considerable lean ore and at the time work stopped the drift was in ore. The 3rd level cross-cut was extended by No. 1 Contract 658' to the North and also cut considerable lean ore.

No. 4 Contract extended the 4th level cross-cut 488' North.

Sinking was resumed in the shaft Aug. 3rd and was continued throughout the balance of the year except during the time the miners were cutting plats on the 5th and 6th levels.

The shaft is now down 869' below the collar and was sunk 149' during the year.

SMITH SURFACE

There was considerable work done on the Smith Surface during the past year. Grading on the stocking grounds was carried on throughout the summer and a new wagon road was constructed which starts just West of the old wagon bridge across the East Branch Channel, thence South 400', thence across the East Branch channel to the stocking grounds, it then follows along the stocking ground to the shaft.

A temporary stocking trestle was erected both Northeast and Southwest of the shaft and ground graded and temporary trestle erected Northwest of the shaft for low grade ore.

A steel head frame was erected by Worden Allen Company of Milwaukee, also steel pulley stands erected.

A new brick engine house was constructed and electric hoist for cage installed. Concrete foundations for rock crusher was constructed Southwest for the railroad tracks near the shaft.

The Munising Railway Company made the fill for pocket tracks and put in pocket tracks and extended the main track 1900' to the Southwest.

KIDDER MINE

There was no work done at the Kidder Mine during the past year.

NORTHWESTERN MINE

No work is being done at the Northwestern Mine at the present time. The concrete shaft was completed by the Foundation Company early in June, and brackets set for steel dividings.

NORTHWESTERN SURFACE

A ditch was dug and pipe laid for air line from the Smith Mine to a point near the Northwestern shaft.

Concrete piers were constructed for the steel head frame.

D. M. & M. LEASE SEC. 35 - 45 - 25.

No work is being done at the C. M. & M. Lease at the present time.

WORK FOR THE YEAR

Ground was cleared around the shaft site. The Foundation Company made excavation at shaft site and placed steel shoe in position.

C. & N. W. LEASE SEC. 35 - 45 - 25

No work is being done at the C. & N. W. Lease at the present time.

WORK FOR THE YEAR

The work for the year consisted in clearing ground around shaft site. The New York Foundation Company moved their plant from the Northwestern Mine to the C. & N. W. Lease Section 35, and have everything ready to start sinking the concrete shaft in the spring.

GENERAL SURFACE

STEAM ELECTRIC EQUIPMENT

The electrical equipment was completed early in the year. The following work was done since the close of last year:

The switch board was erected at the Power Plant and transformer installed in Sub. Station. The balance of the towers were erected and wires strung on the Ishpeming Swanzy Line and wires were also strung on the local lines to the various mines.

Poles were erected, wires strung, and house connections made for lighting at Gwinn.

CENTRAL POWER PLANT

An addition was made to the boiler house and two more boilers installed. An addition was also made to the Blacksmith shop, and five more bents were erected on the Northeast end of the coal dock.

An underground launder was constructed to drain the water from the Central Power Plant and Laboratory. This launder runs from the above buildings along the South side and parallel with the coal dock, its outlet being in the low ground West of the Power Plant.

LABORATORY

A brick crusher house was erected on the North side of the Laboratory.

AUSTIN LOCATION

The two lower rows of houses in the Austin Location and the boarding houses were repainted this year, and 8" sewer line was constructed connecting the Austin boarding houses with the main trunk in the Austin location.

PRINCETON LOCATION

A two inch water line was laid to furnish water to the houses in the North end of the Location.

RAILROAD TRACK TO SECTION 35.

During the summer the Munising Railway and the C. & N. W. Ry. Co. ran survey lines to Section 35; the Munising to the D. M. & M., and THE C. & N. W. to the Northwestern Shaft, on the SE¼ of the SE¼ of the Section. Nothing was done by the Munising Railway except to acquire right of way, but the Northwestern have completed their track into the Northwestern track.

TOWNSHIP WORK IN THE DISTRICT

The superstructure of the steel bridge across the Escanaba River in Section 20 was completed early in the year and the road leading from this bridge to the Austin Location was also constructed.

The township also constructed two more steel bridges this year, one across the creek just West of the junction of Ash and Iron Streets in Gwinn and one across the East Branch of Escanaba River at the junction of Willow and Spruce St.,

GWINN TOWNSITE

PLANTING.

The Club House grounds were graded, grass seed sown and shrubs planted, lime stone walks and a clay tennis court constructed. Wire back stops were erected for the tennis court, a board fence was constructed along the boundary of Maple Street and wire fence along Mica and CEdar Alleys.

The planting at the Club House grounds was very successful. A very good sod was formed on the lawn; and the shrubbery, though planted late, did exceptionally well. These grounds have been a great improvement to that end of the town.

Wire screens were placed around the trees in the business portion of the town, and grass seed sown on the Gwinn Common.

Scotch Pines were planted on both sides of the East Branch Channel.

The Munising Railway Company shipped in soil and spread it on the sand fill around station site.

STREETS

All loose stones were raked and removed from the streets,

A new road was graded from the new bridge across the East Branch. This road extends Easterly to "A" Street, thence North to Iron Street.

It was noticed during the season that some of the larger rock worked through to surface on the macadamized streets. I think this was due to the fact that there was not enough fine material used in the surface dressing of the streets when they were originally made. In other words there was not enough fine material to properly bed the larger under rock, so that traffic during the summer had a tendency to cause the under layer to move and work up. I think it will be necessary next season to have these streets well watered and rolled and possibly more filling material will have to be used to keep them in good shape.

The tree planting along the curb lin of the streets has been disappointing, particularly the Maples. The summer was unusually dry, but every effor was made to keep the trees alive if possible. They were watered daily, but along the streets were houses have been built, horses and cattle browsed the leaves and even broke down the tree guards.

BUILDINGS

The interior of the Club House was completed early in the year, furniture installed and club opened to the public on the evening of May 15th.

The Club House proved to be very popular and is largely attended by the different Nationalities. There are 450 members from the mining department, 12 from the railroad department and 56 outside of the company employes. A womans club has also been organized to meet in the rooms set aside for the purpose and though the organization did not take place until late in the year considerable interest is being taken in it, and it undoubtedly will be a success.

Well points were sunk to a depth of 40' and a pit for pump to furnish water for the swimming pool. This well is near the South-east corner of the building and the pump pit will be connected by a tunnel to the basement of the building.

During the year there were 18 private residences and one business block erected. These buildings are all good structures and have greatly improved the appearance of the town.

Work has been started on Superintendents residence which is being erected in Gwinn on the East side of the East Branch just North of the High School building.

SALE OF LOTS

Thirteen lots were sold during the year.

EXPLORATIONS

The exploration work consisted in testing for shaft site on D. M. & M. and C. & N. W. Lease on Section 35 - 45 - 25.

THE WORK WAS AS FOLLOWS

Drilling was continued on Hole No. 53 to the foot rock. Material: Lean Ore 423' - 434', Jasper 434' - 663'. Black Slate 468' - 486'. Hole stopped.

Stand pipe hole No. 54, located 1600 feet North and 992 feet West of the Southeast corner of Section 35 - 45 - 25. Material: Sand and Gravel 0 - 72', Gravel 72' - 88', Hard Pan 88' - 90', Hard Pan and broken Ledge 90' - 96', Gray Slate 96' - 103', Slate 103' - 110'.

Stand pipe hole No. 55, located 1538' North and 969' West of the Southeast corner Section 35 - 45 - 25. Material: Sand 0 - 40', Clay 40' - 45', Sand and fine Gravel 45' - 67', broken ledge 67' - 85', sand and gravel 85' - 92', Hard Pan 92' - 98', Slate 98' - 162'.

Stand Pipe Hole No. 56. Material: Sand 0 - 35', Clay 35' - 40', Sand and Gravel 40' - 64', Broken Limestone 64' - 81', Sand and Gravel 81' - 91', Hard Pan 91' - 98', Broken Ledge 98' - 100', Slate 100' - 100.5', Hard Pan 100.5' - 102.5', Sand 102.5' - 119', Sand Stone 119' - 127'.

Stand pipe hole No. 57, located 1477' North and 985' West of the Southeast corner Section 35 - 45 - 25. Material: Sand 0 - 42', Clay 42' - 48', Sand and Gravel 48' - 67', broken Limestone 67' - 78', Sand and Gravel 78' - 84', Hard Pan 84' - 90', Conglomerate 90' - 110'.

Stand pipe hole No. 58, located 1506' North and 974' West of the Southeast corner Section 35 - 45 - 25. Material: Sand 0 - 40', Clay 40' - 45', Sand and Gravel 45' - 68', broken Sandstone 68'- 79', Sand and Gravel 79' - 86', Hard Pan 86' - 91', broken ledge 91' - 92.5', Conglomerate 92.5' - 103', Slate 103' - 126'.

Stand Pipe hole No. 59, located 1696' North and 1168' West of the Southeast corner Section 35 - 45 - 25. Material: Sand 0 - 89', Gravel 89' - 94', Clay 94' - 96', Gravel 96' - 97.5'. Slate 97'.5' - 108'.

Stand pipe hole No. 60, located 637' North and 725' West of the Southeast corner Section 35 - 45 - 25. Material: Sand 0 - 40', Sand and Gravel 40' - 60', Sand 60' - 79', Gravel 79' - 85', Quartzite 85' - 105'.

Stand Pipe hole No. 61, located 637' North and 746' West of the Southeast corner Section 35 - 45 - 25. Material: Sand 0 - 80', Gravel 80' - 85', Quartzite 85' - 100'.

FIRES

The forest fires during the summer and fall wer unusually bad, due to the dry season. On May 10th two fires occured on Section 20 - 45 - 25, one on the NW¼ and one in the SW¼ of the SE¼. There was a high wind blowing and the fire in the NW¼ burned to within a few feet of the Central Power Plant Coal Dock before it was gottenunder control and necessitated calling out all the surface men from the Stephenson, Princeton and Smith Mines, also the day shift miners and trammers from the Stephenson Mine.

The fire in the SE¼ was gotten under control before it got much headway.

During the month of June five small fires occured on Section 21 - 45 - 25 and one on Section 16, just North of the cemetery. All of these fires were soon gotten under control and did not do much damage.

Seventeen fires occured during the month of July. The fires that were near or threathened to damage property were as follows:

July 4th a small fire started North of Iron Street andEast of the East Branch bridge on SE¼ of NE¼ Section 21 - 45 - 25. This fire was soon extinguished.

July 18th a fire started South side of county road in Section 22 - 45 - 25 and burned South to the Munising Railway, covering a area of about 80 acres. There was a stong wind blowing and if the fire had not been gotten under control it would have destroyed the town of New Swanzy and probably Gwinn.

Oct. 19th a fire occured on Section 27 - 45 - 25 and burned over about 50 acres. The fire started in the NW¼ of Section 34 and spread to the S½ of SW¼ and SE¼ of Section 27, and it required a large force to get it under control.

September 1st a fire occured in one of the company double houses at 253 and 257 Ash Street in Gwinn. The estimated cost was $289.72 which was covered by insurance.

FATAL ACCIDENTS

There were two fatal accidents during the year. They were as follows:

Louis Busetti was instantly killed by a blast in No. 21 Contract on the 3rd Level of the Stephenson Mine on April 27th, 1910 at 11:30 A. M. Busetti and his partner had prepared six holes for blasting, The fuses, according to his partners statement, being 4 1/2" in length. They had set fire to five holes and the sixth one would not take. Busetti cut another piece off the end of the fuse and again tried to light it. His partner told him to come out and also stated that he took him by the hand but Busetti would not come when the other five holes went off about him and killed him instantly.

John Kroncich was killed at the Stephenson Mine On September 17th 1910 at 11:05 A.M. Kroncich was employed as motorman on the 3rd level and with the brakeman was on his way to the shaft with two loaded cars. There are two tracks near the shaft, one leading to the ore pocket and one to the cage compartment for the purpose of running timber trucks off the cage. The latter track has a switch about 70' back from the shaft. The level is well lighted at the shaft, in addition to these lights there are two powerful lights on the motor. On this particular trip the switch was thrown for the cageway and in coming out of the level Kroncich did not notice it was set in that direction. He tried to stop his motor when he found he was on the wrong track and had brought it almost to a stop when he was about three feet from the shaft put probably being excited he released the brake on the motor

which gained momentum and crashed through the gate and went down the shaft taking the two loaded cars and Kroncich with it. Kroncich was dead when the body was recovered from the bottom of the shaft and probably was instantly killed.

ANALYSIS OF COST SHEETS

The cost per ton of ore for the first eleven months of the year 1910 at the different mines in this district as compared with the same months for the year 1909, averaged higher at the Austin and Princeton and slightly lower at the Stephenson. (As the books have not been closed for December, 1910, I have taken the first eleven months as my basis.) I will take up the mines individually.

AUSTIN MINE

The cost of production for the year 1910 was 92.7 per ton. This averaged about 4¢ higher than the year 1909. It must be remembered that the Austin was closed down from February 5th, 1910 to August 1st; that during the period just previous to the shut down and the first month of opening the product was decreased somewhat, due to this cause.

The General Expense was .043 higher than in 1909. This was due principally to the increase in analysis on account of the comparatively large shipments of Austin and the small tonnage produced over the whole year.

Mine Office shows an increase of .01 due principally to the small tonnage.

MAINTENANCE:

The cost per year was .016 higher than in the previous year. This increase is due to repairs to hoisting machinery, wire rope and to a new drain line underground which is charged to pumps, this drain leading water from the Austin to the Stephenson.

MINING EXPENSE:

The cost per year is .017 less than the previous year. Practically all of the items under this head show a slightly decreased cost over 1909 with the exception of timbering. This item is .06 higher for the year than the previous year and is due to reopening drifts that had broken down during the shut down. This extra amount was more than distributed by the other items under the mining expense so that the expense for the year was .745 as against .762 for 1909.

STEPHENSON MINE

While the tonnage for 1910 was considerably higher than 1909, it was very much lower than it should have been, due to the cave-in of November 1909. January and February products were below normal. In addition to this during the period of the Austin Mine shut down, the district office expense, which is distributed on the basis of the pay roll, for the different mines, was practically cut out of the Austin which threw an unusual expense on the other mines, the Stephenson, of course, had to take its proportion. The first eleven months of the year we show about .016 less per ton than in 1909.

GENERAL EXPENSE:

The General Expense is .005 higher than in the previous year. This is principally all under the item of analysis due to the increased number of samples taken underground as well as the sampling at the stockpiles during the summer. The district office expense shows an increase due to the larger percentage caused by the shutting down of the Austin.

MAINTENANCE:

The cost for the year was .08 lower than in 1909. The reduction was principally under docks, trestles and pockets, where the cost was .032 lower than the previous year on account of the grading that was done in 1909.

Underground tracks and cars showed a saving of .032 from the fact that practically all of our tracks had been laid previous to this year. The rest of the difference is distributed over various items and the smaller charge is principally due to the increased number of tons.

MINING EXPENSE:

The Mining Expense shows an increase of .059 over the previous year. This expense is distributed over most of the items.

Compressors shows an increase of .011 due to the larger distribution against the Stephenson during the Austin shut down.

Hoisting shows a decrease of .016 due to our increase in tonnage.

Pumping shows an increase of .015 due to its taking a larger proportion of the Boiler House Expense since the Austin re-opened. Most of the water in the Stephenson-Austin deposit is now coming into the Stephenson direct on the East side rather than coming through the Austin.

Shaft repairs show .013 higher.

Drifting is .01 higher showing that considerably more rock drifting was done this year than last.

Breaking Ore is .023 higher. This is accounted for by the number of drifts that had to be driven, some on account of the sand rush a year ago, others to open up a regular places for stoping.

Tramming. This item shows a decrease of 5.1 per ton. This decrease is due to the electric haulage which started in May of this year. The months previous to May were as they were a year ago.

Timbering shows .012 increase for the year.

Under Mining Captains and Bosses there is an increase of .005. This increase is caused by our having two extra shift bosses from February 1909 and the whole of the Mining Captains time being charged against the Stephenson during the Austin shut down.

Stocking Ore shows an increase of .013, the principal cause being the erection of trestles for this winters stocking, and the Sand Cave which shows a cost of .028 that does not show on last years report at all.

PRINCETON MINE

The cost per ton for the first eleven months of 1910 showed an increase of .287. This is distributed over each of the three main sub. divisions of the cost of production. General Expense increased. .029, Maintenance increased .024, and Mining increased .234.

GENERAL EXPENSE:

The principal increase was under the headings: Engineering, Analysis, Mining Expense. These items being increased is duemprincipally to slight increase in the salaries and to the decrease in the production.

Under Docks, Trestles, Pockets and Buildings there was a decrease in expense of .011 over the previous year but the increase year was principally to Hoisting Machinery, two ropes having been put on during the year and one charge to installing motor that should have gone against the E. & A.

Top Tram Engines and Cars show an increase of .007 due to the purchase of a new car, two extra ropes and dismanteling and re-installing steam engine when electric motor would not work satisfactorily.

Underground Tracks and Cars show an increase of .019 on account of installing 40 Lb. rail in all of our extensions.

Electric Tram Plant. Cost .006 for the year, was an item that we did not have on our last years sheet.

Compressors. Increase of .026 due principally to a large proportion of Central Power Plant Compressor charge due to the Austin shut down.

Hoisting shows a decrease of .014 . The saving by electric hoist over steam since last summer.

Pumping. Increased .026. The Boiler house at No. 1 Shaft had to be operated to run the underground pumps after electric hoisting started. This extended over a period of some three months.

Sinking and Shaft Repairs. No comments.

Drifting increased .044. The cost per foot for drifting is higher as rock tramming at this mine was never charged to drifting until this year. Previous it has been charged to breaking ore. This cost of tramming was added to drifting which shows a large increase in the cost for the year. The number of feet of drifting was practically the same.

Breaking Ore increased .081. This is very large, but it is due to our raising and drifting on the top sub. levels in the South deposit in our endeavoring to find the top of the ore, alsomto the stopes between this South deposit and the main shaft being practically worked out.

Tramming. Tramming increased .021. The tramming distance to the South deposit being somewhat longer than to the old stopes between the shaft and the South deposit, hence the increased cost .

Timbering increased .028. An unusual large quantity of large timber was used in widening and repairing drifts for electric haulage on main levels.

Mining Captains and Bosses increased .011. During the past year or from the time that electric installation was contemplated it was necessary to keep one boss underground with several men at night to repair drifts, tracks, etc.,

Stocking ore increased .007. The main stocking trestle having been filled we now have to stock by side dumping, necessitating extra men on the stockpile to shift tracks, etc., These men would not have to be employed if our stockpile had been shipped so we could have dumped from our stocking trestle.

GRJ'EB

C R O S B Y M I N E.

SURFACE.

The Production for 1910 amounted to 189,351 tons, which was contributed by the two forties as follows;

East Forty, N. W. ¼ N. W. ¼ 32-57-22	N. E. Deposit Sub Levels,	37,615	Tons.
West Forty, N. E. ¼ N. E. ¼ 31-57-22	Old OpenPit,	3,155	"
	Sub Levels North of Shaft,	6,090	"
	Area "A"	125,271	"
	Area "B" and "C"	16,539	"
	Area "D"	681	"
		151,736	"
Total from both Forties,		189,351	"

This is an increase of 77,261 tons over the production of 1909, but at the same time is, at least, 65,500 tons less than had been anticipated.

More rock, by 6,000 tons, was hoisted than in any one previous year.

11,184 Tons to May 1st, came from the Main Level; was rock which had been stowed in the development drifts under the area being stripped and hoisted preparatory to mining operations; and from the Sub Levels where the accumulation from past years was retarding operations.

2,453 Tons was out of the Main Level drifts from May 1st, to January 1st,

16,366 Tons was part of that which was sorted from the ore during the mining operations in the New Open Pit.

30,003 Tons Total rock hoisted for the year.

Up until April all of the rock brought to the surface was trammed on the dump by hand, but the ever increasing distance made it essential to use some other means so that since April 1st., the system and car used for stocking ore in winter has been employed, with success, the year round for stocking the rock. Four hundred and seventy five feet of trestle was erected on the west side of the Boiler House and three hundred and fifty feet of this has now been filled.

Shipments for the year began on April 2nd., which was earlier than usual, and would have begun the last week in March but for the fact that the Great Northern Railway was repairing and grading the tracks from the Superintendent's residence to the end of the tail track, something which was badly needed.

	Began.	Ended.	Tonnage.
Pocket,	April 2	October 14	146,222
Steam Shovel,	May 22	August 26	13,299
Total Tonnage,			159,521

CROSBY MINE.

This was 65,500 tons less than the estimated amount of 225,000 tons. The shortage was due, primarily, to the Contractors not having the ore ready for us to mine at the beginning of the shipping season when the ore was being freely taken. Their progress had been so slow up to September that the estimates of production were materially cut, and buyers taking advantage of this fact in the face of the reaction in the ore market, we were unable to ship what we were in a position to mine from October 1st., to November 20th. Consequently shipments subsequent to September were light and what evidenced to be an unusually long season proved to be a short one, closing six weeks in advance of the season of 1909.

The Stockpile, January 1st, 1910, contained 838 tons and on April 2nd., 10,022 tons. In loading out the pile an overrun of 3,277 tons was obtained. A portion of this overrun was due to cleaning up some of the loose ore left from the large stockpile of 1908 and 1909. The loading of this pile was greatly facilitated by the grading done in the fall of 1909, as was shown by the few delays incurred from cars and engine off the track and by the reduced cost per ton. The cost per ton for 1910 was .008 as compared with .040 for 1909.

The closing of 1910 finds a stockpile of 30,668 tons on hand. The first trestle, 425 feet in length, which was erected next to the railway track was filled by the end of December and 240 feet of trestle erected on the north side of the first pile was put into commission with the beginning of the New Year. During the winter months the same car was used for ore and rock..

Analysis	Iron.	Phos.	Silica.
Stockpile, January 1st., to April 2nd., in making	55.74	.026	15.36
Stockpile, January 1st., to April 2nd., in loading,	53.73	.030	17.16
Pocket shipments,	56.69	.037	15.22
Total Shipments, Stockpile and Pocket,	55.52	.036	15.34
Lake Erie Ports on shipments,	55.47	.034	
Stockpile, October 14th., 1910 to January 1st, 1911,	55.10	.038	14.38
Average Analysis of production for year, (Mine Sampling)	55.60	.036	15.13

It will be seen from the above figures on shipments for the year, that on the year, the average mine analysis and the average of those of the Lower Lake Ports check very closely, there being a difference of only .05 of 1 per cent. On some cargoes we were lower than the Lake Erie Ports and on the others higher, but this is only to be expected from time to time. The past season we sampled the cars continuously as loaded, that is,

when the cars were one third full, two thirds full and when full, instead of only from the top of the cars as formerly. The knotted rope the entire length of the car was used each time. This required an extra man for sampling on each shift and gave large samples, which required longer in preparation, but it made a system which yeilded accurate results, if the above comparison is any basis for judgement. At any rate, we received less complaints in regard to the anaylses than in past seasons, and on the whole the individual cargoes did check better than heretofore.

Accidents, based on the number of accident reports received from the Physician, show 114 for the year against 79 for 1909, or 5.85 per cent for 1910 as compared with 4.77 per cent for last year, an increase of 1.08 per cent.

Of these, four were fatal. Besides the fatal accidents the most serious were a broken arm and the loss of a finger. The accident in which an arm was broken occurred in the Open Pit. Jones Brothers were blasting up boulders and a flying piece from one of these broke the forearm of No.292, who was working in one of the mills. Albino Dalliden # 53, in trimming some timber caught the handle of his axe in his clothing and chopped off his finger.

The remaining 108 were made up of very slight accidents as cuts, bruises, spraines, and pinched fingers. A great many reports have come in from the hospital on back injuries for which no evidence of injury could be found. Likewise a number of injuries claimed for the eye which were clearly cases of trachoma and not the result of any accident in any way, were received. So that while the above figures show an increase, it is hardly true that there has been any such increase in the number of accidents which actually occurred.

It will be noticed that the only four accidents, which were at all serious, resulted fatally. These were all investigated so thoroughly at the time of their occurance that it is not necessary to repeat the circumstances here.

Delays Hoisting had to be discontinued on the morning of May 27th., until the evening of the 30th., while the damage sustained by the northwest corner of the head frame from hoisting a skip through the top of it, on the morning of May 23rd., was repaired.

The night of May 25th., was lost while the body of Sam Wukovich, buried in a fall of ground in No. 11 Contract working on the 1470 foot Sub Level, was being recovered. From two to four hours were also lost for each of the other three fatal accidents.

A total of 36 hours was incurred from delays caused by rain storms at various times

during the summer. Minor accidents to some of the equipment caused us to stop hoisting for an hour or more at different periods.

The mine was idle four days in October due to not having ore cars. After waiting one day and receiving no cars the time was utilized by replacing the skip ropes with new ones and splicing in the additional length of rope, and making whatever other changes in the Top Tram system, which were necessary to allow ore to be stocked. As soon as these changes were finished operations were resumed, the ore being stocked.

The longest delay was caused by moving the plant from the south side of the shaft to the north side. The actual moving, and getting readjusted, so that every thing ran smoothly, caused hoisting to be suspended for 22 days.

Moving the Plant, so as to make it necessary to shut down entirely, was begun on the morning of February 5th., and had been completed sufficiently by the morning of February 27th., to allow hoisting to be resumed. Three additional days were lost the next month to permit the hoisting engine foundation to be regrouted as it was found that this had not been thoroughly done.

In making the changes a much larger engine house and boiler house were built. These now adjoin each other instead of being seperated as heretofore. The engine house contains the hoist, electric engine, dynamo and compressor. An additional 125 H. P. Burt Boiler, the same as the two original ones, was installed in the boiler house which gives us a battery of three boilers only two of which need to be used at one time. This furnishes an opportunity to clean and to keep in shape one boiler each week, and to change boilers every week so that none of them need run more than two weeks at a firing. The pipe lines from the mine to the boilers were all buried seven feet under ground, which will preclude all the trouble from freezing experienced in previous years. A sump, lined with concrete, was constructed under the boilers so that the tank which in cold weather had formerly been a source of a great deal of extra work and expense could be completely done away with. In addition to the water from the mine, a branch line was run from the Village water line to the Dry, which will insure the boilers their water supply in case of an emergancy.

The Machine Shop which in the old plant was located in the Engine House now occupies a seperate building.

The Dry has a concrete floor, steel lockers, clothes racks of iron pipe, wash troughs, two shower baths, and a seperate room for the Captain equipped with a wash basin and bath

tub. It is a great improvement over the old Dry which had no conveniences whatever. A two inch pipe line supplies it with Village water so that the men now have clean water, hot and cold, for washing purposes. In this line within the Dry is a coupling for our fire hose, so that we are now provided with additional means of fire protection directly at the plant. The old change house was sold for fifty dollars. The other buildings were torn down and the lumber which was saved from them has been used in a number of ways.

The new Carpenter and Blacksmith Shop is a duplicate of the former one. The Oil house and Laboratory were moved over from the old site. The Laboratory, which was constructed of one layer of boards covered with tar paper, was sided up with boards and battons recovered from the old buildings.

The head frame as originally constructedwas adapted for hoisting only from the south side. To permit hoisting from the north side the base was weighted down with broken rock and the south face which was formerly incompression but now in tension, was strengthened by four 1¼ inch tie rods, to each section.

The cost of this work was as follows;	Actual Cost.	Estimated Cost.
Building changes,		
Engine and Boiler House,	$ 1744.00	$ 1702.00
Dry House, complete,	1604.41	1400.00
Machine Shop,	467.00	467.00
Carpenter and Blacksmith Shop,	371.00	371.00
Moving Coal Dock,	666.57	500.00
Changes to Shaft House,	392.47	300.00
Moving Tank and Laboratory,	218.26	300.00
Changes to Equipment,		
1 New Boiler complete,	2574.55	2200.00
1 New Steam Header,	471.35	500.00
Feed Pump,	19.52	350.00
Moving two Old Boilers,	798,46	450.00
Moving Hoist,	576.15	375.00
Moving Electrical Equipment,	212.71	400.00
Moving Shops,	648.29	350.00
Moving Compressor,	59.04	1800.00
Steam Heating for Buildings,	132.70	275.00
New Steam Line to Shaft,	306.92	300.00
New Air Line to Shaft,	52.14	100.00
New Work and other changes,		
Ditching South of Property Line,	823.09	750.00
Moving Coal to New Dock,	375.68	640.00
Grading for Coal Dock,	166.75	200.00
Grading for Approach to Coal Dock,	541.41	1000.00
Piping, Ditching and Cleaning up,	659.78	500.00
Grading for New Buildings,	97.63	
Removal of Lagging Pile,		100.00
Water Line to Dry and Laboratory,		325.00
Total,	13,979.88	15,655.00

The estimates for moving the feed pump and compressor was so much more than the actual charges because a new pump and a new compressor had been included in the estimates. The water line to the dry is included in the charge to "Dry House, complete". The lagging pile did not have to be moved so that there was no charge against that item.

STRIPPING.

During the month of January a second shovel, a 65 ton Vulcan, was put in operation working east along the south boundary of the stripping limits. For this month good progress was made, but from February to April the work went slowly. About the middle of March the Vulcan shovel was removed from the pit, as with the train equipment on hand both shovels could not be kept busy and the work was being retarded by trying to operate two shovels. However, taking out this shovel and operating only one did not improve matters so that during April a change was made in superintendents. From that time until December 5th, when stripping was discontinued, much better progress resulted.

Last winter was a very fine one, there being little snow and comparatively little cold weather, in fact it was ideal for winter stripping. The slow progress made up to the last part of April was due to two causes,

1.Lack of proper supervision on the part of the firm. There were times when as many as eight weeks elapsed between visits to the work, although they knew that it was not progressing satisfactorily and telegrams were sent them requesting that they come up and look the work over with a view to it's betterment.

2. Lack of sufficient locomotives to give an adequate number of trains to supply the two shovels when operating. Cars enough were on hand but there were only eight locomotives on the job. Some two were always in the shop for repairs which left six for use, only enough to operate three trains. Even at the advanced stage the work was in when the change in superintendents was made with ample equipment two shovels could have been operated to advantage.

Although we had an early spring and cleaning could have been started in March no attempt was made to get what ore was uncovered at that time ready for us to mine, until after Mr. McCartney came, the last week in April. Then the force employed was inadequate and it was not until August that the cleaning had progressed so that we could mine to any advantage. During August the western side of the West Deposit was put in readiness for mining so that it was only from the first of September that it can be said that the Contractors had sufficient ore cleaned so that we could mine economically and without being retarded by the stripping operations.

CROSBY MINE.

Our early spring was followed by an early fall with freezing weather so that little cleaning was done in October and nonelater. The shovel continued working up until December 5th., when it had completed removing all that it could take out without greater expense than it would be to remove the remaining yardgae by some other means. There is left, of actual cleaning work about 8,000 yards, and in addition to the cleaning there is also about 7,300 yards on the south stripping limits, south-west of # 136 raise. The 7,300 yards consists of a narrow strip about 200 feet long, forty feet wide and twenty-eight high, directly next to the Hawkins Mine. This can either be removed or the ore taken out on timber. It would however, be more satisfactory to remove this dirt and in the long run would be cheaper than not to do so. To finish up the job in good shape will therefor necessitate the removal of 15,300 yards and it will cost to complete this work anywhere from $ 6,000.00 to $ 15,000.00.

The equipment is still stored at the mine and will probably not be loaded until spring. There is quite a little track in the pit and on the dump to come up before loading, which, with the other dead work which will be necessary to get the shovel up on the tail track and the balance of the equipment loaded, is going to make the loading proposition an expensive one.

The total yardage removed was,

282,591	cubic yards	of	dirt,
24,189	"	"	" Broken Taconite.
566	"	"	" Solid Taconite.

Total, 307,346 cubic yards.

The cost of the work to us has been approximately as follows;

Removal of 307,346 cubic yards at contract prices,	$ 120,186.58
Extras allowed and paid,	683.73
Amount of dispersements over receipts from August 1st., including estimated cost of loading,	3,872.19
Total amount paid to Jones Brothers,	$ 124,742.50
Cost of moving the plant,	13,979.88
Total cost,	$ 138,722.38
The cost per yard for removing 307,346 cubic yards,	.451

The cost to the mine was .006 more per yard than the stripping done the winter of 1907 and 1908, .040 less per yard than that done by Roberts and Kingston, and .067 per yard more than the work of Drake and Stratton.

CROSBY MINE.

The cost of doing this work according to Jones Brothers accounts was as follows:

Up to July 1st., 1910,	$ 86,437.99
For the Month of July,	8,500.00
August 1st., to December 5th., including loading,	45,453.46
Depreciation,	4,554.75
General Office Expense,	562.50
Total Cost,	$ 145,508.70
Cost per yard for removing 307,346 Cubic Yards,	.473
Total cost to Jones Brothers,	$ 145,508.70
Amount Paid them by The Cleveland-Cliffs Iron Co.	124,742.50
Alleged loss sustained by Jones Brothers,	$ 20,766.20

This loss as well as the inconvenience caused us was unnecessary. It was not due to unusual difficulties, although at times the Contractors did have trouble, but was due entirely to lack of proper supervision on the part of the Firm and poor management by those in local charge up to the middle of April, when Mr. McCartney took hold of the work. The job being small did not admit of many mistakes but handled properly it would have given a fair profit, has been the opinion of various mining men and Contractors who saw the work in operation.

EXPLORATIONS.

Up until the middle of March Messrs Cole and McDonald operated two drills completing the explorations started last year.

Holes # 508, 510, 513 and 520 drilled in the area which has been stripped during the year, with # 495 and 502 drilled in 1909, show that there is abody of concentrating ore and some fair grade non-Bessemer ore, below the present Main Level.

No. 520, which was located over former test-pit # 108 at the north-east corner of the old Blacksmith Shop, was the mostly easterly hole drilled in the west forty. It's exact loacation is N 100 and 500 W. It shows the bottom of the ore to be 112 feet below the original surface of the ground, which means that it extends forty feet below the Main Level. The upper twenty-two feet of this forty feet, according to the drilling is solid taconite, but it has often been found in opening up the mine that places thus shown as taconite on drill records have proved to be a fair grade of concentrating material.

No. 513, 432 feet farther west, disclosed thirty feet of ore, averaging 57.82 Iron and .071 Phosphorus, lying beneath the Main Level. Below this ore is twenty-five feet of material averaging 38.18 in Iron, making the bottom of the ore at this point sixty-

five feet below the main level.

No. 508, 300 feet north of 513, was drilled to a depth of 148 feet. Down to 138 feet or 65 feet below the main level it was in decomposed taconite and ore seams. There are only a few anylsis on this material but judging from the formation on the main level near this drill hole the ground cut is probably better than the drilling indicates. And while this sixty-five feet undoubtedly contains no merchantable ore I think that practically all of it will be found to be wash ore.

These holes were not sufficient in number to definitely define the quality and extent of the ore bodies, but they did prove that there is under the new open pit below the main level a body of concentrating ore, probably nearly as large as that above the main level, and a limited deposit of Non-Bessemer ore running better than 57.00 per cent in iron. All of the ore below the main level seems to run higher in Phosphorus than that above it, and it will average .070 per cent, more or less.

No. 509, 511 and 512 were test-pits sunk in area "D", indicated last year by holes # 504 and 507. These were sunk simply to give some idea of the extent of the ore and of it's regularity and was discontinued as soon as the ore was obtained in each at a depth of from 20 to 25 feet.

The north-west corner of the west forty was thoroughly tested by holes # 514, 515, 516,517,518,519,521 and 522,with no results. The west deposit seems to cut off at the northern stripping limits and the ground beyond to be entirelybarren. These holes were located on the corners of 100 foot squares so that it seems that they should have found any ore present, even if it existed only as stringers.

OPEN PITS.

During July and August, in order to increase the production a few men were employed in the old pit sramming on contract at $ 1.00 a motor car. In this way 3,155 tons were won, 1,142 tons of which came from near # 55 chute, and 1,130 tons from near chute # 61. 883 tons were obtained by a few days work near raises # 31, 36, 38, 51, 57, 62 and 63. By September all of the ore which it was possible to obtain without handling a great deal of rock had been mined, so that all the men working here were transferred to the new pit.

Operations were started in the new pit on the morning of May 11th., at raise # 136 and raises # 137, 138, 139 and 180 were opened up before the end of the month. The following month raise # 144, on the west side, was started, but the area around it which had been cleaned was so small and the cleaning was progressing so slowly that it

had to be discontinued until the Contractors were farther advanced with their work.

Up until August the only mills we were able to add to those mentioned above were 181, 182 and 183. In July we were able to begin mining at raises 194, 195 and 196, which greatly helped to increase the production. This was the ore which had been indicated by test-pit # 107, and it proved to be one of the best stopes ever opened up in the mine. This was mined out up to the southern and eastern stripping limits by the end of the season and leaves a hole thirty feet deep. There is still twenty feet of ore in the bottom of this stope which can be mined out over a somewhat decreased area next summer, or at least fifteen feet of it can be mined as to mine the entire twenty feet will bring the bottom of the stope down upon the top of the Main Level. In mining this stope the breast was almost constantly within a few feet of the Contractors and at times we had to ease up on our operations to get out of the way.

The latter part of August some ore on the west side was cleaned and by September we were in a position to begin mining in earnest. During September mills were operated at raises # 78, 79, 80, 81, 82, and 83, over # 13 cross-cut, raises 93, 94, 95, 96 and 97 over # 14 cross-cut, and at raises # 106, 107, 108, 140A, 140, 141, 142, 143, 144 and 145, over # 18 cross-cuts. This west deposit ore was somewhat of a surprise as it did not increase the Phosphorus as much as was anticipated. It raised the Phosphorus from .030 or lower, to .035 to .040, but did not cause it to go as it had been feared, above the Bessemer limit. The west deposit ore has also been much freer of rock than the ore in the other portion of the pit, excepting perhaps the stope at # 195 which turned out comparitively little rock. From a half shift to a shift hoisting of rock a month can keep the west deposit stopes cleaned up so that the rock would not interfere with operations. This was not so with the stopes at raises # 136 to 183, which made a great deal of rock. These have now all been so enlarged that a great deal of rock can be stowed so that mining may be carried on until an opportune time to hoist it without causing inconvenience. By the end of September # 136 and 137 had been mined out to the south up to the Hawkins Mine property and stoping was started on the north side of these raises.

During the last of the season small stopes were opened up at raises # 199 and 203, but because of the amount of rock which had to be handled, progress was slow. As these get larger operations will become easier. The rock accumalating in the stopes from sorting the ore has been kept well cleaned up at all times and before shutting down the CROSBY MINE.

pit for the winter, all of the stopes were cleaned up of loose rock where it would interfere with mining when resumed next spring.

The new pit extends over a much larger area than the old one and the working places were so scattered that two bosses instead of one were required. During the latter part of September and all of October mining in the Sub Levels was discontinued and all the men were employed in the pit. This increased the tonnage, the tons per man, and decreased the cost. Another reason for shutting down the Sub Levels was, that the time required to serve the Sub Levels caused a delay, as more dirt could be pulled from the pit in the same time by allowing the motors to serve the pit exclusively. Two motors were operated sucessfully all summer.

There has been mined from the new pit since May 11th., 128,439 tons. Altogether the new pit looks well and from the present outlook the tonnage of merchantable ore which will ultimately be obtained from it, will exceed the estimated tonnage. The portions of the pit in which mining has been under way is in first class shape for next season. The last ore to be uncovered by the shovel and yet to be cleaned, is some of the best in the pit, and judging from the stope at # 136, will be quite clean and free from taconite. This ore will come in nicely as the shipping season gets older and some of the present stopes play out. There is the disadvantage that this ore extends down to the top of the Main Level and the chutes will have no storage capacity. The stripping was deepest here and the top of this ore is at about the same elevation as the bottom of the ore at raise # 136 and those to the east.

UNDERGROUND.

EAST FORTY.

1502 FOOT SUB LEVEL.

No. 3 contract has been mining at this elevation all year in the neighborhood of # 171 raise, following stringers and making stopes wherever the ore widened out sufficiently to allow it. It is still at this location but is now back near the raise and will soon finish it's work on this Sub Level.

Contracts # 5 and 8 are drifting and stoping 100 feet north of test-pit # 480.

Contracts # 6 and 12 took all of the top ore on the west side of test-pit # 488-465, using raises # 153 and # 154 over # 16 drift. There is still some ore on the east side

of the above mentioned test-pit to come out.

1490 FOOT SUB LEVEL.

Contract # 9 continued taking all of the ore back from the north boundry on the north side of # 482, caving everything as it came. They have now worked back to the raise and have started on the pillars to the south.

4 took out all of the ore along the boundry north of # 170 raise for a distance of fifty feet.

No 12 contract after finishing above has been mining the ore south-west of chute # 153.

No. 10 contract is drifting south of raise # 154.

Contract # 25, working from raise # 151, followed two small seams to the south, and is now drifting south-west toward the old open pit. There seems to be quite a little ore tributary to this raise, in leaders and pockets, similar to those worked from the open pit raises in the winter and spring of 1908.

1478 FOOT SUB LEVEL.

No. 5 contract mined the ore north-east of # 41 raise south of the stopemade by # 12 contract last year.

No. 4 contract took out a triangular piece of ore north-east of raise # 43 extending from the boundry back to within fifteen feet of the raise.

Contracts # 27 and 21 have been taking out the back from some seams of ore south of raises # 42, 43 and 170. These extended up for a distance of from twenty-five to forty feet, to taconite or sand, with varying widths.

Contracts # 7 and 13 have been and are still mining and caving south of raise # 48. At present they are working about 150 feet south of the raise.

No. 16 contract is working south of #'S 7 and 13 on the oposite side of their cave and is tramming it's ore south to raise # 155.

1470 FOOT SUB LEVEL.

This is a new sub level which has been opened up this year from raises # 43, 170 and 171. Contracts # 11, 2, 23 and 24 drifted north to the boundry blocking out pillars. Contracts # 11 and 2 are now drawing back these pillars.

CROSBY MINE.

No. 22 contract followed up some ore seams to the south until they played out and has since then been coming back taking out the ore as high as it went. The territory worked over by this contract is east of that worked by # 27 and 21.

WEST FORTY.

1500 FOOT SUB LEVEL.

This sub level has been started since Novemberand is being opened up from raise # 204. There are at present four gangs here # 15, 18, 20 and 22. This is the ore in area "D"vand at present it looks as if it were going to develope into a fair size deposit. The ore is of a good grade, bearing out the results of the drilling and test pitting of last fall and winter. The drifts are being carried two sets wide so as to give a place to stowewhatever rock is sorted from the ore. If this ore continues in the form of a deposit and does not develope into stringers and pockets this method should facilitate operations and lessen costs.

1490 FOOT SUB LEVEL.

No. 14 contract mined pillars on the west side of the old open pit and east of the track pillar for a distance of 150 feet. The width of these pillars averaged about 50 feet.

No. 1 contract, off from raise # 109, cross-cut west to the west boundry line.

1470 FOOT SUB LEVEL.

Contract # 14 drove three hundred feet west from # 3 raise. It was the intention to go through to raise # 204 but rock was encountered. Attempts to find an ore seam leading to the raise were unsuccessful so that the drift is being driven for the raise through rock and now has about 60 feet to go. No. 14 will then open up at this elevation the ground being mined above by contracts # 15, 18, 20 and 22.

No. 1 contract is now driving north-west in order to be able to take from this elevation the ore mined on the 1490 foot sub level by # 14 contract.

From the sub levels during the year a total of 44,386 tons were mined. The production from this source was curtailed somewhat in the spring by the lack of suitable men. When we shut down in February many of our miners went to the Pearson and LaRue mines.

CROSBY MINE.

and it was not until these mines cut down their working forces that they came back. Plenty of men were to be had but they were in no sense miners, and to employethem would have been to endanger the lives of other men as well as their own and little returns would have been received from their work.

Because of the scattered locations of the various contracts and the amount of territory to be covered, an extra boss was employed each shift underground. He is in reality a sub level boss, as it is his particular duty to look after the sub level contracts. Theaddition has proved an aid to production and to all round general efficiency.

Taking the ore from the 1490 and the 1478 foot sub levels, in the north-east deposit is causing the weight on the timbers to increase very materially and a timber gang of three men has been employed for the special purpose of keeping the sub level drifts in good shape.

The ore in the defined body of the north-east deposit is getting pretty well worked down. This is especially true along the north boundry and to the south of raises # 48, 49 and 482. To start a new sub level under those now being operated will bring the drifts on top of the main level timbers and will allow the chutes no storage capacity. As it is now many of them hold only about a motor car of dirt. Some of this ore shows up on the Main Level and there is no reason why it should not continue down below the Main Level, especially along the north boundry and to the south of # 48 raise under the territory now being worked by contracts # 7 and 13. At any rate this can be tested and if sufficient ore is found to warrant it, a new drift can be driven under this area for the purpose of taking this ore. In the meantime the sub levels should be able to continue their present production this winter, and also next, if not worked during the summer months, while the new development work is being finished. Nothing is to be gained by working the sub levels in summer now that we have the new pit, so that if reserved for winter they will easily allow operations during another winter.

Of the oreseams and bunches outside of the main ore body in the north-east deposit no definite forecast can be made but contributions from these sources in the past have been large and there must be many more such leaders and pockets which have not yet been found.

CROSBY MINE.

MAIN LEVEL.

This year saw the developement work begun three years ago completed. Until the present shaft is sunk or a new shaft put down and a new level opened up there should be no more need of any drifting on the main level. All of the drifts being driven by contracts # 15, 17, 18, 19, and 20 were connected up during the month of April. In order to make the connection between contracts # 15 and 17, drifting east and west respectively 100 feet north of the south property line, as soon as possible work was continued during February when the mine was shut down. The rock was trammed away from the breast and piled in the drifts until hoisting was resumed. The pockets at the shaft were also widened at this time so that they are now large enough to hold a five car train load of ore. This has saved much time. Especially in September when the motors were kept busy, as a trainload of ore could be dumped and the motor get away with the empty train immediately. Heretofore the motor had to wait until some of the ore was hoisted before the entire train load could be dumped. While this has been an improvement, conditions could be still further helped if the pockets held twice as much as they do at present. They could not be made larger at the time without sinking the shaft.

A new sump was cut sixty feet east of the shaft in the old run around, and two Cameron pumps, capable of handling about 500 gallons per minute each, were installed here as emergency pumps. The steam line down the shaft was increased from a three inch to a four inch line to furnish the additional steam which would be required by these pumps. An eight inch discharge line now takes all of the water from all of the pumps, including the new ones, excepting a # 6 and a # 7 Cameron which deliver water to the Boiler House through a seperate two inch line. These are never used for this purpose at one time, but are connected up so that either may be used giving always a reserve pump to supply water to the boilers. The # 7 Cameron can also discharge into the eight inch line to help out the # 9 Cameron and # 10 Knowles when needed. The emergency pumps paid for themselves on two different occasions during the summer, when from heavy rains we got more water than all the other pumps put together could handle.

The rock from the sump, enlarging the pockets, and # 15 and # 17 contracts was hoisted in the two days after hoisting was resumed, prior to again beginning active work.

The total amount of drifting on the main level consisted of fourteen hundred and forty feet of rock and one hundred and ninety three feet of ore. This includes, in addition to the connections mentioned above 107 feet which # 16 extended it's drift to CROSBY MINE.

the east, 73 feet which # 7 carried it's heading east, and 464 feet which # 20 drifted north-west and west to afford an outlet for the ore in area "D". Contracts # 18, 19, 15, 16, 20 and 21 raised 759 feet in rock and 638 feet in ore. This included the driving of raises # 136 to # 196 in # 15-17 drift, 140A to # 145 in 18 cross-cut, raise # 97 in # 14 cross-cut, raises 154 and 155 in # 16 cross-cut, raises # 170 and 171 in # 7 cross-cut, # 3 raise sixty feet north of the shaft and raises #198, 199, 203, 202, and 204 in 21 cross-cut.

Two winzes were put down from the main level to test up the drill holes sunk 100 feet north of the Hawkins Mine. The first pit was located to test # 495 and was located ten feet east of it. A comparison of the hole and the test-pit is given below;

	# 495.	# 523.
	Bottom main level at 70' from surface.	
0 - 5	70-75 taconite.	Broken taconite.
5 - 10	75-80 53.52 .089	Taconite and ore. 52.00
10- 15	80-85 taconite and ore.	Taconite and ore.
15- 20	85-90 54.06 .046	Ore and sand.
20- 25	90-95 52.12 .077	Sand and ore.
25- 30	95-100 Taconite and ore.	Taconite and ore.
30-35	100-105 59.30 .055	Water, unable to sink further.

The second pit, # 524, was sunk 50 feet west of # 135 and 50 feet east of drill hole # 513. The results were as follows;

	# 513.	# 524.
	Bottom main level at 55' from surface.	
0 - 5	55-60 51.15 .026	Taconite and ore seams.
5 -10	60-65 Taconite and ore.	47.00 .048
10-15	65-70 55.84 .039	53.10 .052
15-20	70-75 63.00 .042	57.50 .088
20-25	75-80 56.29 .180	57.00 .090
25-30	80-85 56.64 .094	Water, unable to sink further.

A pit is now being sunk 50 feet west of # 524 and one more will be put down 50 feet west of this one which will determine approximately the width of this ore east and west. When this is finished some pits will be located in # 19 cross-cut to determine it's extent north. That it goes south is reasonably sure from the test-pit on the Hawkins Mine property about 75 feet south of the property line and 175 feet south of # 513.

Aside from the timbering required in advancing the driftsas driven, the main level has required a great deal of timber the past year. The formation is so flat that after it has been exposed to the weather and rains the ground next to the timber settles off

CROSBY MINE.

throwing a great deal of weight on the caps. This has been found to be true in some of the drifts most recently opened, even where little ore is present and the back is mostly taconite. The taconite comes away in huge slabs. Lining sets have been put in at places in # 17 cross-cut, and # 18 cross-cut on the west side, and on the east side in all the drifts running north from the shaft. In the middle one of these drifts lining sets were put in for a distance of over 150 feet. All of the turns which have not already needed lining sets will have to have them before spring and the one near # 83 chute, in # 13 cross-cut, had to be close timbered,all of the original caps being cut out and replaced with new. All of this work was in the drifts which run under the open pits and are exposed to the agencies which cause the trouble.

The north drift under the sub levels, first required lining sets from # 48 chute to chute # 43, then was close timbered, and lately every other cap had to be cut out and new ones inserted. This has been caused by the increasing weight due from the caving of the sub levels above. With this timbering and the building of all the chutes in the new raises, a gang of timbermen has been employed constantly on the main level.

ESTIMATE OF ORE IN SIGHT AVAILABLE FOR MINING.

56.00 Iron .038 to .044Phosphorus .75 to 1.00 Manganese 9.00 to 10.00 Moisture.

East Forty N. W. ¼ N. W. ¼ Section 32-57-22.

North-east Deposit, Around Pit # 488, Around Pit # 480,	183,335 tons.	183,335 tons.

West Forty N. E. ¼ N. E. ¼ Section 31-57-22

Area "A"	289,265 tons.	
Area "B" and "C"	145,171 "	
Area "D"	58,719 "	
Old Open Pit,	6,845 "	500,000 tons.
	Total,	683,335 tons.

ANALYSIS OF COST SHEET.

	1909-13 months, 112,090 Tons.		1910-12 months. 189,351Tons	
	Amount.	Cost per Ton.	Amount.	Cost per Ton
General Expense,	$ 14,794.18	.132	$ 15,505.96	.082
Maintenance,	14,424.19	.129	18,195.68	.096
Mining Expense,	108,290.25	.967	139,505.70	.737
Cost of production,	137,508.62	1.228	173,206.34	.915

General Expensewas $ 711.78 higher than in 1909. There was an increase in Guarantee

Insurance as more men were employed this year, and Mine Office shows an increase of $ 618.69, a large portion of which was caused by the traveling incurred by the visits of the Chief Engineer, Mechanical Department and the Committee on fatal accidemts. Less was expended on account of Personal Injuries and analysis shows a saving of $ 627.77, which is the result of operating our own laboratory.

Maintenance was $ 3,771.00 more than last year due chiefly to increases in three items.

The installation of emergency pumps and of the eight inch discharge line caused Cornish and Steam Pumps to be increased $ 1,376.00.

Top Tram Engine and Cars is $ 682.00 on account of operating the top tram system the year round. Most of this increase was in supplies and includes two new ropes, more rollers and sheaves.

Electric Tram Plant shows an increased cost of $ 4,244.00. This was occasioned by the large amount of wiring required in the new main level drifts, general repairs to cars and repairs to motors. Both of the motors were provided with new sets of wheels and during the month of September three armatures were burned out. Repairs on these and the labor expended in taking them out and putting them in helped materially to swell this account. The cost per ton shows little or no increase because of the increased tonnage.

The other accounts were all about the same or lower, which helped to balance the increase in the above items.

Mining Expense, because of working more men and operating more actively than in 1909, shows a greater expenditure, but the cost per ton was .23 less than in 1909, being .737 as compared with .967. The increase in amount is almost entirely for labor, as the supplies for the increase of 77,261 tons in production cost only $ 3,700.00. Of the individual items, Compressors is higher on account of operating the Compressor all year.

Drifting shows an increase of $ 2,700.00.

Drifting 1909,	3716 feet.	$ 15,274.20	Cost per foot, $ 4.67.
Drifting 1910,	3816 "	17,963.56	Cost per foot, 4.71.

The high cost for this work is due to the poor class of labor obtainable here for this class of work, and to the fact that all the rock trammed during the year was charged to this account.

Breaking Ore was $ .08 per ton lower than last year or about the same as in 1908, and was $ .046 per ton more than in 1907. In 1907 all of the ore came from the open pit CROSBY MINE.

and this charge was not increased by the cost of the sub level ore during the winter months.

Tramming is higher because the motors were operated more months in 1910 than in 1909 and because the operation of two motors in the summer months necessitated an extra motorman and an extra brakeman.

The cost of Timbering was increased by a timber gang be required for the sub levels, a larger amount of timber being used and the slightly increased cost of the timber which was used the last two months in the year.

The employment of the additional bosses in the sub levels and open pit accounts for the higher charge to Mining Captain and Bosses.

Top Landing is higher as the top tram system was operated for the tramming of rock.

Sorting Ore shows an increased outlay of $ 4,730.00, and an increase in the cost per ton of $ .007. This is because of the large amount of rock hoisted and of the time spent in keeping the open pit free from broken rock. During the summer a team was employed hauling from the pit rock capping which was taken off of the ore before starting to mine. The cost of this work was included in this account. It also includes cleaning up piles of taconite which were lying around the surface, in and about the present plant site, which had been picked from former stockpiles.

Charging one half of the amount credited to Top Landing and Tramming to this account would make the total expenditure amount to $ 11,742.26, and the cost per ton $ .39, for the total amount of rock hoisted. Comparing this account for the last five years,

	Tons.of Rock.	Amount.	Cost per ton of rock hoisted.
1906,	7,344	$ 10,090.44	$ 1.37
1907,	10,354	20,113.31	1.94
1908,	11,901	9,947.70	.83
1909,	24,340	4,817.54	.19
1910,	30,003	11,742.26	.39

For 1906, 1907 and part of 1908 the above figures do not show the amount of rock handled as very little was hoisted in comparison to the amount actually handled. The same is true of 1909 and 1910, only the amount hoisted during those years is a very much larger per cent of the total amount of rock which was handled, and probably forms about 90 per cent of the total amount. The above comparison shows that it is cheaper to hoist it. When hoisted it is out of the way once for all, and when it is not hoisted it must be handled several times and the labor thus expended is practically a total loss.

CROSBY MINE.

The charges for 1906 and 1907 will be duplicated when the old pit is cleaned up for futureoperations. The cost for 1910 is higher than for 1909 because of the amount of rock hoisted from the sub levels during the spring, and because, I think, the bosses have been more particular, when men have been rmployed in handling rock in the pit or underground, in charging to this account on their time books.

The cost per ton of ore mined, for sorting ore, for 1906 and 1907 was $ .08, and for 1908, $ .049 per ton as compared with $ .05 per ton for 1910. This also indicates that it is cheaper to hoist the rock and thus avoid handling it several times over.

In addition to the causes effecting the cost of the individual accounts as explained above, there were two general influences which added to the cost of production. The wages of the surface men were somewhat increased making the total increase in surface wages 6.5 per cent. The Captain, Shift Bosses, Motormen and general labor underground was also increased, so that the increase in wages for the entire mine, both surface and underground, amounted to 5.6 per cent. This added $.037 per ton to the cost of production. But the larger influence was the delay caused us by the Contractors, which increased the cost of production on the total amount mined for the year $ .12 per ton.

CROSBY MINE.

ORE STATEMENT DECEMBER 31st, 1909.

	CROSBY	13 mos. LAST YEAR
On hand January 1st, 1910	838	73,515
Output for year	189,089	112,090
Stockpile overrun or shortage)applying on previous years	262	1,249
Total	190,189	184,356
Shipments	159,521	183,518
Balance on hand	30,668	838
Increase in output correspond-(12 months - 88%	88,746	
Increase in Ore on hand	29,830	

AVERAGE MINE ANALYSIS ON OUTPUT.

GRADE	IRON	PHOS.
Crosby	55.57	.037

AVERAGE ANALYSIS ON STRAIGHT CARGOES.

GRADE	IRON	PHOS.
Crosby	55.64	.036

SHIPMENTS FOR 1910.

	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR.
Crosby	146,222	13,299	159,521	183,518
Last Year	62,045	121,473	183,518	
Decrease - 13%			23,997	

CROSBY MINE.

TIMBER STATEMENT FOR YEAR ENDING DECEMBER 31, '10.

KIND	LINEAL FEET	AVG. PRICE PER FOOT	AMOUNT 1910	AMOUNT 1909
6" to 8" timber	68,576	.04	2743.04	1538.94
8" to 10" "	13,715	.04	548.60	769.48
10" to 12" "	4,572	.04	182.88	360.39
12" to 14" "	2,743	.04	109.72	318.87
14" to 16" "	1,830	.043	78.88	158.09
16" to 18" "				32.50
Total 1910	91,436	.04	3663.12	
Total 1909	69,662	.045		3178.27

KIND	LINEAL FEET	AVG. PRICE PER 100'.	AMOUNT 1910	AMOUNT 1909
6 ft. lagging	315,180	.401	1264.18	1295.76
8 ft. "	28,125	.400	112.50	437.75
Trestle timber	720	7.00	50.40	122.40
Total 1910	344,025	.364	1427.08	
Total 1909	583,628	.318		1855.91

	12 mos. 1910	18 mos. 1909
Feet of timber per ton of ore	.483	.621
Feet of lagging per ton of ore	1.81	5.21
Feet of lagging per foot of timber	3.75	8.38
Cost per ton for timber, lagging and poles	.027	.043
Equivalent of stull timber to board measure	148,226	175,372
Feet board measure per ton of ore	.783	1.565
Total Product	189,089	112,090
Total cost of timber and lagging, 1910 12 mos.		5090.20
Total cost of timber and lagging, 1909 13 mos.		5034.18
Total cost of timber and lagging, 1908 12 mos.		4848.19

CROSBY MINE.

COMPARATIVE MINING COST FOR YEAR.

	12 mos. 1910	13 mos. 1909	INCREASE	DECREASE
PRODUCT	189089	112,090	76999	
General Expense	.082	.132		.050
Maintenance	.096	.129		.033
Mining Expense	.738	.967		.229
Cost of Production	.916	1.228		.312
Exploratory	.030	.072		.042
DEPRECIATION.				
Inventory	.014	.023		.009
New Construction	.001		.001	
Experments Concentrating Ore	.015		.015	
Stripping	.211		.211	
Total	.241	.023	.218	
Taxes	.038	.059		.021
Central Office	.033	.051		.018
Cost on Stockpile	1.258	1.433		.175
Loading and shipping	.008	.040		.032
Total cost on Cars	1.266	1.473		.207
No. days operating	279	308		
No. shifts and hours	2-10-hr.	2-10-hr.		
Average Daily product	678	364		
COST OF PRODUCTION.				
Labor	.680	.866		.186
Supplies	.236	.362		.126
Total	.916	1.228		.312

CROSBY MINE.

STATEMENT OF COMPARATIVE WAGES.

	1910 12 mos.	1909 13 mos.	INCREASE	DECREASE
SURFACE				
Total number of days	10,220¾	11,113¾	30½	
Average Rate	2.44	2.27	.17	
Amount	24,916.98	25,398.41		481.43
UNDERGROUND				
Total number of days	41,589¾	30,778½	12,412½	
Average Rate	2.46	2.35	.11	
Amount	102,278.47	72,326.40	29,952.07	
Total days	51,810½	41,892	12442½	
Average rate	2.45	2.33	.12	
Total amount	127,195.45	97,724.81	29,470.64	
Labor cost per ton	.673	.872		.199

For comparison of days for twelve months, December, 1909 is omitted.

COMPARATIVE AVERAGE WAGES AND PRODUCT.

PRODUCT '10 - 189,089	SURFACE		UNDERGROUND		T O T A L	
PRODUCT '09 - 112,090	1910	13 mos. 1909	1910	13 mos. 1909	1910	13 mos. 1909
Avg. no. men working	33	33	129	94	162	127
Avg. wages per day	2.44	2.27	2.46	2.35	2.45	2.33
Avg. wages per mo. 25 days	61.00	56.75	61.50	58.75	61.00	58.25
Avg. prod. per man per day	18.50	10.08	4.55	3.64	3.65	2.67
Labor cost per ton	.132	.227	.541	.645	.673	.872
Diff. in labor cost per ton	-.095	*.010	-.104	-.183	-.199	*193
Avg. product breakg & tramming			891	6.98		
Avg. wages for miners contract			2.45	2.51		
Avg. wages for trammers contract		(none - Electric Haulage.)				
Total avg. wages contract			2.53	2.51		

Average wages theee mos. to March 31st, - $2.35) Average wages for year $2.45

Average wages nine mos. to December 31, - $2.45) Increase in wages 5.1%.

Increase in product per man per day 36.7%.

CROSBY MINE.

CROSBY MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND	QUANTITY	AVERAGE PRICES	12 mos. 1910 AMOUNT	13 mos. 1909 AMOUNT
Black Powder	50	4.20	2.60	81.65
40% "	82,050	9.25	7589.65	6099.33
50% "	600	12.50	75.00	
75% "				41.11
Fuse	129,100	.378	473.54	454.15
Caps	41,200	.623	256.86	268.53
Connecting wire	200		.55	
Total			8398.20	6945.37
Product			189,089	112,090
Pounds Powder per ton of ore			.437	.609
Cost per ton for explosives			.044	.062

T A X E S .

There was a slight increase in the total amount of taxes paid, due:

First: To a higher rate

Second: Additional property now being held under option, and increased valuation in the North Lake and Gwinn Districts.

The changes have been so immaterial that it is unnecessary to make any comments on the valuations and taxes for the past year. The following comparative statement shows the tax rate in the different cities and Townships in which the mines are located for 1909 and 1910.

STATEMENT OF RATE OF TAXATION PER $100.00.

	1910	1909
City of Ishpeming	3.38	3.27
City of Negaunee	2.62	2.52
City of Ironwood	3.25	3.38
Marquette	2.75	2.75
Montreal Twp.	5.90	5.26
Knight Twp.	4.52	4.02
Spurr Twp.	2.70	2.54
Ely Twp.	3.30	3.38
Ishpeming Twp.	5.31	
Richmond Twp.	4.83	2.94
Tilden Twp.	3.09	3.79
Stambaugh Twp.		4.50
Maple Ridge Twp.		3.21
Turin Twp.		3.64
Forsyth Twp.	3.35	3.38

ANALYSIS OF RATE PER $100.00.

		ISHPEMING	NEGAUNEE.
State	Tax	.34	.31
County	"	.67	.61
School	"	1.27	.76
City	"	.18	.20
Highway	"	.42	.24
Sewer	"	.14	
Library	"	.10	
Fire	"	.09	.15
Cemetery	"	.01	
County Road	"	.16	.15
Special			.20
Total		3.38	2.62

LABOR MATTERS.

On April 1st there was an advance in wages averaging seven percent. As stated in the Annual Report for 1909, the cost of living had appreciably increased since the last advance, and it was to meet this that the wages were raised. There has been no dissatisfaction since that time and the supply of labor has been ample. There has not been any improvement, however, in the class of men applying for work; they are largely Finlanders and Italians and do not speak the English language.

In the Gwinn District the Western Federation of Miners have organised a lodge which at one time had 280 members. At the present time there are only 150 in good standing. This organization is a menace to the peace of the district and is receiving the attention that it deserves. Unless it is broken up now, we shall, no doubt, have trouble as soon as better times arrive and there is a greater demand for labor.

CONCLUSION.

In closing this report I desire to express my appreciation of the loyal cooperation and assistance that I have received at all times from the heads of the different Departments. It is a pleasure to work with men who have the good of the Company at heart, and whose every thought is for the improvement of operating conditions, efficiency in their Departments, and the safety of the men under them.

Respectfully submitted,

W. W. Duncan

Agent.

GEOLOGICAL DEPARTMENT

AND

EXPLORATIONS 1910

I N D E X

THE CLEVELAND-CLIFFS IRON COMPANY.

REPORT OF THE CHIEF GEOLOGIST FOR YEAR ENDING DEC.31ST, 1910.

STAFF.

The force of the Geological Department at Ishpeming now consists beside myself of W. L. Scanlan, F. G. Rockwell, Gustav Afuhs, Ernest Allen, J. Frank Connell and Eddie Ham. Messrs. Scanlan and Rockwell are geologists and perform field and underground work, with what office work is necessary, while Gustav Afuhs does drafting only. Ernest Allen collects the core and looks after the drills at North Lake. J. F. Connell was engaged late in November to visit and furnish us with information about the explorations of other companies in Upper Michigan on the Marquette and Menominee ranges. Eddie Ham collects the core from the drills near Ishpeming and looks after the core room.

In addition to those regularly employed by this department, Wm. Conibear superintends our explorations in the Iron River district, and J. F. Hanst does the geological work in the Cliffs Shaft mine, assisted by F. G. Rockwell, but spends most of his time on work for the Engineering Department.

Besides those now employed in the department, R. S. Archibald was employed as geologist on the staff at Ishpeming until he was transferred to the Engineering department in March. He continued to devote part of his time to geological work in the Cliffs Shaft mine until he resigned and left the employ of the Company in July. Gordon Jaedecke performed the work now done by Eddie Ham until he was relieved by the latter in August.

There were also several men engaged temporarily for geological and other work, namely, Alfred Allen, O. P. Peterson, George Burton, R. R. Freeman and G. S. Rollin. Alfred Allen collected the core and looked after our drills at Clowry early in the year, but we had no further work for him when that exploration was finished in April. The other men all had charge of geological surveys during the summer. Messrs. Freeman and Burton will pro-

bably do more work for us next summer. In addition to the names given, there were of course a considerable number of compassmen and cooks necessary for the several parties during the summer.

The work continues under the direction of Mr. H. L. Smyth, Consulting Geologist for the Company.

E X P L O R A T I O N S.

MARQUETTE RANGE.

CLIFFS SHAFT MINE.

The drilling at the Cliffs Shaft mine was done under the charge of Mr. L. Eaton and under the direction of Mr. Smyth.

During the year 25 holes were drilled, a total distance of 3268'. Of this distance, 971' encountered ore above 55% iron, besides considerable lean and second class ore.

The first important hole drilled during the year was No.167 on the 5th level "B" shaft, near the Southwestern extremity of the main drift. This hole encountered 75' of ore averaging 61.33% iron before it passed into the hanging wall quartzite, which looked very well for this end of the mine. Several short holes were drilled on various levels, some to test the hanging, others to prospect for new bodies of ore, but none found ore of any account until No.175 was drilled on the 4th level "A" shaft. This was a horizontal hole, course due South, and encountered in all 151' of ore over 55% iron and 60' of ore between 50% and 55%. It is probable that the reason the drill penetrated such considerable thickness of ore is that the deposit is lying nearly flat on the top of an anticline and is the top of the South lens of ore developed on the 5th level "A" shaft, approximately under this hole.

The next important holes were Nos. 177 to 180 inclusive. These were drilled vertical and at various dips North and South on the 10th level "A" shaft at the Eastern extremity of the workings. Each of the four holes penetrated good ore from 56' to 141' in thickness, showing a fine basin of ore which undoubtedly extends for a considerable distance to the East.

The next hole, No.181, was drilled in a Southeasterly direction from near the Eastern extremity of the 7th level "A" shaft to determine the

position of the slate hanging and the thickness of ore between it and the present workings. It passed through 88' of ore before encountering the hanging, which is very encouraging.

The next hole of importance was No.183 on the 6th level "A" shaft. This was a horizontal hole, course North 30° East, from near the Eastern extremity of the workings to determine the thickness of ore in the Southeasterly extension of the present workings, about 200' Northwest. This hole continued in ore, second class and lean ore, with occasional thin bands of hard ore jasper to a depth of 329', where it was stopped in ore running 54.19% iron because it had reached the boundary line between the Cleveland-Cliffs Iron Company property and that of the Lake Superior Iron Company. The greater part of this ore was below 55%, but it showed a considerable body of minable ore.

The next hole, No.184, was a horizontal hole, course South 25° West, from a point near the Western extremity of the workings on the 8th level "B" shaft to try for a continuation in depth of the ore body cut vertically above on the 7th level. This hole encountered 62' of ore better than 62% iron before it reached the footwall dike, which is encouraging.

Hole No.185 was then drilled horizontal, course due North, on the 6th level "B" shaft to test the block of ground lying between No.157 and the workings at the Northeastern extremity of this level. It was a good hole, showing 79' of ore averaging 60% iron, besides some lean and second class ore.

Three holes, Nos. 186, 187 and 188, were drilled near the Eastern extremity of the workings on the 1st level "A" shaft to test the ground between these workings and the boundary of the Cleveland-Cliffs Iron Company property in the hope that there might be a lens of ore in the slate North of the main fault which runs along the North edge of the workings. Except for a little ore next to the workings, the holes encountered nothing but slate but were not drilled all the way to the boundary.

Hole No.189 on the 9th level "A" shaft was drilling at the end of the year. It started in ore from the Southeastern extremity of the workings and was drilling in a Northeasterly direction to determine whether the ore

body being mined a short distance to the Northwest continued to the East.

Mr. Hanst left the employ of the Company in April and Mr. Archibald then undertook the surveying and geology of the Cliffs Shaft mine. Mr. Archibald left in July and Mr. Hanst took up the work again upon his return in September. He found the geology considerably behind but it has now been brought up to date and the analyses maps are also kept up to date from the bi-weekly stope samples. The North-South cross-sections at 100' intervals can hardly be said to be complete as they are in a continual state of change because the geology of unexplored territory is more or less unknown and the sections have to be changed as new information is obtained. They are in very good shape, however, and are a great help in underground exploration. Mr. Hanst made a contour map of the hanging wall of the Cliffs Shaft mine, including a considerable distance East and West, which is also a valuable aid in obtaining a clear idea of the structure.

SEC.9, 47-27, CLIFFS SHAFT SURFACE.

In all 21 holes were drilled on this section during the year, totaling 5677'. Of these, 7 holes encountered ore, of which 188' was above 55%.

Hole No.16, which was in the hanging wall at the beginning of the year, encountered lean ore at 797'. It passed through 24' of ore above 55% and 20' above 50% and was stopped in hard ore jasper. These results were not as favorable as it was hoped this hole would show.

Holes Nos. 17 and 18 were next drilled North of Nos. 14 and 15 and were very encouraging as they showed the ore to have even greater thickness than found in the two latter holes. They encountered 48' and 40' of ore respectively averaging 60% and showed that the ore continues up over the anticline.

The next interesting hole was No.20, which was drilled about 300' South of No.14. It passed from quartzite directly into soft ore jasper, in which it was stopped, showing that the hard ore formation has been raised by a fault or fold and then eroded.

Holes Nos. 21 to 24 inclusive were drilled a short distance Northwest of the ore encountered at the holes last mentioned to try for a West-

ward continuation but were unsuccessful.

The drill was then moved over a quarter of a mile West near the Carp river, a short distance North of the County Road, to prospect this territory more thoroughly than had been done previously. The first six holes encountered no ore of any consequence, but in hole No.31, 38' of ore above 50% were encountered. Two holes drilled West of this point did not find the Westward continuation, but hole No.34, located nearly 400' Northwest of No.31, encountered 36' of ore running 62.05% iron, besides a little lean and second class ore. This was very encouraging, but holes Nos. 35 and 36, located a short distance North and West of No.34, although they encountered a little ore and lean ore, did not find anything that would indicate an ore body of commercial value. No.36 was still drilling at the end of the year.

SEC.10, 47-27, CLIFFS SHAFT SURFACE.

During January and February two holes, Nos. 9 and 10, were drilled upon this section, totaling 520', both of which encountered good ore, in all 65' above 55%, besides considerable lean and second class ore. They were located a short distance North and West of Nos. 7 and 8, between the mine workings and these holes, which were drilled in 1909. They encountered ore and were much better than the two previous holes.

SALISBURY MINE.

Mr. Archibald kept the Salisbury geological maps up to date until he left. Since then no geological work has been done up to the end of the year, but Mr. Scanlan will bring the work up to date early in 1911.

The attempt to plot the daily stope samples upon the map, thus making a second and separate sampling unnecessary, was unsuccessful. The analyses could be readily plotted in the proper place on the map, but it turned out that the daily analyses of the ore in the breast were not suitable for our purposes. These daily samples are taken to show the ore as mined, whereas we wish to show on the maps the material that is left. It often happens that a drift may be partly in ore, in which case the sample will of course be ore, but one side and a part of the top or bottom may be rock. This is particularly the case at the Salisbury because the formation

stands nearly vertical. We therefore find it necessary to make a second careful sampling of the workings. This work has not been brought up to date for some months but will be done shortly after the first of the year.

NORTH LAKE DISTRICT.

SECTION 6, 47-27.

Sixteen holes were drilled on this section during the year, totaling 6985'. Of these holes 8 were standpipes to locate the position of the fault where it crosses the hard ore contact near the Southwest corner of the section. Of the 8 diamond drill holes 4 encountered ore, cutting in all 821' above 50% iron and minable. This drilling has shown the existence of a considerable ore body on the NW$\frac{1}{4}$ of the SE$\frac{1}{4}$ of Section 6. With the exception of the first drill hole, which was poorly located with respect to the trough between footwall and fault, and the last hole, which had not reached the ore horizon at the end of the year, every hole on this forty encountered good ore. The indications at present are that there is an ore body here of at least 1,600,000 tons above 55%. This is only a rough estimate because no cross-sections have been made of the ore body. It is intended to go back and do this after the ore has been followed as far West as possible with the idea of determining how close it comes to the No.2 shaft.

Hole No.44, which was drilling at the beginning of the year, passed below the ore cut in No.37 and found nothing but a very little lean ore. This was discouraging but it is not proof that hole No.37 did not pass through a good ore body. It seems very probable that this hole may have passed through a continuation of the ore body, which, at the end of the year, had been traced West to about 1000' from this hole.

Hole No.46 was drilled on the South side of the fault which cuts off the No.2 ore body on the East, hoping that it would find a continuation of the syncline in which the No.2 ore body occurs. Although this hole indicated a slight irregularity in the footwall slate, it did not strike the axis of the syncline and encountered only a little ore near the surface.

Only one drill is now working upon Section 6 and attention is concentrated upon determining how far West the new ore body continues.

During the year 9 test pits were sunk upon Section 6 to locate the footwall more accurately North of hole No.58 and to determine more exactly the position of the fault East of the No.2 ore body and of the fault South of hole No.59. The total distance sunk by test pitting was 133½' and the total cost $156.41.

SECTION 7, 47-27.

In connection with the standpiping to locate where the fault crosses the hard ore contact near the Southwest corner of Section 6, two standpipes were sunk during the year upon this section near the Northwest corner. The total distance was 287'.

SECTION 1, 47-28.

During the year 35 holes were drilled upon this section, totaling 6322'. Of these, 31 were standpipes or holes to locate the hard and soft ore contacts and 4 were drill holes. The latter only encountered 80' of ore above 55%. The work was done upon the Barnes & Hecker option, Chase lease and Excelsior Iron Company land.

Hole No.8 on the Chase lease, which was drilling at the beginning of the year, found a little more ore and lean ore but nothing to indicate a merchantable ore body. Eight standpipes were sunk North of No.8, mostly on the Barnes & Hecker option, to locate the jasper-slate contact more accurately and determine if there is any irregularity which would indicate a fold or fault which might be responsible for the slight concentration in No.8. As the contact was shown to be fairly regular, no further work was done at this point.

Hole No.58, which encountered some ore and lean ore during 1909, and which was drilling at the first of the year, continued in rich jasper and encountered 58' more of ore, running 56.27% iron, at a depth of 1000', besides 60' of 51% ore and considerable lean ore. This hole was drilled to a depth of 1280' without reaching the slate and shows that the footwall must dip very steeply at the East end of the ore body. This hole was drilled more for development than for exploration, since previous drilling had shown an ore body of sufficient size to warrant development.

Ten drill holes and standpipes were sunk North of the No.1 ore body to test the formation near the contact and determine the contact more accurately. These were partly upon the Chase lease and partly upon Excelsior Iron Company land.

Thirteen standpipes were sunk on the SE¼ of the SE¼ of Section 1 to try and find where the fault which cuts off the No.2 ore body on the East crosses the hard ore contact in Section 1. It was expected that the fault would be found in the Western part of the forty but standpiping was carried almost to the East line of the section without learning definitely the position of the fault. This work was still continuing at the end of the year.

Two drill holes were started, Nos. 71 and 73, in an attempt to drill a deep vertical hole close to hole No.48. The ledge was so hard and broken up that the holes departed very considerably from the vertical during the first few feet in ledge and this idea was given up until it has been proven more definitely whether there is a fault passing North of No.48 and until the ground Northeast of hole No.4 has been tested more thoroughly for a continuation of the ore in that hole.

SECTION 2, 47-28.

The only work upon this section during the year was upon the Barnes & Hecker option. In all 11 holes were drilled, totaling 5946'. Of this distance 437' was in ore above 55%.

Hole No.35, which had passed through the ore at the end of 1909, was drilled through to the slate early in 1910 to determine whether more ore occurred closer to the slate. No more ore was found and as it has since been determined that the ore found in hole No.25 pitches down to the West, it is evident that the small amount of ore and second class ore found in No.35 was at the top of the ore body.

Holes Nos. 43 and 44 were drilled on the ice at North Lake last winter to try for an Eastward continuation of the ore in hole No.25. Both were blank and if the ore body does continue to the East it must pitch upward very rapidly. It is doubtful if this ore comes to the surface at any point. Three other holes were drilled on the ice at the East end of the lake. Nos. 45 and 47 were practically blank but No.46 encountered 46' of ore at

ledge, besides considerable lean and second class ore. This was a very fair hole but the trough is so narrow at this point between the slate and dike that considering the several holes drilled to the West there seemed to be no chance for an ore body of commercial size and no further work was done.

When the drilling on the ice was finished, hole No.48 was started to try for a Westward continuation of the ore body, assuming a downward pitch to the West. This was a fine hole and cut 215' of continuous ore, averaging over 60% iron, .080 phosphorus, besides considerable mixed ore, lean ore and second class ore. This hole was 400' West of hole No.25 and indicated a considerable ore body. Ever since the ore was cut in hole 25 in August, 1909, drills have been at work searching for a continuation of the ore but No.48 was the first hole that found it in July 1910.

Holes Nos. 50 and 51 were immediately started 200' East and West of No.48 along the strike of the ore body. No.50 had to be abandoned at a comparatively shallow depth because of caving ground and because the rods were stuck in the hole. No.51 was drilled to the ore successfully and encountered 90' of ore over 55%, besides considerable lean and second class ore. As this ore was encountered considerably higher than expected and since considerably less was cut than in No.48, it was suspected that this hole was located a little too far North and the next hole, No.52, was accordingly started 200' West and considerably South of the line between Nos. 48 and 51. This hole has progressed satisfactorily but had not reached the ore horizon at the end of the year.

Although the cross-section of the ore has not been determined very accurately because of the great depth and the very broken nature of the ground which makes difficult drilling, a rough conservative estimate of this ore body is 1,500,000 tons above 55% iron. If hole No.52 encounters ore it will increase this estimate materially and Mr. Smyth recommends that no further drilling be done as sufficient ore will have been shown up to warrant development.

SECTION 3, 47-28.

During the year 20 holes were drilled upon this section, totaling 5841'. The only ore of any consequence was in hole No.47, which encountered 86' of lean and second class ore near the surface and 55' of ore and second

class ore at about 750'. Since this ore occurred in a trough between the slate footwall and a dike dipping North, it was considered sufficiently encouraging to warrant another deep hole in the trough further West. This hole, No.52, was drilled to a depth of 1130' but only encountered some lean and second class ore at a depth of over 1000'.

Hole No.51 was drilled to determine the dip of the footwall and whether the lean ore cut near the surface in hole No.47 had any width. It found the footwall to be very steep and encountered no ore worth mentioning. In all 7 holes, all of considerable depth, were drilled upon the NW¼ of Section 3 during the year with very unfavorable results. We have tested the soft ore contact very thoroughly and found the formation to be very unfavorable for a commercial concentration of ore. It seems to be entirely undifferentiated and not broken up at all as is the case in the favorable parts of the iron formation. It is not intended to test any further for soft ore at present, but there is still a possibility of hard ore on this quarter section.

Six standpipes were sunk upon the NE¼ to determine a shaft location and these of course were for development rather than exploration.

Considerable drilling was done East of the Barnes ore body to try for an Eastward continuation, but with the exception of one hole, no ore whatever was found. Two very complete cross-sections of six holes each were made, which showed that the ore was cut off by a very lean formation intruded by many dikes. The last drill hole on this quarter section was No.50, which was drilled at what seemed to be the most favorable location, judging by the results of Mr. Bradt's work some years ago. This hole encountered slate at 136' and a very lean formation above that, and was so discouraging that no further work was done.

MAAS AND NEGAUNEE MINES.

Mr. Scanlan brought the geological maps of the Maas mine up to date early in the year but did not do anything with the Negaunee mine. No geological work has been done in either of these mines since Mr. Scanlan started his field work last spring.

LUCY MINE.

Early in the year, Mr. Scanlan made a set of geological maps and cross-sections of this mine upon which he recorded all of the geological data obtained in a thorough examination of the mine. There were still several problems to be worked out, however, which he did not have an opportunity to do before he had to start field work in the spring. No geological work has been done since that time.

SECTION 1, 47-27, JACKSON.

Hole No.66 was advanced 263' during the year. The hole was reamed all the way down to the bit which was stuck in the hole at 1626' during 1909 before it could be recovered. This work was finally completed during October and drilling proceeded at a good rate during October and November. During the latter month, however, the casing broke in the bad ground at about 1200' and efforts to pull the lower part of the broken casing were unsuccessful. The broken coupling has been removed and an attempt is now being made to couple on some new casing. I think that this attempt will be successful, although it is slow work. If this can be done, we should once more be able to drill and will probably bottom the hole successfully.

PIONEER FURNACE.

From April to June six standpipes were sunk at the Pioneer Furnace in connection with theconstruction of some new plant. The total distance was 774'. This of course had nothing to do with exploring.

SWANZY DISTRICT.

The standpiping for a shaft location, which was started during 1909, was continued until March 1910. During the year drill hole No.53 was completed and eight standpipes were sunk, a total distance of 994'. These [illegible] were for development and not for exploration.

CLOWRY DISTRICT.

SEC.31, 48-28, NE¼ of SW¼, N½ of SE¼ & SE¼ of NE¼, HOUGHTON COUNTY OPTION.

This option was taken in October, 1909. Drilling was not started until late in December and the first hole was bottomed in January, 1910. As it encountered greywacke, supposed to be a part of the Siamo slate formation, and as it was discovered at that time that George Maas had a lease on this land, it having been optioned to us by a mistake on the part of the Houghton County officials, no further work was done. The drilling on this hole during 1910 amounted to 36'.

SEC.26, 48-29, SE¼ of SE¼, LOWNEY OPTION.

This option was taken in December, 1909, and drilling was started in January and four holes were drilled. The first encountered greywacke, supposed to belong to the Siamo formation, and the other three encountered the quartzite of the Ishpeming formation. As the ore formation for which we were searching must lie between the Siamo and Ishpeming formations, and as holes 1 and 4 were only 75' apart, the width of the formation was limited to less than this distance and it was decided that it was not worth while to do any more work. The last hole was finished in April. The total distance drilled was 734'.

SEC.36, 48-29, NW¼ of NE¼, DAVIDSON-STERLING OPTION.

This option was taken in March, 1910, and work started the same month, two holes being drilled. It was found that previous drilling by George Maas on the South and West boundary lines showed that if the ore formation occurred at all on this property it must simply cut across the Southwest corner of the forty. The second drill hole was therefore located at the Southwest corner, dipping 70° North. As it started in quartzite and was bottomed in a slaty chert, either the Siamo formation or possibly a very lean phase of the Negaunee formation, it was decided that there was no possibility of any ore occurring on this land and drilling was stopped in April. In all, 329' of drilling was done on this section.

IMPERIAL MINE.

Drilling was continued on Section 25, 48-31 Imperial and 12 holes were drilled during the year, totaling 3364'. Of these six holes encountered good ore of the Imperial grade, that is, averaging over 52% iron, and the average thickness was 47'. In all 282' were drilled in ore. Every hole drilled North of the fault encountered ore and every hole South of the fault was blank. The drilling proved up roughly 1,000,000 tons of ore, averaging 52% or better, in addition to the 500,000 tons of ore in sight in the mine. This estimate was made in August, 1910. There is a possibility of an additional tonnage, but the drilling was stopped before this could be proved up.

Mr. Scanlan completed his geological survey of the Imperial mine early in the year and made a careful geological report. No geological work was done here during the summer, but he brought the maps up to date again in December.

GOGEBIC RANGE.

ASHLAND MINE.

In April, 1910, a drill hole was started on the 17th level No.9 shaft at the Ashland mine. The hole was started in the quartzite footwall and it was intended to drill in the footwall parallel to the ore formation and determine whether the quartzite was cut by any dikes, which would presumably also cut the ore formation and form troughs in which ore would probably occur. The hole was started at too shallow an angle and it ran out of the quartzite at 227'. The drilling in jasper below that point was difficult, but the hole was drilled to a depth of 665'. Ore was cut from 572' to 614', averaging 59.71% iron and .082 phosphorus just above a dike. Another dike was encountered higher up in the hole but no ore was found above it.

As soon as the hole had passed through the ore and dike beneath it trouble began with caving ground and the bit was lost in the hole by a careless runner. Considerable time and money were spent in trying to recover it, but it was impossible and was finally left in the hopes that future mining operations might recover it.

Of the 665' drilled, 42' were in ore averaging 59% and 11' in second class ore above 52%.

MENOMINEE RANGE.

MENOMINEE COUNTY.

On Mr. Smyth's recommendation, considerable magnetic work was done East of Waucedah in Townships 39 North 26, 27 and 28 West during the summer to trace out the Eastern extension of the Menominee Range under the Cambrian sandstone. Two parties were kept in the field most of the time from July to October inclusive and the magnetic lines were traced successfully for ten miles Eastward beneath the sandstone. This survey cost about $1500. The area covered was 27 square miles.

The results of the magnetic work were so encouraging that steps were immediately taken to secure options upon practically all of the land in 39-27. It was found difficult to obtain correct abstracts of thesd lands and considerable delay was experienced for this reason. By December, however, options on the J. B. Goodman Company and Wisconsin Land & Lumber Company holdings in this township had been signed and drilling will be started during January. We expect to be able to secure options upon all but a few scattering forties.

FLORENCE COUNTY, WISCONSIN.

During June and July one field party conducted a geological and magnetic survey to try and find a Westward continuation of the Menominee Range beyond the Menominee river. The country between Iron Mountain and the Menominee river was first covered to obtain an idea as to what magnetic readings might be expected over the iron formation. The magnetic line was then traced for a short distance West of the river but it died out very shortly, showing that the ore formation probably pitches downward beneath the Hanbury slates. The survey was carried considerably further West but nothing more of importance was encountered. As Mr. W. O. Hotchkiss, State Geologist of Wisconsin, and the geologists for the Florence Iron Mining Company were both in the field and intending to cover this territory during the summer, and as there were no indications sufficiently favorable to warrant the expenditure of any more money, the survey was stopped in July and this party started on a magnetic survey North of Amasa. The survey near Florence cost about $500. The area covered was about 18 square miles.

IRON COUNTY.

AMASA DISTRICT.

During July, August and September one field party made a geological and magnetic survey of the country North of Amasa, particularly to do more detailed work along the magnetic lines shown upon the U. S. geological survey map of the Crystal Falls district. Considerable magnetic attraction was found and several lines of high dips and much variation of the compass needle. The lines were traced six miles North from Amasa, the survey covering about 12 square miles. This survey cost about $600.

At the end of September it became necessary to have some geological work done in Minnesota and as there was very little time left for field work before winter weather would set in this party was sent West to do it. It is intended to continue this magnetic work at the first opportunity.

There have been several explorations in this district but the Channing at Red Rock is the only one that bears any resemblance to a mine. It was operated for about two years until August, 1910, when it was closed down. They are reported to have about 400,000 tons of 42% ore blocked out. The mines at Amasa on this same formation, however, seem to be doing very well and considerable drilling has been done recently and is still going on to search for new ore bodies.

IRON RIVER-SAUNDERS DISTRICT.

SEC.8, 42-34, E½ of E½ & SEC.9, 42-34, SW¼, HOLMES OPTION.

This option was taken in December, 1909. Drilling was started early in February and up to the end of the year 12 holes had been drilled, totaling 2750'. No ore formation was encountered in the 7 holes on Section 9, which constituted almost a complete cross-section across the property. This was the first work done on the option and the drill was then moved to near the Southwest corner of the option on Section 8. This was the nearest point to the ore formation previously discovered on the SW¼ of the SE¼ of the same section. Although no ore formation was encountered in this hole, some of the slate was so ferruginous that it was considered a favorable in-

dication and more holes were drilled to the North, making another North-South section. Up to the end of the year five holes had been drilled on Section 8. Holes Nos. 3 and 4 encountered the ore formation with some lean and second class ore. No.5 had not reached ledge at the end of the year. As the material encountered in Nos. 3 and 4 was encouraging, since it contained bands of ore, Mr. Smyth recommends that we continue drilling to the North. He thinks that the formation may be striking nearly North and South and on this hypothesis the formation must turn East again very soon.

SECTIONS 9, 10 & 11, 42-34, WISCONSIN LAND & LUMBER CO. OPTION.

In February, 1910, an option was taken from the Wisconsin Land & Lumber Company upon 28 forties in the above three sections. Drilling was started in March upon Section 10 and four holes were drilled, totaling 496', besides two union holes on the South line of the section. The drilling began at the South line and progressed North at intervals in a search for the iron formation. It was not found and as the work on the Holmes option on Section 9, a mile further West, seemed to preclude the possibility of the iron formation extending Eastward, where we expected it, work was stopped and the option was relinquished in July.

SECTION 10, 42-34, W½ of NE¼ & NE¼ of NW¼.

SECTION 11, 42-34, LOT 3 & SW¼ of SE¼, D. M. & M. RAILWAY CO. OPTION.

An option was taken on these lands in December, 1909, but no drilling was ever done. The lands were located farther North than we expected to find the ore formation and when drilling on Sections 9 and 10 showed that the ore formation did not continue East, where we expected it, the option was relinquished.

SEC.14, 42-34, NW¼ & SEC.15, 42-34, N½, SCHRIBER OPTION.

This option was taken in January, 1910. During March and April, one drill hole was put down at North quarter post of Section 15, a distance of 142'. There was also a union hole at the Northwest corner of the section. This option was held almost entirely by test pitting. Four pits were sunk, a total distance of 364', along the West line of the option. These sufficed to hold it until the last of August. At that time drilling on the Wakefield

option on Section 16, and on the Wisconsin Land & Lumber Company option on Section 10, taken in connection with the greenstone found in test pit No.3 on the Schriber option, showed that there was no chance for any ore formation on the latter and it was accordingly relinquished.

SEC.16, 42-34, SW¼, SW¼ of NW¼, SW¼ of NE¼ & W½ of SE¼, HAMILTON & MERRYMAN COMPANY OPTION.

An option on these lands was applied for and the papers drawn up and signed by the Hamilton & Merryman Company in August, 1910. This was at the time that we were drilling the Wakefield option on the same section and three of the holes were drilled on the boundary line of the Hamilton & Merryman Company land. As these holes indicated that the ore formation did not pass through Section 16, where we expected it, and as the option called for two drills and contained other unfavorable features, it was never signed by the Cleveland-Cliffs Iron Company. When work was stopped on the Wakefield option, the Hamilton & Merryman Company were notified that we did not care to accept the option.

SEC.16, 42-34, N½ of N½, SE¼ of NW¼, SE¼ of NE¼ & LOTS 1 & 2, WAKEFIELD OPTION.

In March, 1910, an option was taken on these lands. Drilling was started during the same month and continued until the last of September. In all 7 drill holes were put down, a total distance of 1073', making almost a complete North-South section across the property. Taken in connection with the other drilling in the district, they showed that there was no chance of the ore formation occurring on the property and the option was therefore relinquished.

IRON RIVER-BATES DISTRICT.

SEC.15,43-34, SW¼ of SW¼, BENSON OPTION, & SE¼ of SW¼, CARLSON OPTION.

In June, 1910, options were taken on these descriptions on the strength of the ore which had just been encountered in hole No.6 Section 21, as it was then supposed that the ore formation continued in a North-easterly direction. One hole was drilled between the two options, a distance of 377'. As it gave no indication of being near the iron formation, and as magnetic work since the hole was started showed that the ore formation found on the Erickson option probably turned more to the East, the option was relinquished when the first hole was finished.

SECTION 15, 43-34, N½ of SE¼ & SW¼ of SE¼, EMMA ERICKSON OPTION.

At the same time and for the same reason that the Benson and Carlson options were taken, an option was taken on the above land. A drill hole was started at the same time, namely in July, but owing to the great depth of surface it had not yet reached ledge. The pipe was driven to a depth of 414', where it was broken and various kinds of trouble experienced. Cole & McDonald have not yet succeeded in reaching this depth again. Work is still progressing.

SECTION 16, 43-34, S½ of S½, WISCONSIN LAND & LUMBER CO. OPTION.

In July, an option was taken on this land because it was supposed at that time that the ore formation found by the Florence Iron Company at the Hall exploration on Section 19 continued East through Section 16 or Section 21. As we had proved by standpiping between the Larson & Langendorf options that the ore formation did not cross the NW¼ of Section 21, we thought that it must lie upon Section 16 and this option was taken before the last standpipe was put down on the North line of Section 21. Just about this time magnetic work showed that the ore formation would not be expected to cross

here at all and so this option was given up without having any further work done upon it.

SEC.21, 43-34, SW¼, ERICKSON OPTION.

The second drill hole upon this option which had just reached ledge at the first of the year ran into ore early in January and continued in ore and second class ore for 370'. The bottom of the ore was reached at 800', but the hole was drilled to a depth of 1256' without finding anything but considerable lean ore high in manganese. This was a fine hole and drilling on the Erickson during the year has all been for the purpose of extending the limits of this ore body. A cross-section of three holes was made, all of which found ore, and showed that the ore body at that point has a section of 92,000 square feet, which means in round numbers 5,250 tons per running foot, allowing 14 cubic feet per ton and 20% for rock.

The next hole was 200' Northeast of this section along the strike of the formation and it encountered even better ore than the corresponding hole in the cross-section mentioned. It seems certain that we have a good ore body here but drilling still continues to determine the extent along the strike.

In all five holes were drilled during the year, a total distance of 3370'. Of the four which reached ledge, all encountered good ore, cutting a total distance of 826' of minable ore better than 50% iron. Two test pits were sunk in advance of the drill holes, a distance of 191'.

SEC.21,43-34,W½ of NW¼,LARSON OPTION & E½ of NW¼,LANGENDORF OPTION.

In January and February options were taken on the above lands. As mentioned above, these were taken to look for an Eastward continuation of the ore formation encountered on Section 19.

A complete cross-section was made North and South on the boundary line between the two options at one eighth mile intervals and one hole was also drilled on the Langendorf option near the South boundary. None of the six holes encountered anything to indicate that we were near the ore formation and the options were given up late in September. In all 1163' of drilling was done upon the two options.

SEC.21, 43-34, N½ of SE¼ & SW¼ of SE¼, HANSON OPTION,
S½ of NE¼ & S½ of NW¼ of NE¼, ANDERSON OPTION.

These options were taken in July, immediately after ore was encountered on the Erickson, as it was naturally supposed that the ore formation continued to the Northeast. Since then 7 holes have been drilled on the boundary line between the two options and one hole on the Hanson option. One of the union holes encountered 20' of ore and a shallow iron formation. Other holes a short distance East and West, however, showed that this iron formation was very thin and it seems probable that it was not the main formation. The hole upon the Hanson option and one of the union holes encountered material which is an indication that they were close to the iron formation, but no hole on either of these options has yet penetrated it. Drilling still continues upon the boundary line to complete the East-West section and it is hoped and expected that one of the two holes now drilling will encounter ore formation.

The 8 holes drilled totaled 2121'. There was also one test pit sunk in advance of drilling, a distance of 111'.

The work here, as on all the options in the Bates district, goes very slowly on account of the great depth of surface, which ranges from 140' to about 450'. The holes near the iron formation range from 250' to 350'.

SEC.22,43-34,SW¼ of NW¼, PETERSON & HEDSTROM OPTIONS,
SE¼ of NW¼, JOHNSON-VOSBERG OPTION.

In June, 1910, options were taken on these lands, with the exception of the ten acres owned by Carl Hedstrom. Later in November an option on easy terms was obtained on the said ten acres from Carl Hedstrom, which required no work in addition to that done upon the Peterson option. These options were taken at the time that the shallow iron formation was encountered between the Hanson and Anderson options, as it was then considered certain that the ore formation continued to the East or Northeast. It is now thought that the hole mentioned did not penetrate the main iron formation, but magnetic work still makes it probable that the Erickson ore formation does continue to the East and connect up with the Chicagon Lake mine. Two holes have been drilled between the Peterson and Johnson-Vosberg options,

a total distance of 499'. Only one of these had reached ledge and that was rather too far North to encounter the ore formation. Drilling on the second hole has progressed very slowly but is now going on at a more rapid rate and it should reach ledge early in the year.

SEC.22, 43-34, SE¼ of NE¼, SJOQUIST OPTION,

SW¼ of NE¼ & N½ of NW¼, G.M.WAKEFIELD MINERAL LAND CO.OPTION.

In November the above options were taken on the strength of the summer's magnetic work, which made it seem probable, in fact almost certain, that the ore formation is continuous across Section 22, between our Erickson exploration and the Chicagon Lake mine. Application was also made for the S½ of Section 22 owned by the Thomas Estate, but the papers have not yet been signed.

One test pit was sunk during December, a distance of 80', between the Wakefield and Sjoquist options, and a drill hole will be started from this pit immediately.

SEC.23, 43-34, S½ of SW¼ & SW¼ of SE¼, KRANS & HANSON OPTION,

N½ of SW¼ & NW¼ of SE¼, GUSTAFSON, ET AL OPTION.

In November these options were also taken on the strength of magnetic work during the summer. The Southeastern part of the Krans option, adjacent to the Chicagon Lake mine, has been explored by the Munro Iron Company, but their work only testedaa small part of the property, whereas it is probable that a quarter mile length of ore formation underlies it.

One test pit was sunk between the two options, a total distance of 105', and a drill hole will be sunk from the bottom of the pit immediately. Another test pit was sunk on the West line of the Gustafson option by Cole & McDonald but this was merely for water supply, although we have the privilege of drilling a hole from the bottom of it if we so desire.

MAGNETIC & GEOLOGICAL SURVEY OF BATES DISTRICT.

Early in May, Mr. Scanlan started a geological and magnetic survey West of Crystal Falls, but after one or two weeks field work, it was decided that the party could do more valuable work in the Bates district, where we were then drilling, in the hopes that he might be able to trace the

course of the ore formation. This work continued during the summer under the charge of Mr. Scanlan, sometimes with one party, sometimes with two, until bad weather in November forced him to leave the field. A few weeks magnetic work at the end of the season was done in the Saunders district, but practically the entire season was spent in Bates township. The work was successful, although it was found that the ore formation was not itself magnetic. Several greenstone outcrops and drill holes in greenstone had been located a short distance South of the known position of the ore formation and it was found that this greenstone could be traced by the dip needle. The greenstone was found to form a continuous belt and supposing the ore formation to parallel it, as is probable, we have a very good clue to the position of the ore formation. Several options were taken in the Bates district on the strength of this work, as above mentioned.

Besides this magnetic work in tracing out the probanle course of the ore formation, the whole district was covered carefully, all outcrops located and the Northern limit of the slates at their contact with the greenstone was mapped by magnetic means.

In all 39 square miles were covered at a total cost of about $2800. This cost was a little higher than it would otherwise have been because several new men were broken in by Mr. Scanlan's party and because owing to the very slight but important magnetic disturbance some of the work had to be done two or even three times to be certain of accurate results.

IRON RIVER-STAMBAUGH DISTRICT.

SEC.34,43-35,SE¼ of SE¼ & SEC.2, 42-35,NW¼ of NW¼, COE & YOUNGS OPTION.

Six more test pits were sunk upon this option during the year, totaling 613', and then two drill holes were sunk, a total distance of 760', in the center of the formation as determined by test pitting. They encountered a considerable thickness of ore formation, but no ore. We considered that these two holes, taken in connection with the test pitting, had given the property a thorough test and the option was given up in May.

SEC.34, 43-35, SW¼ of SE¼ & S½ of SW¼, HAMILTON-MERRYMAN OPTION.

Three pits were bottomed on this option during the year, besides two union pits with the Coe & Youngs option. The total distance test pitted was 257'. The ore formation was found to cut across the NE corner of the option, but as it was found to be lean on the Coe & Youngs, the Hamilton-Merryman option was given up in May at the same time as the other.

SEC.35, 43-35, W½ of NE¼ & E½ of NW¼, SELDEN OPTION.

Six more test pits and churn drill holes were sunk upon this option during the year, a total distance of 349'. They only encountered 16' of ore above 50% and did not increase appreciably the estimate of 50,000 tons made last year. It was decided that this ore body was not large enough to warrant development by our Company, but a lease was taken and turned over in June to J. H. Bartow et al.

MESABI RANGE.

CROSBY MINE.

Drilling continued at the Crosby mine until late in March. Twelve holes were drilled, totaling 1188', of which only 97' was in ore above 50%. The greater part of this was in one hole which cut 65' of ore and second class ore. This drilling was done under the direction of Superintendent Reigart and I presume that he will discuss it in his report.

SECTION 10, 56-23.

A third diamond drill test of this state lease was made during the year from March to June. In all 12 holes were drilled, totaling 1425', of which only 91' was in ore above 50% and only 10' above 55%. These results were so discouraging that it was decided to do no further exploring on the property. The work was done under the direction of Mr. Jopling and Superintendent Reigart and I presume that they will discuss it in their reports.

CUYUNA RANGE.

BELLE PRAIRIE GEOLOGICAL SURVEY.

During October, Mr. O. P. Peterson and a compassman spent about two weeks in making a geological and magnetic survey of the land offered us by

Mr. Victor Beckman in Section 14, 41-31, Belle Prairie township. This is located a few miles Northeast of Little Falls, Minnesota, and a considerable distance South of, although it is locally considered to be part of, the Cuyuna Range. Some magnetic disturbances were discovered there and several options taken on the strength of these readings. Our men found that although there were some irregular disturbances they were undoubtedly due to igneous and gneissic rocks which outcrop in the neighborhood and we refused Mr. Beckman's offer of an option on his property. This survey cost $130.

CUYUNA GEOLOGICAL SURVEY IN AITKIN COUNTY.

When Mr. Peterson finished the survey near Little Falls he spent nearly a month in Towns 49-22 and 50-22 North of Tamarack, Aitkin County, Minnesota. This work was done to prove or disprove the reported occurrence of magnetic disturbance, as the lands of the Central Land & Timber Company lie a short distance to the West and any magnetic line in these townships would presumably run West or Southwest across those lands. The high dips reported by various parties were not verified but slight magnetic disturbances were found, which would justify more magnetic work later on. There was no time this season for the careful work necessary. The total cost of this survey was $175.

OPTIONS.

The options now held in the North Lake District cover the following lands. From Barnes & Hecker an extention to July 31st, 1911, was taken on the Northwest quarter of Section 1, 47-28; and the Northwest quarter of the Northeast quarter and Lot 1 of Section 2, 47-28. From the Barnes Land Co. an extention to July 31st, 1911, was taken on Lot 2 of Section 2, 47-28, and the Northwest quarter of Section 3, 47-28.

EXPLORATIONS
Section 6.

Section 6 is owned entirely by the Cleveland Cliffs Iron Company, it being part of the Holdings of the old Excelsior Iron Company. No. 2 Shaft ore body was located here in 1909, and one hole had been drilled 1500 ft. Southeast of the Shaft to test the soft ore formation. This hole showed 83 ft. of ore averaging 59.00 Iron, .120 Phos. at a depth of 1000 ft. The next hole was drilled at an angle of seventy five degrees to cross cut this ore body; it was started in December 1909, and completed in May 1910 at a depth of 1404 ft. It showed several small runs of lean ore, but undoubtedly passed under the ore shown up in the previous hole. The next hole was drilled at a point 900 ft. South of No. 2 Shaft to prove whether the main ore body extended to the East beyond the fault. This hole showed a flattening of the footwall, but failed to find ore. It is possible that it passed to the North of the ore, and later on it is expected to do more drilling at this point.

Test pitting on the Northwest quarter of the Southeast quarter indicated a fault with the Northeast-Southwest strike, this fault being parallel to the one near No. 2 ore body. A total of six holes have been drilled here at intervals of 200 ft, in four of which considerable ore was encountered. They indicate two runs of ore seperated by a horse of jasper, part of the upper run being a high grade bessemer ore. One of these holes showed 65 ft. of 65.06 Iron, .040 Phos. at a depth of 165 ft. below the surface. The ore is close to surface near the intersection of the fault and footwall, being 3000 ft. distant

from No. 2 Shaft. The ore has been proven to extend to the West for a distance of 800 ft., the last hole being only 2200 ft. distant from the shaft. It is planned to continue drilling to the West following the ore to prove whether it will be advisable to mine this ore by drifting from No. 2 Shaft. Only two of the holes were drilled in line North and South, giving one narrow cross-section at the East end of the trough near the intersection of the fault and footwall. Figuring the ore in the other holes on the basis of this section, shows 1,250,000 tons developed here to date of December 31st, 1910, of which about 250,000 tons is a high grade Bessemer ore.

In the Southwest quarter of the Southwest quarter eight standpipe holes were put down to ledge to locate the fault on the contact of the hard and soft ore formations. Since the fault has been located it has been possible to locate drill holes more nearly in the center of the trough between the fault and the footwall.

EXPLORATIONS
Section.1.

Four holes have been drilled on this section the past year, and thirty standpipes put down to ledge. Hole 8 on the Northwest of the Southwest, located about 375 ft. South of the footwall, was started in October 1909 and completed in January 1910 at a depth of 978 ft. This hole showed a number of small runs of lean ore between 400 and 600 ft., also several runs between 800 and 900 ft; 10 ft. of this latter run averaging 60.45 Iron and .075 Phos. It showed a rich iron formation to exist at this point. Later in the year eight standpipes were put down North of hole 8 to find if there was any irregularity in the footwall which would account for the concentration in this hole, but nothing was found which would warrant further drilling here.

Hole 58 on the Northeast of the Southeast, located 900 ft. from No. 1 Shaft, was started in December 1909 and finished in January 1910. This hole showed 44 ft. of ore averaging 55.60 Iron and .046 Phos. at a depth of 614 ft., and 58 ft. of 56.00 Iron and .249 Phos. at a depth of 1000 ft., besides several

runs of low grade ore. This hole showed that ore would be found on the Excelsior Iron Company's land by drifting direct South of No. 1 Shaft. This ore will then be followed to the West, and it is hoped that it will connect with the ore on the Moore-Chase lease.

Hole 60 and 61 were drilled near the footwall contact about 600 ft. Southwest of No. 1 Shaft. They each showed some silica ore averaging about 48.00 Iron, a short distance below the ledge.

Seven standpipes were sunk on the footwall contact on the Northwest of the Southeast in an effort to locate the inter-section of a fault on the footwall. This fault had been indicated by two standpipes, to determine the hard and soft ore contact on the Northeast of the Southwest. No evidence was shown of a break on the footwall contact, but this is not taken as conclusive evidence of the non-existance of the fault, as the fault as indicated, makes a very slight angle with the footwall, rendering it extreemly difficult to find the actual point of inter-section. It is planned to test further on the hard and soft ore contact, as the proving of a fault here would give good reasons for assuming that another large ore body might be developed in the vicinity of diamond drill hole 4, about one half mile West of No. 1 Shaft.

On the Southeast of the Southeast thirteen standpipes have been put down to ledge in an effort to discover the inter-section of No. 2 Shaft fault on the hard and soft ore contact. This inter-section is indicated by the last standpipe. It is thought that one or possibly two more holes will complete this work.

EXPLORATIONS.
Section 2.

During 1909 several holes were drilled at the West end of North Lake which showed ore. In 1910 four holes were drilled in an effort to locate both an Eastward and Westward extention of this ore body. Two holes were drilled to the East on the ice, neither of which found ore, both of these holes showing a rich iron formation with several runs of silica ore. The two holes to the West struck the ore, proving that it extended for a distance of 700 ft. along the footwall. One of these holes had an unbroken

NORTH LAKE EXPLORATIONS.

run of 215 ft. of 60.44 Iron, .080 Phos. The other hole showed 100 ft. of ore the best of which averaged 59.35 Iron, .070 Phos. This hole, however, cut the top of the ore body; the hole now being drilled 200 ft. further West is located so as to strike the center of the trough at a depth of 1000 ft. If this hole proves successful it will assure over 3,000,000 tons proven here, with probably much more ore to the West. The tonnage developed here to date of December 31st, 1910, is estimated on two cross sections only, and from these a conservative estimate shows 2,000,000 tons in sight.

In 1909 some ore had been proven up by a drill hole through the ice near the East end of North Lake. This ground was further tested by drilling three holes during the past winter. One of these holes struck ore at ledge showing 56 ft. of 60.00% Iron and 10 ft. of 56.00% Iron; the other two holes showed practically no ore. The drilling here showed a concentration at the upward end of a pitching trough. The dike which forms the South side of the trough dips to the South nearly parallel with the footwall. The formation where tested is narrow and if ore in large quantities exists, it will be found at depth. To test this by drilling would be very expensive and might even then be inconclusive owing to the great depth at which the dike intersects the footwall. This ground can later be explored by drifting from the mine to be opened at the West end of the Lake.

EXPLORATIONS
Section 3.

The ground to the East of the Barnes Mine ore body has been thoroughly explored in an effort to find a continuation of this ore. Only a shallow iron formation was found which was badly cut up by dikes. After ten holes had been put down here explorations to the East were permanently abandoned.

On the Northwest quarter of the Section, seven holed have been drilled on four lines 660 ft. apart. The formation was found to be hard and not leached. A dike runs East and West parallel with the footwall, dipping to the North and intersecting the footwall at a considerable depth. A slight concentration was found between the dike and footwall, but not enough to prove encouraging.

NORTH LAKE EXPLORATIONS.

5.

It is probable that explorations will be abandoned along the contact, on the completion of the hole now being drilled.

ENGINEERING DEPARTMENT.

I N D E X

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1910,

AND A BRIEF OUTLINE OF THEIR WORK,

BY M. H. BARBER, ASSISTANT ENGINEER.

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THE FORCE.

The following engineers, M. H. Barber, C. J. Stakel, Carl Brewer, E. C. Weinsheimer, C. T. Kriebel and R. J. Chenneour, and helpers, E. G. Sterling, Albert Rock and Arthur Aas, have been employed steadily throughout the past year. J. F. Hanst worked as an engineer in this department until the 1st of April, when he resigned to accept a position as mining engineer with a company operating in Mexico. Hanst returned to the Company September 21st, taking up his work at the Cliffs Shaft mine. H. O. Moulton was engaged by the Company April 1st and has worked as a helper and engineer during the balance of the year. During Hanst's absence, R. S. Archibald, who had been in the Geological department for about two years, looked after his work.

Generally speaking, the work of the department has been carried on very satisfactorily, and the accuracy of the men, as well as the standard of work, has been placed on a higher plane. The department at present is composed of men thoroughly familiar with their particular work and there has been a noticeable improvement in the dispatch of the various jobs which have come up during the past twelve months.

The following is a table showing the total number of days worked by the several members of the department, days spent on vacations, time lost through illness, total and the percentage of days worked:

TABLE I.

NAME.	DAYS WORKED.	DAYS VACATION.	DAYS LOST THROUGH ILLNESS.	TOTALS.	PERCENTAGE OF DAYS WORKED.
M. H. Barber	261	25		286	.91
C. J. Stakel	275	11		286	.96
Carl Brewer	255	21	10	286	.89
E.C.Weinsheimer	264	22		286	.925
C. T. Kriebel	275	11		286	.96
J. F. Hanst	170	3	6	179	.95
R. J. Chenneour	270	13	3	286	.94
E. G. Sterling	267	11	8	286	.93
H. O. Moulton	207	5		212	.98
Albert Rock	278	4	4	286	.97
Arthur Aas	271	11	4	286	.95
R. S. Archibald	69				
J. K. Osborne	44				

The following table shows the class of work and the time of such work of all extra help employed during 1910:

TABLE II.

NAME.	DAYS WORKED.	CLASS OF WORK.	RATE PER DAY.
J. E. Hayden	42½	General helper	$2.50
Edward Ham	48	Rodman	2.00
Donald Hayden	17	"	2.00
Edward Sandberg	25	Cook	2.50
Fred Fredette	5	Axeman	2.50

NOTE: These men were employed on the Iron River and North Lake district surveys.

A brief description of the division of work among the members of the department follows:

M. H. Barber, besides having general supervision of the men, laying out their work, ordering the necessary supplies, writing the Engineering, Lake and Imperial mines reports and keeping the time of the department, spent considerable time on the Au Train water power job, the surveys at Iron River, Ashland mine and North Lake district. Mr. Barber also wrote the annual reports for the Lake and Imperial mines and devoted considerable time to supervising the work in connection with the annual report books. As usual, he ran numerous check surveys underground when there were special holing jobs, such as at the Lake, Negaunee, Lucy and Ashland mines.

C. J. Stakel's time, with the exception of a few days when he was engaged in checking up the vault filing, has been devoted entirely to assisting Superintendent Elliott at the new shaft, Negaunee mine. Mr. Stakel has really acted in the capacity of shaft foreman, having charge of the shaft stripping, as well as the concrete and steel work. His time during the first few months of 1911 will be devoted to this work.

Carl Brewer had charge of the Lake mine surveys until August and has looked after the North Lake district work during the entire year. A great many odd jobs have come up at North Lake and together with the time spent in extending the coordinate surveys, locating diamond drill holes, plumbing shafts, giving lines underground, locating roads, buildings, etc, and designing underground pockets, etc, for Superintendent Graff, he has been very busy. Mr. Brewer ran

a survey in the Clowry district to locate the holes drilled during the year by the Company and assisted on the Ashland mine monthly survey for December.

E. C. Weinsheimer's time has been divided between the Salisbury and Imperial mines, the former getting the larger share. Numerous holing jobs have been in progress here, accounting for the large amount of time spent on the surveys. Mr. Weinsheimer also devoted considerable time to the getting out of several special maps and assisting the other engineers to figure their surveys.

C. T. Kriebel looked after the Maas and Negaunee mines surveys and all the necessary surface work in and about the City of Negaunee. Owing to the large amount of development work going forward at the Maas and Negaunee propertoes, his time was largely taken up here. Mr. Kriebel also assisted on the Au Train water power surveys and did all the office work in connection with them, such as figuring surveys, making maps, etc.

J. F. Hanst, during the seven months he has been employed in the department, was engaged entirely with the Cliffs Shaft mine work. Besides running the surveys, he did all the geological work and such pillar sampling as Superintendent Eaton desired. Mr. Hanst has made a complete set of mounted analyses maps and has kept the geological and mine maps posted up to date.

R. S. Archibald, during the five months (May 1st to September 1st) that Mr. Hanst was absent, looked after his work at the Cliffs Shaft mine.

R. J. Chenneour has had charge of the Lucy mine surveys, has done all the necessary sampling at this property and at the Maas and Negaunee mines and has assisted Mr. Kriebel on the Maas and Negaunee mines and the City of Negaunee surveys. Mr. Chenneour is now thoroughly familiar with the Maas and Negaunee mines and could take care of the surveys at these properties with some one to check him up from time to time. He had charge of the Iron River surveys, which occupied altogether about a month and a half of his time.

H. O. Moulton started working in the department April 1st. He assisted Mr. Brewer on the Lake mine and North Lake surveys until August and since that time he has had charge of the Lake mine work. Mr. Moulton has also assisted Mr. Weinsheimer at the Salisbury mine and Mr. Kriebel at the Maas and Negaunee mines.

E. G. Sterling has looked after the Moro mine work and the sampling at the

Imperial mine. He has had charge of the blue printing department, doing all the mounting, has masked, printed and filed the annual report plates and acted as helper on the Cliffs Shaft, Imperial and Lake mine surveys.

J. K. Osborne has worked in this department the greater part of the last three months of the year and at odd times during the previous few months. He has been engaged as helper on the Cliffs Shaft, Lucy, Maas and North Lake surveys and in the office making agent and captains tracings.

Albert Rock and Arthur Aas have been employed as general helpers, both on the surveys and in the blue printing department. They have not as yet done any drafting, excepting of the roughest kind.

UNDERGROUND WORK.

A brief description of the special surveys will now be taken up under the several mine headings.

ASHLAND MINE.

Check surveys were run over the entire 8th, 13th and 18th levels, into the fault zone workings on the 15th and 17th levels and down the winze to the 17½ and 18½ levels and subs. The survey on the 8th level was for the purpose of giving lines for holing No.9 shaft to the No.3 shaft workings. The drifts holed satisfactorily. Levels were also run over a portion of the lower workings of the mine, but as time was pressing, most of this work was left until a regular engineer should be sent to the property.

BARNES MINE.

The coordinate surveys in the vicinity of this property were carefully adjusted, the shaft plumbed and lines taken off on the 1st level. Now that the 2nd level is being opened up the survey on the 1st level will be checked and lines carried down to the 2nd level.

CLIFFS SHAFT MINE.

A number of check surveys have been run here, but no holing jobs of importance came up. Careful levels have been run and checked throughout a goodly portion of the mine. During the early part of 1911 this work will be completed.

IMPERIAL MINE.

Check surveys have been run over the 3rd level and carried down No.1 shaft to the 4th level. A drift is now being driven on the 4th level with the intention of raising up on an inclination to the bottom of No.2 shaft when the workings are extended far enough.

LAKE MINE.

From the four check surveys run down the underground shaft from the 4th to the 5th level during 1909, lines were carried along the 5th level and four plugs set under the corners of the shaft, which was bottomed 40' below the 4th level, or 90' above the 5th level. The shaft was raised full size and timbered, holing to the operating shaft in a very gratifying manner. Several check surveys were also run into the 364' and 383' sub workings, special care being taken in the vicinity of the L. S. I. Company's boundary.

LUCY MINE.

No.3 shaft was plumbed and lines taken off on the 4th, 5th and 6th levels. Check surveys were carried over the levels, it being necessary to reset almost all the plugs as the mine had been under water six years and the points naturally were in an unstable condition. When plumbing the shaft the work was started from the City of Negaunee surveys and thus the Lucy mine was put on the Maas system of coordinates, similar to the other Negaunee and Ishpeming properties.

MAAS MINE.

Owing to the large amount of development work being carried on at this property, it has been necessary during the past year to keep the surveys checked up to date continually and lines have been given for the holing of numerous drifts and raises. A great deal of trouble was experienced in running surveys up the raises, many of them being crooked and having no timber, excepting an occasional sprag. All holing jobs have been carried through successfully.

NEGAUNEE MINE.

The 9th level winze was plumbed and lines given for the cutting out of the 10th level plat at the new shaft. A raise will soon be started to hole into the bottom of the shaft at the 9th level. As was the case with the Maas mine, the quantity of development work has necessitated a considerable amount of check surveying.

NORTH LAKE MINE.

No.2 shaft has been plumbed twice, the lines being taken off at the 1st level on the first job and on both the 1st and 2nd levels on the second plumbing. Check surveys and levels have been carried into the breasts of the several drifts. It will be some time yet before the 1st level No.1 shaft is started and hence no work need be done here aside from measuring the monthly extension of the sinking.

SALISBURY MINE.

Lines have been given for a number of raises which were put up from the upper workings to surface. A space was cleared and a few feet sunk and cribbed, so that it was necessary to hole these raises fairly accurately. A number of check surveys (some of them rather difficult) were run, connecting the 5th, 8th, 9th, 10th and 11th levels and subs between.

SPECIAL SURFACE SURVEYS.

At North Lake the rectangular system of coordinates surveys have been extended East from the origin (the Northwest township corner of 47-27) along Sections 6 and 5 and tied in across these sections in several places to the 2400' line. To assist in the location of diamond drill holes a number of the 800' and some of the 200' lines have been run out in Sections 1, 2 and 3, 47-28 and in Section 6, 47-27. The location of all diamond drill holes put down during the year have been checked and levels established on the collars. The Barnes location and an extension of the North Lake location were staked out and the mine buildings, trestles, shaft houses, etc, located at both properties. The stripping for the surface lay out at Nos. 1 and 2 shafts was completed in February and the total yardage removed carefully measured. The total of the yardage estimated by months was checked very closely by these figures.

Several days were spent during March in the Clowry district, locating diamond drill holes put down by our Company; also any other holes in reach of the surveys. All topography along the C. & N. W. right of way and available to the survey was taken.

A survey was made early in the spring of the lands flooded by the water pumped from the Negaunee mine.

The Au Train water power job required considerable attention from this department; in fact, a party spent on the average of one day out of every two weeks during the first six months of the year on this work, staking out the dam, power house and surge tank, running out the pipe line, leveling and giving grades. A survey was finally made, tying in the entire plant and locating the surrounding topography.

The new crusher and steel trestles at the Cliffs Shaft mine were staked out and templets set accurately for the concrete piers. This job took considerable time as portions of the work had to be done over owing to changes made by the Mechanical department and the construction engineers.

True North was determined at Iron River July 8th by an observation on Polaris at Eastern elongation. The Northeast corner of Section 21, 43-34, which is the center of the township, was used as the origin of the surveys. A rectangular system of coordinate surveys were extended over Sections 21 and 22 to locate the diamond drill holes and such topography as came on land held under option by our Company. To avoid heavy chopping the surveys were run along the roads across Sections 15, 21 and 22 and tied into the regular rectangular lines. Such drill holes and topography as were available were located from these latter surveys. Levels have beennrun to the collars of the drill holes, but as yet have not been tied up with the railway sea levels at Iron River. This work will be done later.

Work on the 1909 annual report was not completed until the early part of February 1910; in fact, the entire department was engaged exclusively on this job and getting out the monthly surveys for January. The views for the 1910 report were taken during October, with the exception of those at the Cliffs Shaft mine, which were delayed until December so as to get in as much as possible of the new construction work. The mine surveys were started about the middle of December and the work of plotting up and in most cases the post-

ing of the annual report tracings were posted before the end of the year. Everything possible in connection with the report was done early in the year, such as posting the surface maps and making the necessary new tracings.

Very little new equipment has been ordered during the past year, Two Bruntons were received and two 200' steel tapes purchased and two of the underground transits were sent to the factory for general overhauling. These were the only items aside from the usual supplies.

A transparentizing solution, which was supposed to render a blue print capable of reprinting and then to bring it back to the original, was tried but not satisfactorily. A very poor copy was obtained and it was found absolutely impossible to bring it back. A direct white printing process paper was also experimented with, but owing to the brittleness of the paper and the fact that it could be kept but a very short time, was not considered at all satisfactory.

WATER POWER.

Mr. F. O. Blackwell, of the engineering firm of Viele, Blackwell & Buck, New York, has continued to advise the Company in regard to the proposed developments of water power and has directed the installation at Au Train, as well as the transmission lines in Marquette County and installation at the different mines of the Company.

AU TRAIN.

Mr. Blackwell sent Mr. W. L. LeRoy to take charge of construction of the dam, etc, on the Au Train river development and he arrived during the first week of January. The work was done under the supervision of Mr. O. D. McClure. ,After the dam was nearly finished and the power house begun, Mr. LeRoy left and Mr. Thompson, of the Mechanical department, was placed in charge. The plant was finished, the transmission line built and the transformers installed at the Munising Paper Company where the power was turned on November 19th.

In the proposed storage basin clearing was continued during the year under the Lumbering department. It was hoped that a small amount of storage could be obtained just South of the County Road, but surveys showed that the amount of storage so obtained would not justify the expense until more land had been purchased. This storage would also interfere somewhat with the operations of the Lumbering department. Surveys have just been started to determine the exact limits of the full storage which will be needed, according to the plans of Mr. Blackwell.

CARP RIVER.

In May Mr. Blackwell presented the preliminary report on the development of the Carp river water power. It was decided to make a number of changes and Mr. Blackwell's final report was dated July 18th. In order to locate the pipe line Mr. Blackwell's engineer, Mr. J. C. K. Gronholt, who had finished the survey on the Sturgeon river, was employed to correct the line and he and his party were in the field for about a week. Later on Mr. Blackwell sent us the drawings indicating in a general way his location of the pipe line. The actual and definite location must yet be made upon the ground in order to avoid

excavating rock and exactly locating the necessary curves, both horizontal and vertical. This work can easily be done in the spring by engineers on the ground. All the land that is necessary for the development of the Carp river has been negotiated for.

No surveys were made in the storage basin, as Mr. Townsend is still purchasing land in the same. There are still ten forty acre tracts which must be purchased in order to complete the storage area. This does not take into account the lands owned by the Lake Superior Iron Company.

The transmission line connecting the Carp river power house with the plant at the Maas mine has not been located on the ground but arrangements are being made for its right of way.

STURGEON RIVER.

On January 20th, Mr. W. S. Prickett of Sidnaw offered this Company the lands he had bought on the Sturgeon river to the North of Sidnaw in Baraga and Houghton counties. He submitted a report by Mr. T. W. Orbison and also one by Mr. H. VonSchon, giving the plans of developing the water powers on this river. On January 23rd, Mr. McClure and I met Mr. Blackwell in Chicago to discuss the project and later Mr. Blackwell sent in his report. As it seemed feasible to develop about 10,000 horse power at a relatively low cost, it was determined to make surveys to verify the information supplied in the reports by Mr. Orbison.

On May 9th, Mr. Gronholt, who was sent by Mr. Blackwell, arrived to make the survey and immediately took the field with an assistant and party. Owing to the rough topography of the country and the fact that about twenty miles of river valley, part of it having precipitous banks from 100' to 200' in height, the survey was not finished until the first week in August. Besides surveying the Sturgeon river, another was made of the branch called the Perch and also surveys of a general character to determine possible areas of storage at Worm, King and Perch lakes. These surveys were platted in the office and Mr. Gronholt and party left for New York on September 25th to make the finished drawings for the report. Mr. Blackwell's final report was dated October 5th. The original maps upon which the surveys were platted have been retained in this office. Several of the cross-sections were taken to New York, but copies of all

of these, together with blue prints of all the finished drawings, were returned by Mr. Blackwell, so that the entire maps, profiles, etc, of the survey are on file in this office. In case the Sturgeon river is developed these maps will be of great assistance to the engineers who would lay out the work.

WHITEFISH RIVER.

In 1906-7 surveys were made and a report written by Mr. T. W. Orbison on the use of the possible water power on the Whitefish river near the line between Delta and Alger counties by building a dam on Section 4, 43-21 W. The lands that would be flooded by the proposed dam and which were owned by this Company were withheld from sale. In final answer to the question as to whether this water power could be developed profitably, Mr. Blackwell has given his opinion that the amount of power that could be developed is too small to make it worth while. You have been advised that the project of developing this water power would not be feasible and that as far as this purpose goes it is no longer necessary to withhold the lands from sale.

ABSTRACT DEPARTMENT.

Mr. G. L. Randall left the Company's employment in March. The position, which is one of a confidential nature, is difficult to fill and it was July before Mr. A. E. Primeau was employed. Except with the aid of some stenographic work from time to time, Mr. Primeau has done all the work in the office which he was able to, but owing to the accumulation of three months work and also to the fact that a great deal of work came in, practically none of the back work has been accomplished during the past year. This includes the proper arrangement of the documentsiin connection with the Negaunee purchases, which is the most important piece of work in the office, and should be accompanied with a full set of maps of the Negaunee district. Besides this there is a large amount of clerical work to tabulate the information already in the office and then there is the work of obtaining land owners on all the different mining ranges, which has not yet been brought to a conclusion.

OPTIONS FOR MINING LEASES.

During the past year about twenty five new options have been secured on mineral land. The book of maps showing the record of explorations indicates the amount of exploration which was done upon these options. At the end of the year the following options were in force:

No.12,	North Lake,	Barnes Land Co.,	expires July 31, 1911.
No.13,	" "	Barnes & Hecker,	" " 31, 1911.
No.24,	Iron River,	Erickson farm,	" " 1, 1911.
No.63,	" "	Wm. A. Holmes,	" Dec. 31, 1911.
No.69,	" "	Nels Hanson,	" Jan. 29, 1911.
No.70,	" "	Olaf Anderson,	" " 29, 1912.
No.74,	" "	Johnson & Vosberg,	" Dec. 4, 1911.
No.77,	" "	Eric Peterson,	" June 10, 1911.
No.78,	" "	Emma Erickson,	" Dec. 16, 1911.
No.81,	" "	Sjoquist,	" Apr. 14, 1912.
No.82,	" "	Gustafson,	" " 4, 1912.
No.83,	" "	Krans,	" Nov. 4, 1911.
No.84,	" "	Hedstrom,	" July 29, 1912.
No.85,	Menominee,	Houghton County,	"
No.86,	"	Wis.Land & Lbr.Co.	" Oct. 18, 1911.
No.88,	Iron River,	Wakefield,	" Nov. 18, 1911.
No.90,	Menominee,	J. B. Goodman Co.	" Dec. 6, 1911.

MINING LEASES.

During the year the only mining lease taken out on lands held under option was No.30 Iron River, Selden Homestead, executed March 31st, 1910, expires March 31st, 1960.

On June 22nd, 1910, this lease was assigned to J. H. Bartow et al of Cleveland.

MINING OPTIONS SURRENDERED.

Drilling was finished on options Nos. 64 and 66 in the Clowry district and as no encouragement was found, all the lands held by the Company were surrendered and explorations in the district discontinued.

The other options surrendered were all in the Iron River district, either on the Southeastern extension in 42-34 or in the Northeastern extension towards the Chicagon Lake mine in 43-34. A map in the exploration book shows clearly the position of these expired options in reference to the land still being held. The numbers of the options in the Iron River district so surrendered are: Nos. 62, 65, 68, 71, 72, 73, 75, 76 and 79.

NAMES OF LAND OWNERS.

For reasons stated above, but little progress was made during the

year in obtaining the names of land owners upon the different iron ranges of Northern Michigan. In the case of T. 39-27 W. Menominee County, where explorations are now being started, ownerships were obtained through the Menominee Abstract & Land Association.

TRANSMISSION LINES.

Titles to the lands passed over by the main transmission line between the Maas and Princeton have practically all been secured. A map was prepared to show the different ownerships and the original transmission line easements were forwarded to Cleveland. There is still considerable work to be done in getting the necessary easements for this line into shape, which is practically in the nature of obtaining easements from the different owners of land now under lease to the Company and also in transfers from the different sub companies to the Cleveland-Cliffs Iron Company, which is now being done.

On the Au Train transmission line most of the land is owned by this Company. The right of way for this transmission is not entirely perfected as far as the records go. Rights of way were obtained from Mr. Lobb and Mr. Niness. The completion and proper recording of this right of way is another subject in which this office is behind owing to press of business.

LAND OWNERS.

During the year there were received at this office 101 land offers, the last number being 404. These have been reported monthly, giving a short description as to the district in which the lands were situated. This will be supplemented by a full description of the lands offered. Most of these offers have been reported on by letter, giving the best information that could be obtained as to their value.

MESABI RANGE EXPLORATIONS.

CROSBY MINE.

Diamond drilling was continued on the Crosby until March. The result of this work is shown in the report of Mr. Reigart on the Crosby mine and the ore found is included in his estimate. Much of the drilling was done to disclose the ores of washing grade.

SECTION 10, 56-23.

This property was again explored by a diamond drill until the end of June. The existence of the supposed body of ore was practically disproved by this work. From the result of the diamond drilling, Messrs. Cole & McDonald gave an estimate of 370,000 tons of ore running 42.30% Iron and .026 Phosphorus. This material would be of the washing grade and would take practically two tons to make one ton of shipping ore. The showing of ore on this property being so poor and the cost of development proportionally high by the tonnage, it was thought best to try and sell the property. Attempts were made at different times in the second half of the year but the Company was unable to find a purchaser.

J. E. JOPLING'S TRIPS.

The different water power projects was the occasion of most of my trips during the year.

General supervision of the surveys on the Sturgeon river took me to Sidnaw in all nine times from May to September. The Au Train was visited seven times and I went four times to look after the surveys on the Carp.

I made visits to Minnesota in February, July and October for the purpose of the estimates of the ore at the Crosby mine. This object also took me twice to St. Paul to see the Tax Commission. The proposed washing plant at the Crosby was also investigated and visits made to Coleraine and Marble.

In connection with offers of mineral land, I made one excursion to the Vermillion Range in July and two to the Cuyuna Range; the former in July included the Little Falls district and the latter in August was with Mr. Smyth and Mr. Samuel P. Snider, when we went to see the Company's lands in Aitkin County and the developments of the Deerwood district.

I was at the Imperial mine in June and August to look over land offers in the vicinity with Captain Marks.

In May I also reported an inspection of the Few mine on the Menominee Range, at which time I saw the Jones Furnace at Iron Mountain.

On June 15th, I went to Seney to see some bog ore on the Upper Peninsula Land Company's property and in August Mr. Joseph Winter took me to Republic and also Southeast of Negaunee to see lands in which he was interested.

Besides the above, there were a number of shorter trips to visit properties near the mines in this district.

On October 28th, I visited the Ashland mine in connection with the surveys.

In relation to the explorations in 39-27 Menominee County, I was in Chicago in October, in Menominee in March and in Hermansville in October and November.

With Captain Rough, I inspected the mines of the Lake Superior Iron Company and the Regent Iron Company in November.

In February and March, I was in Cuba and a report of the mines in the Eastern part of the Island was made. Returning from Cuba, I spent a few days at Birmingham, Alabama, and Chattanooga, Tennessee.