ANALYSIS OF COST SHEETS

The conditions at the operating mines in this district were very different in the years 1915 and 1914, so that the comparison in cost of production will not mean a great deal. To compare the amounts spent would mean nothing and I have confined my explanations to the difference in the cost per ton. The monthly comparison is as usually made.

The following should be borne in mind when making the comparisons:

The Stephenson Mine in 1914 operated double shift from January 1st to June 1st. Single shift June 1st to Oct. 1st; four days a week Oct. 1st to December 31st and this latter period at a 10% reduction in wages. In 1915 it operated at four days a week and 10% reduction in wages January 1st to August 1st and at six days a week and normal wages for the balance of the year.

The Gwinn Mine started operating April 1st, 1914, the force gradually increasing throughout that year and in 1915. Both years on two eight hour shifts. The reduction in wages was effective here as at the Stephenson.

Below is a comparison of the Cost Sheets for the years 1915 and 1914 for the operating mines in the Gwinn District:

STEPHENSON MINE	1915	1914	INCREASE	DECREASE
Average product for month,	17,310	17,884		
General Expense,	.131	.158		.027
Maintenance,	.126	.167		.041
Mining Expense,	.929	1.120		.191
TOTAL	1.186	1.445		.259

GWINN MINE				
Average product for month,	10,608	4,032		
General Expense,	.183	.298		.115
Maintenance,	.151	.569		.418
Mining Expense,	1.340	2.323		.983
TOTAL	1.674	3.190		1.516

The Details making up these differences follow:

ANALYSIS OF COST SHEETS - For Years 1915 and 1914.

*** *** ***

	1915	1914	INC.	DEC.	REMARKS
COST OF PRODUCTION					
GENERAL EXPENSE					
Analysis,	.031	.043		.012	In 1914 32998 Dets. Cost .184 In 1915 25193 " " .175
Mine Office,	.020	.021		.001	Staff reduced account change in operating Mine. (See Note below.)
District Office,	.048	.071		.023	Staff reduced, reduction in salaries and other mines bearing a larger proportion of this charge.
MAINTENANCE					
Tracks & Yards,	.004	.007		.003	Less cleaning on surface and in 1914 a new road built on surface and dry house grounds laid out.
Dks, Tres. & Pkts.	.005	.040		.035	Less expenditure required on permanent trestles and sollar plank owing to a much larger quantity of ore being shipped in 1915.
Buildings,	.002	.007		.005	In 1914 considerable sums spent on fire protection, coal dock, dry house and office building.
Shop Machinery,		.003		.003	Proportion of charge Central Shop machinery.
Boiler Plant,	.001		.001		Increase due to more repairs required to Boilers and Boiler House Building.
Hoisting Machinery,	.006	.003	.003		Increase due to more expenditure for wire ropes and heating shaft in 1915.
Comp. & Pwr. Drills,	.010	.007	.003		In 1914 11 power drills chgd. In 1915 18 power drills chgd.
Pumping Machinery,	.007	.012		.005	In 1914 considerable expenditure was made for repairs on plunger pump and in 1915 there was considerably less expenditure on ditches and raise launders in mine.

	1915	1914	INC.	DEC.	REMARKS
MAINTENANCE (CONT'D)					
Top Tram Eng & Cars,	.018	.016	.002		In 1915 more repairs required to Top Tram System.
Elec. Tram Plant,	.060	.055	.005		Increase due to cost of remodeling 30 main line cars and balance purchase of 2 mine locomotives
Tel. & Saf. Devices,	.002	.006		.004	Less expenditures in 1915 for appliances for injured persons, safety devices on shaft house, pulley stands, etc.,
MINING EXPENSE					
Air Pipes,	.008	.009		.001	Decrease due to change made in operating mine.
Compressors,	.052	.073		.021	Decrease due to change made in operating mine and to Gwinn, Francis and Princeton Mines paying a percentage of operating Compressor room.
Hoisting,	.039	.043		.004	Decrease due to change made in operating mine.
Sinking and Shaft Repairs,	.013	.006	.007		Increase due to cutting plat on 6th level.
Rock Drifting,	.091	.088	.003		Increase due to cost of opening 6th leveland smaller production in 1915. Practically same amount of Rock Drifting in 1914 as 1915.
Breaking Ore,	.303	.381		.078	Decrease due to larger production per man stoping.
Tramming,	.062	.097		.035	Tramming confined principally to one level 1915. Fewer chutemen and car dumpers employed.
Timbering,	.155	.200		.045	Less timber used per ton of ore produced.
Captain and Bosses,	.029	.039		.010	Decrease due to larger production per day and fewer bosses employed.
Dry House,	.012	.014		.002	Decrease due to change made in operating mine.
Top Landing & Tramming,	.021	.036		.015	Less ore stocked in 1915.
Stocking Ore,	.044	.037	.007		Increased cost acct. erection of temporary trestles and stocking No. 2 ore.
Sorting Ore,	.007	.003	.004		Increase account rock pickers employed during the year and extra Rock Pickers during shipping season.

	1915	1914	INC.	DEC.	REMARKS
Product,	207,724	214,608		6,824	
Days Operated,	249	279		30	
" Idle,	64	34	30		
Average Daily Product,	834	769	65		

NOTE:

Changed from double to single shift June 1st, 1914. Operated four days per week from October 1st, 1914 to August 1st, 1915, when mine again commenced to operate single shift six days per week. Decrease of 10% in wages effective October 1st, 1914, to August 1st, 1915.

ANALYSIS OF COST SHEETS - For Years 1915 and 1914.

	1915	1914	*** INC. ***	DEC.	REMARKS
COST OF PRODUCTION	1.674	3.190		1.516	
GENERAL EXPENSE					
Engineering,	.021	.047		.026	Less Engineering,
Analysis,	.062	.077		.015	Larger product.
Personal Injury,	.004	.000	.004		Increased acct. charges for Workmen's Compensation charged.
Mine Office,	.019	.036		.017	Larger product.
District Office,	.076	.136		.060	Larger proportion in 1914 and larger product.
MAINTENANCE					
Tracks and Yards,	.008	.020		.012	More cleaning in 1914.
Docks, Trestles and Pockets,	.033	.098		.065	More work to trestle and stocking grounds in 1914.
Buildings,	.002	.013		.011	Repairs to barn and shop buildings 1914.
Shop Machinery,		.002		.002	No shop charge 1915.
Boiler Plant,	.002	.008		.006	More repairs to Heating Plant and main boilers.
Hoisting Machinery,	.010	.083		.073	New gears cage hoist counter weight, etc., in 1914.
Comp & Power Drills,	.016	.108		.092	New 6" air line from Austin 1914.
Pumping Machinery,	.010	.014		.004	Higher product,
Top Tram Engines and Cars,	.010	.043		.033	Final payments for equipment in 1914.
Skips and Skip Roads,	.007	.016		.009	Putting in plates skip dump in 1914.
U.G. Tracks & Cars,	.045	.124		.079	Larger product 1915, more new track 1915.
Elec. Tram Plant,	.003		.003		Started Opt. Elec. Haulage Oct. 21st, 1915.
MINING EXPENSE					
Air Pipes,	.019	.035		.016	Larger product 1915.
Compressors,	.075	.180		.105	Larger product 1915.
Hoisting,	.062	.109		.047	Larger product 1915.
Pumping,	.055	.087		.032	Larger product 1915.

MINING EXPENSE (CONT'D)	1915	1914	INC.	DEC.	REMARKS
Sinking and Shaft Repairs,	.014	.186		.172	Sinking winze 1914.
Rock Drifting,	.171	.590		.419	More Rock Drifting in 1914.
Breaking Ore,	.525	.464	.061		Developing ore deposit in new area 1915.
Tramming,	.193	.236		.043	Operating electric haulage last few months 1915 reduced costs greatly.
Timbering,	.126	.228		.102	Square sets employed in 1914. Method changed in 1915.
Captain and Bosses,	.030	.058		.028	Larger product.
Dry House,	.028	.060		.032	Larger product.
Top Landing and Tramming,	.035	.073		.038	Larger product.
Stocking Ore,	.002	.002			"
Sorting Ore,	.001	.007		.006	Larger Product.
Product,	127,300	48,389		78,911	

NOTE:

Mine started operating April,1st, 1914.

ANALYSIS OF COST SHEETS

BELOW IS A COMPARISON OF THE COST SHEETS FOR THE MONTHS OF DECEMBER AND NOVEMBER FOR THE OPERATING MINES IN THE GWINN DISTRICT

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STEPHENSON MINE	DECEMBER AMOUNT		DECEMBER COST PER TON	NOVEMBER AMOUNT		NOVEMBER COST PER TON	INCREASE AMOUNT		INCREASE COST PER TON	DECREASE AMOUNT		DECREASE COST PER TON
General Expense,	2597	09	.103	2550	49	.118	46	60				.015
Maintenance	3789	43	.151	2444	86	.114	1344	57	.037			
Mining Expense,	23882	28	.949	19742	81	.919	4139	47	.030			
TOTAL	30268	80	1.203	24738	16	1.151	5530	64	.052			

GWINN MINE

General Expense	2067	88	.140	2002	81	.142	65	07	.002			.002
Maintenance	2044	64	.139	3384	46	.240				1339	82	.101
Mining Expense,	14806	90	1.005	13472	04	.955	1334	86	.050			
TOTAL	18919	42	1.284	18859	31	1.337	60	11				.053

The Details making up these differences follow on the attached sheets.

ANALYSIS OF COST SHEETS - Explaining Increase and Decrease in

Various Accounts between the months of December and November 1915.

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ACCOUNT	DEC.	NOV.	INC.	DEC.	REMARKS
GENERAL EXPENSE					
Analysis,	536.67	630.67		94.00	Fewer determinations in Dec. acct. loading one week by steam shovel in Nov. 1961 Dets. in Dec. 2457 " " Nov., and less cost per det. in December.
Personal Injury,	274.65	342.09		67.44	This amount charged by General Office.
Mine Office,	329.04	358.65		29.61	Decrease due to cost of taking inventory charged in November.
District Office,	1137.68	895.64	242.04		Increase acct. proportion charged operating Gwinn Club House.
MAINTENANCE					
Tracks and Yards,	9.09	35.34		26.25	Less cleaning on surface in December.
Docks, Trestles and Pockets,	639.31	111.39	527.92		Erection of Bessemer permanent trestle.
Buildings,	13.83	22.70		8.87	Decrease due to less expenditure on Barn Building.
Hoisting Machinery,	164.47	106.36	58.11		Increase due to charge of piping for steam line in shaft and charge from Bo. Room for same.
Comp. & Power Drills,	100.00	402.75		302.75	In Nov. 4 auger drills charged and one charged in December.
Pumping Machinery,	164.55	10.21	154.34		Increase due to repairs to steam and plunger pumps, cutting ditches in mine.
Skips and Skip Roads,	29.50	59.45		29.95	Decrease due to less repairs required to skip roads and skip dump in Dec.
U. G. Tracks & Cars,	135.35	225.41		90.06	Less repairs in Dec. and less rail used for sub. levels and less charge for building sub. level cars in December.

ACCOUNT	DEC.	NOV.	INC.	DEC.	REMARKS
MAINTENANCE (CONT'D)					
Elec. Tram Plant,	1948.46	880.41	1068.05		$1000 balance purchase of new mine locomotive charged in December.
MINING EXPENSE					
Air Pipes,	138.74	272.15		133.41	Less air pipes and air hose charged out in December.
Compressors,	1292.68	1040.08	252.60		Increase charge due to increasedcost operating C.P.P. Boiler Room.
Hoisting,	600.64	811.89		211.25	Decrease due to distribution of Steph. Boiler Room expense and less coal used in December.
Pumping,	1597.20	1534.92	62.28		Increase due to increased charge for current and oil.
Rock Drifting,	2655.63	2119.14	536.59		In Nov. 290 ft. Rock Drifting and Raising, in December 370 feet.
Breaking Ore,	8198.47	6748.60	1449.87		Increase due to increased production in Dec. and more ore drifting in mine.
Tramming,	1453.18	1308.19	144.99		Increase due to increased production in December.
Timbering,	4662.66	3240.41	1422.25		Increase due to more retimbering and more timber used in mine.
Captain and Bosses,	631.25	599.45	31.80		Increase due to mine operated one day more in December.
Dry House,	181.71	248.66		66.95	Decrease due to redistribution of Steph. Boiler Room expense and less coal used.
Top Land. & Tramming,	708.00	589.57	118.43		Increase due to the fact that both grades of ore were stocked in December.
Stocking Ore,	1652.92	1149.49	503.43		Increase due to erection of temporary trestle in December.
Sorting Ore,	109.20	78.20	31.00		Increase due to two rock pickers employed full time in December.
Product,	25,155	21,486	3,669		
Days Operated,	26	25	1		
Days Idle,	1	1			
Avg. Daily Product,	968	859	109		

ANALYSIS OF COST SHEETS - Explaining Increase and Decrease in Various accounts between the months of December and November 1915.

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ACCOUNT	DEC.	NOV.	INC.	DEC.	REMARKS
GENERAL EXPENSE					
Engineering,	249.12	232.67	16.45		More Engineering,
Personal Injury,	67.05	100.08		33.03	Lower charge to Workmen's Compensation.
District Office,	849.22	756.65	92.57		Increase account higher charge for Gwinn Club House.
MAINTENANCE					
Docks, Trestles and Pockets,	818.60	1637.20		818.60	Less labor and supplies stocking grounds.
Buildings,	67.24	2.81	63.43		Rep. to old Dry Building and Warehouse Building.
Boiler Plant,	61.73	17.63	44.10		Dismantling old boilers.
Hoisting Machinery,	49.65	246.93		197.28	1380 ft. 1 1/4" rope charged in November.
Comp. & Power Drills,	290.52	325.39		34.87	Less repairs to air line on surface.
Pumping Machinery,	47.76	93.58		45.82	Less repairs to pumps.
Top Tram Eng. & Cars,	148.00	231.01		83.01	Top Tram Rope charged in November.
Skips and Skip Roads,	57.83	202.15		144.32	Rep. to skip in November $134.47.
U. G. Tracks and Cars,	143.17	285.24		142.07	Less work on sub. level cars.
Electric Tram Plant,	302.23	270.59	31.64		Operating wholly on 5th level with electricity in December - partially in November.
MINING EXPENSE					
Air Pipes,	251.68	91.53	160.15		More air piping.
Compressors,	944.02	809.48	134.54		Higher charge from Cent. Power Plant acct. more coal used.
Hoisting,	677.56	659.87	17.69		More days and more Electric power used.
Sinking and Shaft Rep.	1381.82	217.69	1164.13		Sinking winze started in November.

ACCOUNT	DEC.	NOV.	INC.	DEC.	REMARKS
MINING EXPENSE (CONT'D)					
Rock Drifting,	595.44	1036.70		441.26	Less Rock Drifting in December. 71 feet Dec. 167 feet in November.
Breaking Ore,	7195.55	6536.65	658.90		Larger product, more powder used and more drill repairs.
Tramming,	1177.02	1425.65		248.63	Decrease account Electric haulage.
Timbering,	738.69	969.39		230.70	Less timber used, less labor on chutes.
Captain & Bosses,	333.48	320.24	13.24		More days in December.
DrynHouse,	432.71	381.74	50.97		Larger proportion from Heating Plant.
Top Landing and Tramming,	481.53	434.85	46.68		Higher cost from Heating Plant.
Product,	14,735	14,112	623		
Days Operated,	26	25	1		
Days Idle,	5	5			
Avg. Daily Product,	576	564	12		

REPUBLIC MINE.

Operations at the Republic Mine ran along comparatively smoothly during the past year. Production and shipments were much better than for twenty-four years previous.

Very few changes in organization or methods were made since our report of last year when radical changes were shown.

Our underground forces have been slightly increased as development work has permitted.

During the first few months of the year the work at the Water Power Plant was completed; a Picking Table installed in No. 9 Shaft Headframe: a Revolving Screen with 4½" holes was placed in our screening plant, and a new Rock and Ore Trestle built at Pascoe Shaft, which were practically the only new constructions undertaken during the year.

Our operations underground were crowded to capacity all during the year. Both shafts were sunk an additional lift and development work was carried on rapidly on both shifts both by Diamond Drilling and Rock Drifting. Loading pockets for skips were placed on the important levels in No. 9 Shaft which expedites the loading of the skip in this shaft.

Six #18 Ingersoll-Leyner Drill Machines were purchased and placed in work during the year. We also purchased and made up a total of 18 tons of drill steel during the past twelve months.

PRODUCTION.

Our production for the twelve months totals 185,187 tons and is the greatest for any one year during the past 24.

The grades were as follows:-

	TONS	%
Bessemer Ore,	92,002	49.70
Basic Ore,	47,169	25.46
Pascoe Ore,	46,016	24.84
TOTAL,	185,187	100.

We have not only secured the largest production in 24 years but we have accomplished it with a much smaller force of men, and the results are reflected in our "Tons per Man" and "Costs per ton".

PRODUCTION MONTHLY AND PER MAN PER DAY AND PER YEAR.

1915.	PRODUCT	TONS PER DAY	NO MEN	TONS PER MAN PER DAY			TONS PER MAN PER YEAR	ROCK HOISTED
				SURFACE	U.G.	TOTAL		
January	12,807	512	254	8.77	2.61	2.01		
February	12,466	519	256	8.96	2.61	2.02		
March	15,206	563	256	9.90	2.83	2.20		
April,	13,302	554	251	9.00	2.86	2.17		
May	14,355	552	219	8.77	3.54	2.52		
June	14,588	583	259	8.12	3.12	2.25		
July	17,165	660	262	8.94	3.45	2.49		
August	18,914	727	265	10.05	3.76	2.74		
September	18,270	731	267	9.98	3.74	2.72		
October	17,926	689	268	9.80	3.47	2.56		
November	16,229	649	275	9.16	3.16	2.35		
December	13,959	538	271	8.70	2.58	1.99		
TOTAL 1915	185,187	607	261	9.19	3.14	2.34	710	59,510
1914	124,920	434	296	5.34	2.07	1.48	422	30,543
1913	148,102	525	410	4.88	1.74	1.28	361	
1912	142,322	518	375	5.04	1.91	1.38	377	
1911	120,089	461	375	4.16	1.74	1.23	320	
1910	169,219	590	437	4.71	1.89	1.35	380	
1909	138,118	483	396	4.46	1.69	1.22	349	
1908	107,595	418	377			1.11	285	
1907	173,328	570	487			1.17	356	
1906	166,574	549	486			1.13	343	
1905	144,311	476	414			1.15	350	
1904	123,538	406	398			1.02	310	
1903	127,013	384	427			.90	298	

Our production has dropped off the last two months of the year on account of the enormous quantities of rock we are compelled to handle from our ore stopes and also from development work.

COST OF PRODUCTION.

Following our tons per man per year, our costs are naturally the lowest the mine has secured for a great many years.

The following statement shows the costs for the year by months and total costs for previous years for comparison:-

1915 MONTH.	LABOR STATEMENT LABOR COSTS PER TON			COST SHEET COST OF PRODUCTION			COST SHEET EIGHT MONTHS OF 1914		
	SURFACE	U.G.	TOTAL	LABOR	SUPPLS	TOTAL	LABOR	SUPPLS.	TOTAL
January	.274	.927	1.201	1.203	.664	1.867			
February	.272	.969	1.241	1.247	.691	1.938			
March	.242	.873	1.115	1.116	.573	1.689			
April	.266	.872	1.138	1.138	.610	1.748			
May	.270	.710	.980	.958	.385	1.343	2.098	.704	2.802
June	.287	.808	1.095	1.050	.461	1.511	2.141	.935	2.876
July	.257	.745	1.002	.971	.446	1.417	1.948	.974	2.922
August	.252	.737	.989	.964	.401	1.365	1.838	1.014	2.852
September	.256	.746	1.002	.977	.459	1.436	1.733	.708	2.441
October	.261	.786	1.047	1.021	.554	1.575	1.542	.708	2.250
November	.282	.878	1.160	1.146	.529	1.675	1.480	.809	2.289
December	.299	1.065	1.364	1.397	.557	1.954	1.371	.653	2.024
1915 Average,	.268	.843	1.111	1.099	.522	1.621	1.735	.791	2.526
1914						2.526	(8 Mo. CCICO.)		
1913						2.969	(Rep. Iron Co.)		
1912						2.629	"		
1911						2.840	"		
1910						2.522	"		
1909						2.665	"		
1908						2.919	"		
1907						2.764	"		
1906						2.517	"		
1905						2.440	"		
1904						2.545	"		
1903						3.335	"		

We show for the year just closed, not only, a much lower cost than that secured by former operators, but we have also beaten our own costs for the eight months of last year by 90¢ per ton.

During the year we hoisted from stulls 34,946 tons and should we charge our cost of production with this tonnage at the cost per ton for breaking ore during the past year (.534), it would make our total cost of Production $1.721 in place of 1.621. We had to draw, tram, sort and hoist all of this excess and were ahead only the breaking of the ore.

REPUBLIC MINE TAXES.

The Tax Commission materially reduced the Republic Mine assessment this year which accounts for the smaller amount of taxes paid as compared with previous years.

	1910	1911	1912	1913	1914	1915
Valuation,	581,760	1180,456	1131,413	1264,090	1156,399	566,826
Rate percent,	3.23	2.12	1.78	1.84	1.80	2.52
TAXES						
State,	1745.28	3458.75	2127.05	3994.51	2231.84	1801.95
County,	3490.56	4485.73	2489.11	2983.23	3110.72	1587.11
Township,	989.01	1180.46	1335.08	1238.82	1202.64	937.53
Road Repair,	639.92	826.33	667.54	619.40	601.32	437.60
School & 1 Mill,	8493.70	10978.23	10182.72	11111.36	10419.15	7367.04
Highway,	1279.87	1558.22	1335.04	1238.82	1191.08	874.58
Water Bond,	861.04	1534.57	1269.16	1150.31	1075.49	765.22
County Road,	1279.87	944.37	780.69	985.99	982.94	510.16
Collection Fees,	187.79	249.67	201.85	233.23	208.15	142.81
TOTAL TAXES,	18967.04	25216.33	20386.24	23555.67	21023.33	14424.00
Product-Tons	169,219	120,089	142,322	148,102	124,920	185,187
Taxes per ton Product,	.112	.209	.143	.159	.168	.0779
Shipments-Tons,	150,423	113,012	158,051	135,879	47,457	215,182
Taxes per ton Shipped,	.126	.223	.129	.173	.443	.0670

SHIPMENTS.

Our shipments are the heaviest made from the mine in twenty-four years.

The following statement shows the different points to which ore was forwarded during the year:-

SHIPPED TO:-	BESSEMER		BASIC		PASCOE		TOTAL	VIA:
	LUMP	CRUSHED	LUMP	CRUSHED	LUMP	CRUSHED		R.R.
LS&I. Dks. Marqt.	38810	62952	14525	20839	8753	32760	178639	C&NW
C&NW " Escanaba		2336		446		1239	4021	"
Antrim Iron Co., Manaline, Mich.				100			100	DSS&A
Am. Steel Fdrs., Ind. Hrbr.,			301	36			337	C&NW
Do. E. St. Louis,			610				610	"
" Granite City,			466				466	"
Federal Pressed Steel Co., Milw.,				100			100	CM& St.P
Charcoal Iron Co. of Am., Newberry, Mich.				2008			2008	DSS&A
Can. Steel Fdris. Pointe St. Chas.			153				153	"
" Longue Pointe,			328				328	"
Standard Steel Co., Montreal,			36				36	"
Am. Car & Fdry Co. St. Louis,			48				48	CM& St.P
Algoma Steel Cor. Sault Ste. Marie,			17990				17990	DSS&A
Hubbard Steel Fdry, E. Chicago,			88				88	C&NW
Commonwealth Steel Co. Granite City, Ill.,			294				294	CM& St.P
The Falk Co., Milwaukee,			49				49	"
Nat'l Brake & Elec. Co. Milw.,			236				236	C&NW
Transferred from P.I. Stockpile to L.S.& I. Docks,		4011		5668			9679	LS&I
TOTAL,	38810	69299	35124	29197	8753	33999	215182	

GRADING AND MIXING OF ORES.

We have gained experience during the past season in making mixtures of Republic ores and the following is a statement showing grades shipped from docks to lower lake ports and the percentage of the different ores going into the mixtures together with the check analysis between mine and lower lake chemists:-

REPUBLIC ORES TO LOWER LAKE PORTS SEASON 1915.

	BASIC LUMP.	BASIC CRUSHED	BESSEMER CRUSHED.
Mine Analysis, Iron,	64.81%	61.84%	65.44%
Lower Lake " "	64.79	62.71	64.81
Mine high,	.02%		.63%
Mine low,	----	.87%	------
Percentage of different ores used in Mixtures,			
Bessemer Ore,	61.4%	40.5	92.8
Basic Ore,	24.2%	27.2	0.0
Pascoe Ore,	14.4%	32.3	7.2

It will be noted that we check very closely on Lump ore but the results on Crushed are more variable.

We have very little trouble with our regular grades of Bessemer and Basic ore but the Pascoe Lean ore is a tough proposition. This is a lean ore to begin with and is also badly banded with Jasper streaks and in addition considerable Quartz is distributed through it.

We have been very careful with the mixtures during the past season but have been handicapped, at times, on account of car and vessel movements. We would be called upon on short notice to load a boat with ore then in dock, which made it difficult to provide the proper percentages of the different ores. Car service by the railroad was also poor and served to retard and disturb shipping and mixing operations.

SORTING ORE.

This continues to be a source of great trouble and expense to us and every pound of ore produced is subjected to hand sorting before leaving the mine.

On April 19th our Picking Table at No. 9 Shaft was placed in work and is doing satisfactory service. We have one man on the stockpile to catch any rock that gets by the table.

We have difficulty in separating the very fine soaprock in the Pascoe Shaft product. This Soaprock slabbing off the walls in the stopes breaks up very fine and is hard to sort out.

STEAM SHOVEL LOADING.

We received a Model 60 Marion Shovel from the Crosby Mine and have kept our old shovel to provide mixtures from lean ore piles. We purchased a new chain and pair of Crane engines for the Crosby Shovel during the season.

During the season the following tonnages were loaded by shovels:-

COST PER TON FOR LOADING.

YEAR	TONS LOADED	LABOR	SUPPLIES	TOTALS	TOTAL COST PER TON
1915	101,478	1,804.93	1,311.05	3,115.98	.0306
1914	26,657	1,135.05	513.12	1,648.17	.061

We show a reduction of about 50% in loading costs as compared with last year.

In addition to the above we loaded 9,680 tons of the ore stocked at Presque Isle at an expense of $417.00. Cost per ton, .043¢.

Car service was poor throughout the season.

BUILDINGS.

We have been to but slight expense for maintenance of our mine buildings during the year just closed.

With the exception of No. 9 Dry, all are in good condition and repair.

Our mine dwelling houses are in about the same condition as at the close of last year. Very little work has been necessary on them and only ordinary repairs have been made.

Eleven of these houses are vacant at this time.

DOCKS, TRESTLES AND POCKETS.

During the first part of the year a new rock trestle was erected to care for the rock from Pascoe Shaft, the old rock dump having become filled. This new trestle runs from North of the Top Tram Engine House West across the tracks to the area at the base of the mountain and is also connected at the shaft with the ore trestle which deliveres the product to the ore pockets and stockpile. The trestle is now in the form of a loop, crossing itself above grade near the ore pocket. It was built in this form in order to permit one man, one engine and one car to serve all three places under the endless rope haulage system, thereby permitting us to dispense with two men on this operation.

Our ore pockets are old and demand constant attention. In another year these may have to be renewed entirely.

We have just erected a one leg permanent ore stocking trestle at Pascoe Shaft and are trying it out. This is built along the general line of the one at the Negaunee Mine but is of wood in place of steel and concrete.

SHAFT HOUSES.

The Shaft Houses at both shafts are in excellent condition and require little attention.

During February and March a picking table was installed in No. 9 Head-frame and placed in work on April 19th, 1915. This equipment is built of steel and is of fireproof construction and consists of a movable table of steel flights, driven by a motor, on which the ore is dumped.

This installation permits us to dispense with six rock pickers, on each shift, underground while two men on the table are all that are required.

The cost of the work was $3,573.09

TRACKS AND YARDS.

Our surface expense is mainly taking care of the surface water and maintaining our roadways.

Our mine tracks are looked after by the Railway Company and therefore are of no expense to us.

TOP TRAMS.

Pascoe Top Tram Plant is the same as last year and has given practically no trouble.

No. 9 Top Tram was changed when our picking table was put in work in April month. The car runs out by gravity at this point and was pulled back by skip coming up by a cable running over the sheave shaft. This arrangement did not prove elastic enough and we therefore installed a motor and can now handle this car at will.

We are replacing the wood boxes on our underground tram cars with steel boxes which we know will pay for themselves in a short time.

CRUSHING AND SCREENING PLANT.

This plant was kept reasonably busy during the shipping season and numerous delays were experienced due to breakages to Crusher and equipment. Extensive repairs will be necessary before operations are resumed next year.

On account of complaints received of fines in our lump product, we were compelled to open our top screen and in doing this we received a great many large slabs in our Crushed ore, and in order to eliminate these we installed a 48" Revolving Screen with 4½" round holes to take the ore as it came from the Crusher. This permitted us to send out a desirable product and we have heard of no complaint being made since this equipment was installed.

On account of the character of Republic ores we are sure to develop considerable "fines" in the lump while it is being transported.

HOISTING PLANTS.

We have had a number of delays to our hoisting during the year due to breakages to hoisting plants. The most serious occured on May 14th which tied up our hoisting in Pascoe Shaft for a period of ten days. On this date the friction band broke on one of the drums on our Sullivan hoist and before the brakeman stopped his engine, the flying pieces broke several gears and the rope ran from off the drum and down the shaft. On its way to the shaft the rope swept down all the sheave stands.

Our costs for hoisting ropes are heavy - all of the cables are 4,700 feet long and the service is so severe that wear is very rapid.

NO. 9 BALANCE.

We have had considerable trouble with the flat rope which operates the skip balance weight in No. 9 Shaft, and during the year we replaced the flat rope with a new one.

BOILER PLANTS.

Both No. 5 and Central Boiler plants are in excellent condition and have given us no trouble during the past year. Maintenance charges are low.

FUEL CONSUMPTION.

We show a decrease of 1,790 tons Coal consumption for the twelve months as compared with last year and this is due to our Water Power Plant being in operation a longer period on account of the exceptionally large flow of water this year.

This Water Power Plant was out of commission for over three months last year undergoing repairs.

We are also operating three less shafts than last year, which cuts down fuel consumption.

SHOP MACHINERY.

We have on trial, a Sullivan Drill Sharpener Machine in our Blacksmith Shop. This is an excellent machine for shanking drills.

We desire a machine that will successfully sharpen the "Car" bit and the makers of this sharpener are making an effort to do this.

COMPRESSOR PLANTS.

On January 4th the new large water wheel for the Water Power plant was received and put in place during the month. On January 30th, the work of rebuilding the water end of this plant was completed and one wheel driving one of the compressors was placed in operation. On account of low water but one of the wheels could be operated and the two wheels were not put in work until the latter part of March, in fact, both wheels were only worked a total of 53 hours during this month, but on April 13th both were placed in operation and kept at work until August 27th when, on account of low water, we were compelled to shut off one wheel and start our steam compressor. On September 16th both wheels were again placed in operation and are, on account of an exceptionally large amount of water for this time of the year, still at work.

During April month the boulders in the river below the Power House were drilled, blasted and removed. This permits the water to get away rapidly from the tail race.

ELECTRICAL EQUIPMENT.

We keep calling on this plant for additional power and same is now right up to its capacity, in fact, during the summer months when our Crusher is operating, we cannot run it and our underground pumps at same time. We do most of our pumping on the night shift when Crusher is not running.

We continue to furnish current for lighting the Village of Republic and the number of takers has materially increased during the past year.

During the summer some trouble was had in maintaining the proper voltage in No. 5 plant and an independent exciter was installed at the generator and a voltage regulator placed on the switchboard.

STOCKPILE BALANCES.

Our balances in stock as of December 31st, 1915, are as follows:-

	BESSEMER	BASIC	PASCOE	TOTAL.
No. 8 Shaft,	1,531			1,531
No. 9 Shaft,	9,694		54,619	64,313
Pascoe Shaft,	6,711	2,679		9,390
Presque Isle Stockpile,	1,526	1,371		2,897
TOTAL TONS,	19,462	4,050	54,619	78,131

ESTIMATE OF PRODUCTION.

Our estimate of production for the coming year is as follows:-

300 days @ 650 tons per day 195,000 tons.

This exceeds our present year's production by 10,000 tons and it will keep us hustling to make it.

TOWNSHIP LIGHTING.

The revenue received from this source for electric service during the past year is as follows:-

1915	K.W.H.	RATE	AMOUNT
January,	3,072	.03	92.16
February,	2,860	"	85.80
March,	2,800	"	84.00
April,	2,342	"	70.26
May,	2,230	"	66.90
June,	1,885	"	56.55
July,	1,706	"	51.18
August,	1,902	"	57.06
September,	3,084	"	92.52
October,	3,433	"	102.99
November,	4,137	"	124.11
December,	4,186	"	125.58
TOTALS,	33,637	"	$1009.11
1914 total(8 Mo.)	13,152	3¢	394.56

No extra labor has been necessary to furnish the above service and the cost to us is represented only by the additional coal burned to produce the current.

We deliver the current to the Township line at our switchboard and bill them as per our meter readings.

FARM.

Part of the cleared land was leased to Hjalmer Erickson during the year and we use the balance (about 30 acres) for hay and oats.

We secured 38 tons hay and 115 bushels oats from here during the past season. This gives us more hay than we require and we have some of it for sale.

The oat crop in the district was a failure this year on account of the cold, wet weather.

LEASED LOTS.

During the past year all the parcels of land occupied on mine property were covered with leases properly signed. These number 559.

RAILROAD SCALES.

This equipment is owned by the mine and during the year we placed a new plank top on same.

SAFETY WORK.

We continue this work and try to impress on our men that they must at all times, obey the Safety Rules and take care of themselves "first" and carry on their work "secondly".

PERSONAL INJURIES.

We are pleased to be able to report no fatalities during the year.

We have had the usual number of minor injuries but none of a serious nature.

Most of our accidents are due to chunks hitting the men on hands and feet, we have also had a number of accidents reported as "sprained backs".

LABOR.

We are working a slightly larger force than last year and plenty of miners are available, but we have difficulty in keeping our tramming gangs filled. Our tramming is all done by hand and the work is necessarily heavy and men will not tram when they can get other work.

On August 1st the wage schedule was placed back to where it was at the time the reduction was made on October 1st, 1914.

Due credit is hereby given to our organization for such results as have been secured during the year just closed.

HOME GARDENING PRIZES.

The practice of giving prizes for "Best Kept Premises", "Flower and Vegetable Gardens", etc., was adopted at Republic during the year and we look for considerable benefit from this source.

Property owners and tenants seem to be greatly interested and we have no doubt but what the prizes will be a good influence.

BENEFIT CLUB AND HOSPITAL.

VISITING NURSE.

No change was made in the method of handling these matters during the year.

We would like very much to remodel the Hospital Building along the lines discussed last year. This building is not laid out properly to care for the patients. Only one ward is maintained and there are no private rooms available. The sanitary and plumbing arrangements are also bad.

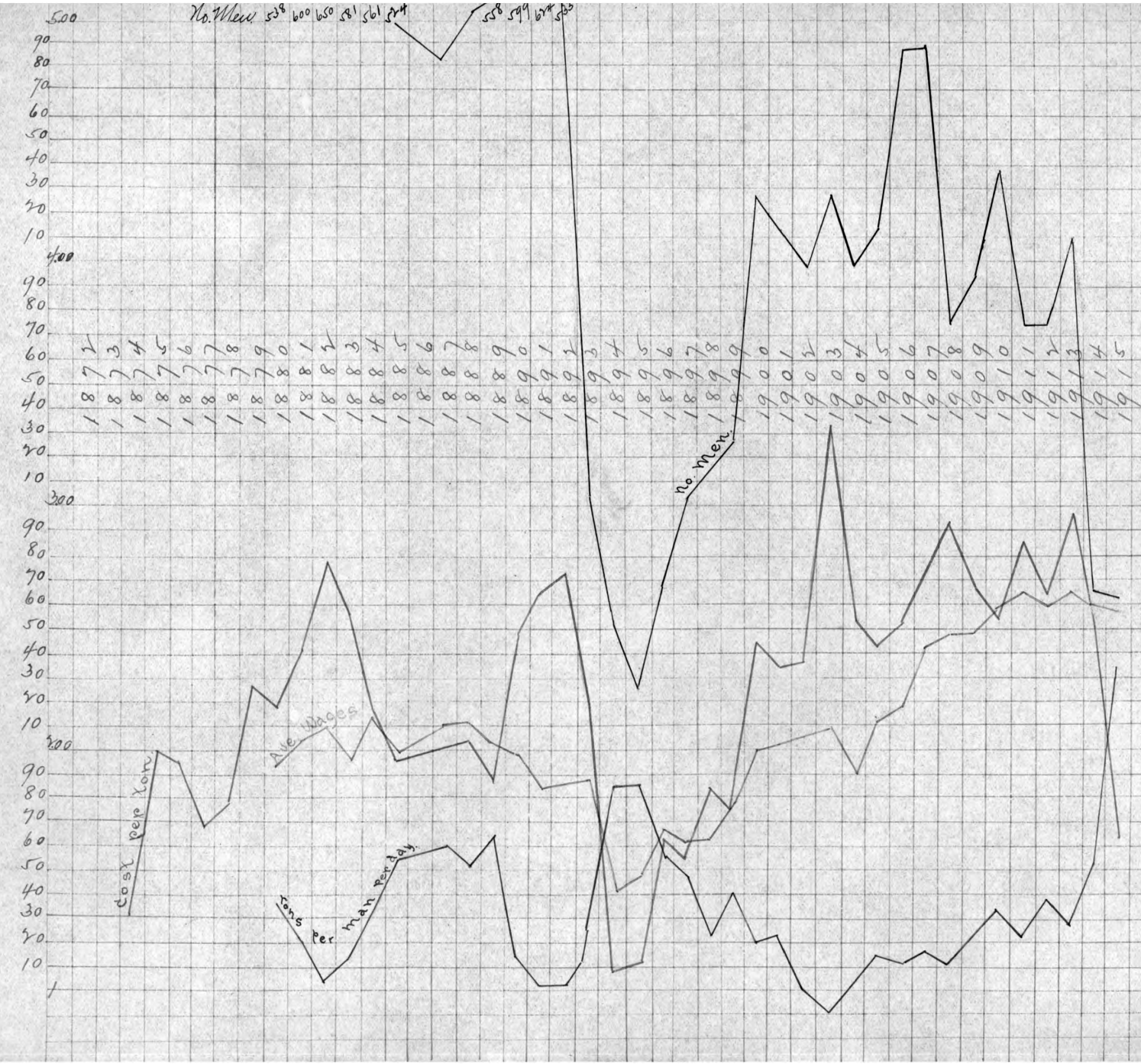
We would also like to recommend that a trained nurse be employed at Republic. Some arrangement could be made whereby one-half her time could be at the Hospital and one-half on visiting nurse work.

CHART SHOWING COSTS, ETC., FOR REPUBLIC MINE, YEARS 1872 TO 1915.

The following Chart shows:-

Cost per ton -	Red Line.
Average Wages -	Green Line.
Number of Men -	Violet Line.
Tons per Man per day -	Brown Line.

The first is shown since the year the Mine was opened in 1872 and the others give the information since the year 1880 only. This Chart shows we worked fewer men than for any year since 1895. We produced more tons ore than for any year during past 24 and the tons per man are away above that for any year in the history of the Mine.


No. Men
538 600 650 581 561 524 558 599 674 503
500
400
300
200
100
1873 1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915
no. men
Ave. Wages
Cost per ton
tons per man per day

UNDERGROUND.

GENERAL.

Underground operations are about the same as at the end of last year except that we are handling more rock in proportion to the amount of ore being produced.

During the year a number of stopes were completed and are now in process of being drawn and cleaned out; most of these are now giving us considerable trouble and expense on account of the enormous quantities of rock which is slabbing from off the walls and coming down with the ore. This rock must all be sorted from the ore and is proving quite a burden. A great amount of time and study is being given to this matter.

During December month we hoisted 13,959 tons ore and in getting it, we hoisted 8,293 tons rock, so it can readily be seen the conditions we have to meet.

ORE BODIES.

We were fortunate in developing a nice stope of good ore on the 1935' Level, No. 9 Shaft, during the year. This has now been carried up a distance of over 50' above the level in excellent material. We do not look for this to go up much farther as it has every appearance of cutting out very soon.

During the year the ore from #3 Stope, 1815' Level, No. 9 Shaft, was located on the 1935' Level by Diamond Drill holes and has now been opened. This ore lens was very small on the bottom level but a good tonnage will be secured as this should extend thru to the other level.

We regret we are unable to report any new finds of ore in Pascoe Shaft territory. We have several rock drifts going ahead in this end of the mine and hope to be able to make a showing here during the coming year.

SYSTEM OF MINING.

We have modified our system of mining, somewhat, during the year. We find our ore breaks in such large slabs that it was quite expensive maintaining our chutes. We have, on the 1935' Level, No. 9 Shaft, built sollars the same height as the tram cars and have left out the chutes entirely. The deposit is opened by the raise and pillar method and the ore comes down the raises to the sollars from where it is loaded into tram cars. This is working very satisfactorily.

ROCK.

This is one of our heaviest expenses and during the year just closed, we hoisted a total of 59,510 tons which is nearly one-third as great as the ore tonnage secured.

In addition to the rock hoisted, we handled and dumped underground a total of 13,259 tons additional.

SORTING ORE.

Our costs for sorting ore have been reduced for the year due to the installing of a Picking Table at No. 9 Shaft Head Frame. This was placed in operation during April and from then until December 31st, 7,584 tons rock were picked from the ore passed over same.

The sorting in Pascoe Shaft continues to be made by car-pickers underground who sort out the rock as the trammers fill the cars.

SHAFTS.

Two shafts have been operated all the year.

No. 9 Shaft is in good condition and require little attention. Pascoe Shaft is a continual source of expense on account of its depth and the several angles of dip. A crew of men is sent thru this shaft every working day and numerous repairs are necessary.

No. 9 Shaft has now reached a vertical depth of 2082 feet and Pascoe Shaft 2150 feet. Pascoe Shaft is 3170 feet deep on the underlay.

BREAKING ORE.

Our breaking ore cost shows a material reduction for the year - due in part to the excess ore taken from stulls over that broken. We look for increased costs under this head during the coming year due principally to the heavy increase in cost of powder.

TIMBERING.

Under our raise and pillar method of opening the Stopes, a saving in timber has been accomplished and our main charge under this head is for cribbing for the mills which are carried up thru the stopes.

MINE WATER AND PUMPS.

Our flow of water has not increased during the year and remains practically the same.

Our pumping arrangement has not been changed from that in force at the end of last year.

A pumping station and sump has been cut on the 2082' Level, No. 9 Shaft, and the electrical pump will be moved there from the 1935' Level.

In February month a new electric cable was placed in No. 9 Shaft from surface to the 1153' Level at a cost of $661.60. This serves our electrical pumps and was necessary to replace old cable burnt out.

NO. 9 SHAFT.

911' LEVEL:-

The balance of the ore remaining on this elevation was taken out during the first four months of the year and nothing is now being done here.

950' LEVEL:-

The work of taking the old floor above this level was carried on during the first six months of the year and a total of 5,172 tons ore were mined.

1050' LEVEL:-

During the year the ore in the old floor above this level was broken and is now being trammed and hoisted.

NO. 9 SHAFT. (CONTINUED).

1665' LEVEL:-

During the year the stopes coming up from the level below were holed thru to this level and part of the ore broken above this elevation is now being taken thru the filling places on the 1815' level. The balance of the ore remaining in stopes 1, 2 and 5 is being trammed to skip on this (1665') level.

1815' LEVEL:-

Operations have been crowded on this level during the year and a total of 68,831 tons ore and 9,853 tons rock were hoisted from here.

During the first part of the year, stopes 1 - 2 and 3 were completed thru to the level above.

In March month we discontinued the breaking of the lean ore in No. 3 Footwall stope as we have a great quantity of this poor material already broken. We can go back there at any time.

The ore in No. 1 Footwall stope has all been taken. This was found not to extend thru to the next level.

We have run into a serious condition with the ore reserves broken on this level. It seems that when the stopes above the 1665' level were carried up completed at the time we purchased the mine, the lean ore stope holed into the first class ore stope and afterwards the quartzite lens separating these two ore bodies caved and now we find all three - first class ore, lean ore and quartzite coming down all mixed together. The process of separating these will slow up our production at this point.

NO. 9 SHAFT. (CONTINUED).

1935' LEVEL:-

We are pleased to be able to report more encouraging news from this level than at the close of last year.

We have Nos. 1 - 2 and 3 stopes now at work on this level - all in first class ore.

During the year we drove a crosscut 125' into the hanging quartzite from which point six drill holes were put down towards the foot to cut the measures at a lower elevation. None of these encountered ore.

Two Diamond Drill holes, Nos. 355 and 356, were put in from the main drift and No. 356 encountered two small lenses of ore to which a cross cut was driven. These lenses proved to be a continuation of the ore in the stopes on the 1815' level and same are now being worked.

These stopes are all opened by the raise and pillar methods and no timber is used.

The ore seems to be cutting out in stope No. 2 both on and above the level, but the fact that we have this ore now for a distance of 250' is very encouraging for the bottom part of the mine.

After locating the ore in No. 3 Stope we drove a drift to connect with the main level to the shaft in order to shorten the tram.

During the year No. 1 Footwall Stope was carried thru to the level above, completed and cleaned out. A short drift was driven ahead from this stope to ascertain if this ore extended but nothing was found.

A total of 21,297 tons ore were produced from this level during the year.

NO. 9 SHAFT. (CONTINUED).

2082' LEVEL:-

No. 9 Shaft was sunk to this elevation during the year, and the plat was cut and pumphouse and sump provided.

A loading pocket was also placed in the shaft after which drifting to the ore measures was placed underway. This drift has now reached a point 165 feet from the shaft. The rock is exceptionally hard and progress is not rapid. The work is being carried on on both day and night shifts.

A drift has also been started from this level to meet the one coming across from Pascoe Shaft.

SINKING.

As soon as our pump has been installed on the bottom level, the sinking of No. 9 Shaft will be resumed.

PASCOE SHAFT.

922' LEVEL:-

During January month the balance of the ore, 173 tons, remaining on this level was taken and nothing is now being done on this elevation.

1335' LEVEL:-

We have only one stope on this elevation and breaking ore was discontinued in January month on account of its poor quality. This was started up again in April month and kept under work until December when all of the ore in sight was broken. We are now cleaning out this stope and the hanging wall is caving badly - thousands of tons of rock coming down mixed with the ore. We have over 6,000 tons ore broken in this stope but are tramming large quantities of rock from same.

We are mixing in some of this material, which is lean ore, with our lump shipments to the Algoma Steel Corporation.

In September month we started to drive the main level west in rock on this elevation and the drift has now reached a point 320' from the shaft. We have about 130 feet still to go to reach a small lens of ore encountered in drill hole No. 159.

We are anxious to get our workings out into this territory for exploratory purposes, as very little work has heretofore been done in this part of the mine.

During the year 10,369 tons ore were taken from this level.

PASCOE SHAFT.

1500' LEVEL:-

In September month this old level was cleaned out and a drift started to find the ore cut by drill hole No. 296. About 250 feet of drifting will be necessary.

1570' LEVEL:-

The work of taking old floors and pillars in this territory has been continued all the year. We are filling the old stopes with rock as we come up.

12,444 tons ore were won from this work during the twelve months - all of excellent grade.

1850' LEVEL:-

The rock drift driven Southwest of the shaft cut a small lens of ore (#1 West) which was stoped out during the year. The ore coming up from below was not located and further work will be done here.

When the drawing of completed Stope No. 1 North was commenced, it was found that the timbered stull was in such bad condition that it could not be held, we therefore ran a drift around this stull connecting with the main drift to the north and are now tramming from this stope.

We find enormous quantities of rock coming down with the ore at this point and for days at a time, we produce nothing but rock from this stope where we show 8,550 tons ore as being broken.

1850' LEVEL(CONTINUED)

We found the ore from No. 7 Stope on the level below was up near this elevation, we therefore drove a drift around No. 5 Stope North and holed into the old main level drift which was put in and abandoned by the previous operators. This main drift was driven ahead and encountered the ore within fifteen feet. This ore has been connected by a winze with No. 7 Stope coming up and breaking is now in progress. It is planned to stope down all this ore thru No. 7 Stope to the 1950' Level and thereby save the work of developing same by raises, etc.

1950' LEVEL:-

No. 6 Stope on this level, did not extend thru to the level above but cut out 75' above the level. The ore broken and remaining in the stope totals 4,220 tons, but we have not been able to get any of it for some time on account of the large amount of rock that has slabbed off the walls and is coming down.

No. 7 Stope has been holed thru to the level above and breaking ore is again underway.

No. 1 Stope was completed last year and we have been cleaning it out this year. We show over 2,000 tons remaining in this stope but we can not secure this on account of thousands of tons of rock having caved in from the hanging. This ore will be recovered through the stope now coming up from the level below.

During the year, 19,107 tons ore were taken from here and in doing it, 10,417 tons rock were handled.

2050' LEVEL:-

The main drift on this elevation is being driven to connect with No. 9 Shaft and has now reached the 3400' Meridian and we have about 400 feet yet to go.

A small lens of ore (No. 3 North) was encountered in this drift but it extended only a short distance above the level and has all been mined.

Stope No. 2 North was completed and holed thru to the level above during the year and is now being cleaned out. We show 8,074 tons ore broken in this stope but have been tramming rock entirely for the past few weeks on account of enormous quantities having caved from both foot and hanging. This is Soaprock and we have difficulty in separating it from the ore.

Stopes Nos. 2 and 3 are being carried up in excellent ore and will no doubt, continue thru to the level above.

A drift is being driven to locate the ore cut in drill hole No. 352 and is now in the first lens which is being developed.

A total of 26,257 tons ore were taken from this level during the year and 12,920 tons rock were handled in the same time.

2150' LEVEL:-

The lift in this shaft was started and completed to this level during the year, the plat cut and skip pit sunk. The pocket is now being cut after which the pentice will be removed and the skip-way placed.

When the skips come to the level drifting to the ore measures will be commenced.

ORE IN SIGHT.

Following is a statement showing Ore in Sight as of December 31st, 1915.

NO. 9 SHAFT.

LEVEL	ORE BROKEN ON STULLS		ORE IN PLACE	SHAFT PILLARS	PROSPECTIVE ORE	TOTAL
	AVAILABLE	NOT AVAILABLE				
911'			720	1,800		2,520
1000'				3,000		3,000
1050'	1,076			6,000		7,076
1153'			3,200			3,200
1665'	59,682					59,682
1815'	44,475		21,990			66,465
1935'	15,109		78,180		19,710	112,999
2080'					24,780	24,780
TOTAL,	120,342		104,090	10,800	44,490	279,722

PASCOE SHAFT.

860'		950				950
1335'	6,319		560			6,879
1640'			10,000	2,700		12,700
1710'		12,800		24,000		36,800
1780'		22,000		28,500		50,500
1850'	8,550	3,200	9,080	21,000		41,830
1950'	15,361		16,930	29,000		61,291
2050'	27,362		33,860	17,000	7,400	85,622
2150'					24,310	24,310
TOTAL,	57,592	38,950	70,430	122,200	31,710	320,882
GRAND TOTAL #9 & PASCOE SHAFTS	177,934	38,950	184,550	133,000	76,200	600,604
LESS SHAFT PILLARS,						133,000
NET TOTAL,						467,604

Deducting the 38,950 tons unavailable broken ore leaves a balance of 428,654 tons.

REPUBLIC MINE.

Following is a statement showing Ore in Sight, Product and Development for the year 1915 and previous years:-

	1912	1913	1914	1915
Ore in place Jan. 1st,	1182,000	1133,600	969,700	516,350
" Broken in Mine Jan. 1st,	202,275	219,875	247,485	250,830
Total ore in sight " "	1384,275	1353,475	1217,185	767,180
Product,	142,322	145,540	124,920	185,187
Balance,	1241,953	1207,935	1092,265	581,993
Ore in Place, Dec. 31st,	1133,600	969,700	516,350	383,720
" Broken in Mine Dec.31st,	219,875	247,485	250,830	216,884
Total ore in sight " "	1353,475	1217,185	767,180	600,604
Developed Fiscal Year,	111,522	9,250	325,085*	18,611

*Loss

In above statement we have, each year, shown all ore in sight including Shaft Pillars and unavailable broken ore.

Of this unavailable broken ore, 38,000 tons is tied up in stopes back of Pascoe Shaft, is covered with broken rock and must be left until this shaft is abandoned. The balance, 950 tons, is in the West Republic Shaft at which point no work is at present being done.

UNDERGROUND GENERAL.

We regret to have to report that we do not close the year in as good condition as we began it. We show less ore in place and it is so widely distributed it can not be attacked rapidly. We also show approximately 35,000 tons less ore broken on stulls, and most of that which is broken we find to be so badly mixed with rock as to make the winning of same slow and costly.

The development work in this mine should be further ahead than it is at the present time. Our shafts should be two levels ahead of our stopes at all times, for the reason that the ore lenses are so small that no great tonnage is received from any one level, and it takes such a large amount of rock drifting to locate the ore bodies on each level. When we took the mine very little development work had been carried on for the two years previous, which leaves us just that far behind.

We hope the two new levels we are now opening will show up good ore bodies and we have reason to believe they will.

DEVELOPMENT WORK.

Our plans for development for the coming year cover a large amount of rock work. Both shafts will be sunk another lift and in addition seven rock drifts will be underway.

It is absolutely necessary to crowd our development work as rapidly as possible in order to maintain sufficient ore stopes to work our miners.

Our costs under this head will be high during the coming year.

ORE ON STULLS.

Following is a statement showing the Ore on Stulls as of December 31st, 1915.

NO. 9 SHAFT.

		AVAILABLE			NOT AVAILABLE.		
LEVEL	STOPE	TONS	IRON	PHOS.	TONS	IRON	PHOS.
1050'	#1	1,076	66.70	.045			
1665'	#1	3,550	64.00	.060			
"	#3, N. end,	4,985	58.00	.062			
"	#3, S. "	8,750	62.00	.062			
"	#4,	10,950	65.00	.055			
"	#5, S, end,	31,447	55.00	.062			
1815'	#1, Hang.N & S ends,	24,452	66.70	.044			
"	#2,	5,605	65.04	.036			
"	#3, N.end,	12,582	55.91	.061			
"	#3, Extreme N.end	1,350	56.43	.053			
"	#3, Footwall,	486	59.00	.045			
1935'	#1,	7,201	65.50	.026			
"	#2,	7,908	64.90	.032			
	NO. 9 TOTAL,	120,342					
	PASCOE SHAFT.						
1335'	#1, West,	6,319	64.40	.072			
1710'	#3,				12,800	65.00	.075
1780'	#3,				18,900	66.00	.066
"	#4,				3,100	64.00	.068
1850'	#1, N. end,	8,550	65.26	.143			
"	#3,				3,200	66.00	.087
1950'	#1,	1,680	64.00	.077			
"	#1, West,	2,017	67.00	.034			
"	#4,	1,872	66.00	.082			
"	#6,	4,220	66.60	.045			
"	#7, Magnetic,	5,572	69.27	.027			
2050'	#1, West,	4,356	66.20	.062			
"	#1, N.	919	68.18	.082			
"	#2, N.-S.end,	868	68.11	.050			
"	#2, N.-N. "	8,074	68.30	.043			
"	#2, West,	6,697	66.80	.041			
"	#2, Hang. West,	1,596	67.00	.049			
"	#3, West,	3,927	67.30	.070			
"	#3, N.	925	68.40	.092			
	PASCOE TOTAL,	57,592			38,000		
West Rep. 860' Level-#1,					950	64.00	.044
	WEST REPUBLIC TOTAL,				950		

SUMMARY

SHAFT.	AVAILABLE	NOT AVAILABLE	TOTAL
No. 9 Shaft,	120,342		120,342
Pascoe "	57,592	38,000	95,592
West Republic,		950	950
TOTAL,	177,934	38,950	216,884

REPUBLIC MINE

AVERAGE MINE ANALYSIS OF OUTPUT FOR YEAR-1915

GRADE	IRON	PHOS.	SILICA
Republic Bessemer,	65.81	.042	
Republic Pascoe,	57.56	.048	
Republic Basic,	64.20	.078	

AVERAGE ANALYSIS ON CARGOES FOR YEAR-1915

	Mine			Lake Erie		
GRADE	IRON	PHOS.	SILICA	IRON	PHOS.	MOIST.
Republic Bess. Lump,	65.32	.036	4.22	65.03	.044	.70
Republic Bess. Crushed,	65.44	.040	3.84	64.81	.039	1.61
Republic Basic Lump,	64.81	.051	4.73	64.79		.34
Republic Basic Crushed,	61.84	.051	7.55	62.33	.068	1.62

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE

ORE STATEMENT - DECEMBER 31ST, 1915

	RUN OF MINE			BESS. LUMP	BASIC LUMP	PASCOE LUMP	BESS. CRUSHED	BASIC CRUSHED	PASCOE CRUSHED	BESS.CR. P.I.ST.P.	BASIC CR. P.I.ST.P.	TOTAL	TOTAL LAST YEAR
	BESS.	BASIC	PASCOE										
On Hand Jany. 1st, 1915,	37,697	5,896	52,035		19,265					5,538	7,039	108,270	78,553
Output for Year,	92,000	27,200	45,700		19,264	349		674				185,187	77,174
Transferred between Grades,	111,761	30,417	43,116	38,810	15,900	8,404	65,288	22,893	33,999				
Total,	17,936	2,679	54,619	38,810	35,229	8,753	65,288	23,567	33,999	5,538	7,039	293,457	155,727
Shipments,				38,810	35,124	8,753	65,288	23,528	33,999	4,012	5,668	215,182	47,457
Balance on Hand,	17,936	2,679	54,619	0	105			39		1,526	1,371	78,275	108,270

1914-- 2-10 Hr. Shifts - 4 days per week during month of May.

1 - 8 " " June 1st to Dec. 31st.

1915-- 2 - 8 Hr. Shifts during year.

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE

SHIPMENTS FOR YEAR--1915

GRADE	POCKET	STOCKPILE	TOTAL	TOTAL LAST YEAR
Republic Bessemer Lump,	15,998	22,812	38,810	372
Republic Basic Lump,	27,414	7,710	35,124	33,766
Republic Pascoe Lump,	5,767	2,986	8,753	2,181
Republic Bessemer Crushed,	22,835	42,453	65,288	0
Republic Basic Crushed,	15,443	8,085	23,528	11,138
Republic Pascoe Crushed,	16,567	17,432	33,999	0
Republic Bessemer - Crushed (P.I.ST.PILE)		4,012	4,012	0
Republic Basic - Crushed (P.I.ST.PILE)		5,668	5,668	0
Total,	104,024	111,158	215,182	47,457
Total Last Year,	20,604	26,853	47,457	
Increase - 353%			167,725	

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REPUBLIC MINE.

REPUBLIC MINE.

REPUBLIC MINE.

COMPARATIVE MINING COST FOR YEAR.

	1 9 1 5.	1 9 1 4.	INCREASE.	DECREASE.
PRODUCT	185,187	8 Mos. 77,174	108,013	
General Expense	.202	.154		.052
Maintenance	.201	.343		.142
Mining Expense	1.318	2.029		.711
Cost of Production	1.621	2.526		.905
Exploratory	.028	.009	.019	
DEPRECIATIONS.				
Original Purchase	.250	0	.250	
Plant Account (	.100	0		
Equipment (	.018	.148		.030
Total Depreciation	.368	.148	.220	
Taxes	.072	.175		.103
Central Office	.085	.128		.043
Supply Inventory	-	.001	.001	
Miscellaneous	.002		.002	
Sundry Expense	.061	.059	.002	
COST ON STOCKPILE	2.237	3.044		.807
Loading and Shipping	.061	.043	.018	
Total Cost on Cars	2.298	3.087		.789
No.Days Operating	305	193	112	
No.Shifts and Hours	2-8hr	1-8hr		
Avg.Daily Product	607	400	207	
COST OF PRODUCTION,				
Labor	1.087	1.735		.648
Supplies	.534	.791		.257
Total	1.621	2.526		.905

REPUBLIC MINE.

COMPARATIVE WAGES AND PRODUCT.

	1915.	1914.	INCREASE.	DECREASE.
		8 Mos.		
PRODUCT	185,187	77,174	108,013	
No. Shifts and Hours	2-8hr	2-8hr		
AVERAGE NUMBER MEN WORKING				
Surface	65	77		12
Underground	193	187	6	
Total	258	264		6
AVERAGE WAGES PER DAY				
Surface	2.45	2.50		.05 (2. %)
Underground	2.62	2.63		.01(.38%)
Total	2.58	2.59		.01 (.39%)
WAGES PER MONTH OF 25 DAYS				
Surface	61.25	62.50		1.25
Underground	65.50	65.75		.25
Total	64.50	64.75		.25
PRODUCT PER MAN PER DAY				
Surface	9.20	5.05	4.15(82.2%)	
Underground	3.14	2.16	.98(45.4%)	
Total	2.34	1.51	.83(55. %)	
LABOR COST PER TON				
Surface	.267	.495		.228
Underground	.834	1.220		.386
Total	1.101	1.715		.614
Avg.Product Breaking & Trm'g	4.73	4.10	.63	
" Wages Contract Miners	2.73	2.77		.04
" " " Trammers	2.76			
" " " Labor	2.74	2.77		.03
TOTAL NO. OF DAYS				
Surface	20,138	15,294¼	4,843¾	
Underground	59,037	35,778¼	23,258¾	
Total	79,175	51,072½	28,102½	
AMOUNT FOR LABOR				
Surface	49,446.43	38,224.65	11,221.78	
Underground	154,456.44	94,129.19	60,327.25	
Total	203,902.87	132,353.84	71,549.03	

Prop. Surface to Underground Men.
1915 - 1 to 3.
1914 - 1 to 2.34

NOTE: Wage rates reduced 10% from schedule adopted February 1, 1913, - Oct.1,1914.
Aug. 1, 1915, Wages restored to scale in effect prior to October 1, 1914.

Avg.wages 9 Mos. Jan.1st to Sept.30,1914 ...	2.68
" 10 " Oct.1,1914,-Aug.1,1915	2.46
Decrease during 10 month period	.22
PerCent " "	8.21

REPUBLIC MINE.

STATEMENT OF EXPLOSIVES USED FOR BREAKING ORE.

KIND.	QUANTITY.	AVERAGE PRICES.	AMOUNT 1 9 1 5.	AMOUNT 1 9 1 4.
50% Powder	194,064	.108	20,458.51	11,616.29
Fuse	233,000	.438	1,020.00	598.00
Caps	64,200	.783	502.97	257.63
Cap Crimpers	4	25	1	5.53
Total Fuse,Etc.			1,523.97	861.16
" All Explosives			21,982.48	12,477.45
Product			185,187	77,174
Pounds Powder per Ton Ore			1.05	1.39
Cost per ton for Powder			.1105	.150
" Fuse, Caps, Etc.			.0082	.011
" All Explosives			.1187	.161
Avg.Price Per Lb. for Powder			.108	.108

ANNUAL REPORT

(1915)

OF THE

IMPERIAL MINE.

Production and Shipments.

The Imperial Mine was closed throughout the year 1915.

Surface.

The two No. 6 crushers were taken down from the shaft-house in May and sold to the Lake and Negaunee Mines. There was no other work done on surface.

Estimate of Ore Reserves, Jan. 1, 1916.

Level	Shaft Pillar Tons	Available Ore Tons	Total Tons	Partly Developed Ore Tons	Total Tons
First	12,000	2,000	14,000		14,000
Second	23,000	28,000	51,000		51,000
Third	24,000	178,000	202,000		202,000
Fourth	45,000	200,000	245,000	80,000	325,000
Total	104,000	408,000	512,000	80,000	592,000
Less 10% for loss in Mining		41,000	41,000	8,000	49,000
		367,000	471,000	72,000	543,000

A factor of 13 cu. ft. per ton was used, and incidental rock was deducted on each level.

CROSBY MINE.

ANNUAL REPORT FOR 1915.

Operations at the Crosby Mine during the past year were confined entirely to work in connection with preparing for the extraction and treatment of the wash ore. No ore was hoisted in the shaft, or shipped from the property, during the year; in fact, the pumps were not operated and the small amount of underground work undertaken was in the nature of repairing, ditching, and cleaning.

At the beginning of the year but four men were employed - the Superintendent, two watchmen, and a teamster. This force was not increased until work in connection with the washing plant, railway spur, and storage dam was started, the latter part of April. The progress of this work will be taken up later under the various headings, as outlined in the "Estimate and Authorization."

STOCKPILE.

As a result of the development work carried forward on the second level during 1914, a total of 8,324 tons of lean ore were dumped on the stocking grounds adjacent to the shaft. This material averages 45% in Iron and .050 in Phosphorus, and is available for steam shovel loading when the washing plant is started in the spring. Because of the high Phosphorus content of the ore, it will be necessary to use care in feeding it to the mill. The material to come from the west pit will also average high in Phosphorus, and it will, therefore, be a question of mixing in the right proportion of the east pit product to hold the grade to our guarantee in Phosphorus. The Iron content in the ores to be treated the first season should be above the general average, and there should be no trouble experienced on that score.

ORE ESTIMATE OF JANUARY 1, 1916.

As no exploratory or development work was undertaken during 1915, and no ore was removed from the property, the estimate as of January 1, 1916, will be the same as reported for January 1, 1915:

MERCHANTABLE ORE.

	In sight January 1, 1916.
East Forty	86,000 tons.
West Forty	122,000 "
Total	208,000 tons.

This ore averages 56% Iron and .040 in Phosphorus. As it would be necessary, in order to maintain the grade, to mix that part of the ore tied up in the shaft and track pillar, this 208,000 tons of direct shipping ore will not be available for some years; in fact, not until the present hoisting shaft is abandoned. It will probably be advisable to handle this tonnage on an inclined tramway from the open pit, subsequent to the completion of wash ore operations.

WASH ORE.

	In sight January 1, 1916.
Open Pit	1,431,000 tons.
Underground	1,091,000 "
Total	2,522,000 tons.

This estimate is based on an average of 50% Iron and .045 Phosphorus. Figuring on a 60% concentration, the treatment of the 2,522,000 tons of wash material would yield 1,513,200 tons of concentrates. With the costs obtained at the Mine and Mill during the coming season as a basis, it will be possible to make an accurate statement as to what part, if not all, of the underground ore can be mined and treated profitably. Some of the underground ore is situated a considerable distance from the shaft, occurs in comparatively narrow lenses, and the mining cost would approximate at

least 90 cents per ton. With a 60% concentration, a crude ore averaging 50% Iron and .040 Phosphorus, and costing 90 cents per ton to mine, would bring the total cost per ton of concentration to $3.42 f.o.b. Lake Erie, according to my estimated figures. This $3.42 is made up of $1.50 mining cost, $.42 for royalties, $.25 for transportation and washing, $1.15 freight, and $.10 for insurance and commissions.

UNDERGROUND CONDITIONS DURING 1916.

As stated before, the pumps were not operated during the past year, and with the exception of a small amount of necessary repairing, which was done during the month of December, no underground work was attempted.

The water stood in the shaft from 8 to 12 feet below the First Level floor, excepting during flood periods, which were the result of the spring thaw and various heavy rains during the summer months. The workings in the immediate vicinity of No. 1 Shaft were flooded upon several occasions, but the water soon drained off and no damage resulted therefrom. The timbering at the First Level plat and in the shaft, between the first and second levels, was replaced during 1914, and blocking was wedged between the timber and surrounding ground, so that the action of the water would not cause any serious damage to the flooded workings. In order that work on the Second Level pump house may be started at an early date, it will be necessary to begin pumping operations about March 1st. The small Cameron pumps will be used to lower the water in the shaft and drain the Second Level.

As the main haulage level has not been cleared of the material washed down through the open pit milling chutes since 1913, considerable quantities of sand, gravel, and ore have accumulated in places, and the drainage ditches are filled. Where dams were formed by this wash material a channel was cut, so as to allow the backed up water to drain off and avoid the necessity of chopping ice when tramming operations are started in the spring. If ice were allowed to form, it would result in heaving the tracks. In order to keep as much frost as possible from the drifts, all openings to

the pits were blocked with hay and lagging during the fall and later snow was banked up on the pit side. The presence of frost in the underground workings during the winter always means a slabbing of the material from the back and sides of the drifts with the advent of the warm weather in the spring.

Some twenty sets of timber were replaced on the main haulage level, lining sets were set in at several of the switches and a considerable quantity of lagging was used in blocking along the back and sides of the drifts, especially in the westerly workings of the mine. It will be necessary to do more or less repairing and a large amount of cleaning prior to the resumption of tramming operations. In order to make sure that everything will be in shape for mining activities with the opening of navigation, a force of men will be put on this work March 1st.

In order to make the description of the work in connection with "Crosby Wash Ore" more comprehensive, the detail statement of the charges to date under the various headings will now be given. This will be followed by an explanation of the work undertaken and accomplished during the past year.

DETAIL STATEMENT OF CHARGES TO "CROSBY WASH ORES"
FROM NOVEMBER, 1913, TO JANUARY, 1916. E & A #283.

NAME OF ACCOUNT.	ESTIMATE.	EXPENDED TO DATE.	UNEXPENDED BALANCE.
GENERAL EXPENSE.			
a. Insurance	$ 630.00	$ 657.97	27.97
b. Engineering	1,400.00	1,477.47	77.47
c. Analysis	100.00	64.23	35.77
d. Personal Injury Expense	1,380.00	37.95	1,342.05
e. Mine Office	9,300.00	11,083.57	1,783.57
f. Central Office	4,000.00	5,441.09	1,441.09
g. Taxes	2,200.00	3,654.85	1,454.85
h. Mining Captain	625.00	375.00	250.00
TOTAL	19,635.00	22,792.13	3,157.13
BUILDING EQUIPMENT.			
a. Rebuilding Shaft House	4,500.00	4,270.14	229.86
b. Repairing Mine Bldgs.	1,000.00	962.83	37.17
c. Erecting Rock Trestle	300.00	275.17	24.83
d. Repairing Office & Wrhse.	500.00	480.04	19.96
e. Rebuilding Coal Dock	100.00	81.88	18.12
f. Rebuilding Dry House	3,000.00	2,260.28	739.72
g. " Engine & Boiler Hse.	1,700.00	2,077.33	377.33
TOTAL	11,100.00	10,407.67	692.33
GENERAL REPAIRS.			
a. Water Heater	76.32	76.32	
b. Motor and Cars		1,157.63	
c. TopTram Eng.& Cars)		)	
d. Pumps)	3,500.00	43.10)	1,196.55
e. Hoists)		10.51)	
f. SteamShovels		1,092.21	
g. Electric Engine	7.82	7.82	
h. TramCars	250.00	206.53	43.47
l. General Equipment	350.00	268.76	81.24
TOTAL	4,184.14	2,862.88	1,321.26

DETAIL STATEMENT OF CHARGES TO "CROSBY WASH ORES" (CONT'D)
FROM NOVEMBER,1913, TO JANUARY, 1916. E & A #283.

NAME OF ACCOUNT.	ESTIMATE.	EXPENDED TO DATE.	UNEXPENDED BALANCE.
MACHINERY EQUIPMENT.			
a. Mine Pumps & Piping	5,200.00	4,717.82	482.18
b. Hoisting Plant	4,000.00	4,629.38	629.38
c. Compressor & Drills	2,107.75	2,107.75	
d. Motors and Cars	4,500.00		4,500.00
e. Lathe	300.00		300.00
f. Steam Shovels	8,000.00	3,485.52	4,514.48
g. Electric Engine	1,746.42	1,746,42	
TOTAL	25,854.17	16,686.89	9,167.28
SHAFT & UNDERGROUND			
a. Retimbering Shaft	1,250.00	1,199.52	50.48
b. 19,000 tons rock at 30¢	6,496.95	6,496.95	
c. 2,000 " " " 50¢	931.30	931.30	
d. 4,000 yds. sand " 45¢	1,670.56	1,670.56	
e. Cleaning Sump	300.00	157.40	142.60
f. Cutting Pocket & Sump	976.68	976.68	
g. Retimbering Main Drifts	1,538.57	1,538.57	
h. Extending Bottom Drift	2,494.29	2,494.29	
i. Exploring 400' & Raising	4,086.69	4,086.69	
j. Pumping Expense	9,200.00	, 8,286.98	913.02
k. Cribbing Track Pillar	51.06	51.06	
l. Drifting 1400' & Raising	12,178.73	10,566.23	1,612.50
m. Sinking Old Shaft	985.46	985.46	
n. Cross-cutting 2nd Level		750.77	750.77
o. Stripping 2nd Level		861.73	861.73
p. Re-opening Mine	4,000.00	395.84	3,604.16
TOTAL	46,160.29	41,450.03	4,710.26

DETAIL STATEMENT OF CHARGES TO "CROSBY WASH ORES" (CONT'D)
FROM NOVEMBER, 1913, TO JANUARY, 1916. E & A. #283.

NAME OF ACCOUNT.	ESTIMATE.	EXPENDED TO DATE.	UNEXPENDED BALANCE.
WASHING PLANT.			
a. Washer Building	20,675.00	20,879.58	204.58
b. Machinery Erected	24,645.00	24,372.18	272.82
c. Pumping Plant	15,600.00	14,279.17	1,320.83
d. Dam & Spillway	6,500.00	6,674.68	174.68
e. Pressure Tank	2,200.00	2,176.20	23.80
f. Power Plant	2,500.00	6,170.77	3,670.77
g. Transmission Line	2,000.00	1,673.67	326.33
h. Telephone Line	600.00	142.46	457.54
i. Temporary Buildings	300.00	289.73	10.27
j. Temporary Equipment	1,000.00	926.09	73.91
k. Supervision	1,000.00	404.15	595.85
l. Engineering	500.00	495.71	4.29
m. Preliminary Work	1,027.41	1,027.41	
n. Railway Construction	16,946.00	18,237.31	1,291.31
o. Nine 50 Ton Steel Cars	9,000.00	66.67	8,933.33
p. One 50 Ton Locomotive	5,000.00	5,126.79	126.79
q. Scales Installed	4,000.00	2,202.89	1,797.11
r. Lands	3,244.60		3,244.60
TOTAL	116,738.01	105,145.46	11,592.55
GRAND TOTAL	223,671.61	199,345.06	24,326.55

"GENERAL EXPENSE."

The sub-headings under this caption were estimated to include the expense up to September 1st, 1915, and upon that date there was an unexpended balance of $653.74 in the total. It has been necessary to keep this account open because of the fact that there was a delay in delivering some of the material such as the pumps, hoist, powerhouse motors, powerhouse and washing plant wiring, fittings for the dry and pressure pipe line and material for the scales, and the fact that some alterations in the original plans were deemed advisable. In case "General Expense," under E & A. No. 283, was closed, the several items would have to be carried as "Idle Expense," and it was considered expedient to keep the account open until wash ore operations were actually begun and the entire E & A account closed. At the end of 1915 the estimate had been exceeded by $3,157.13, and figuring on carrying the account to the opening of navigation, about April 15th, the total overrun will be close to $6,700.00.

"BUILDING EQUIPMENT."

2a. "Rebuilding Shaft House." While most of the work in connection with this account was completed during 1914, an expense of $535.06 was incurred in 1915 and covered the placing of the skip guides and dumps, including the plates and dump runners, and the building of the railway pockets and grizzly platform. The unexpended balance now amounts to $229.86, and should be ample to cover the cost of completing this job. The lining plates for the pockets are now on the ground and will be drilled and placed prior to March 1st.

2.b. "Repairing Mine Buildings." The 1915 charges covered repairs, which were made on the shop buildings, barn, and pipe lines, the painting of the various buildings, and the erection of a 14 x 20 foot addition to the warehouse, which will be used for storing pipe fittings and repairs for the underground haulage equipment, locomotives, and the material used only occasionally. The expense of tearing down the temporary boiler house and

removing the boilers was also charged to this account. The contemplated work has now been completed, and there remains an unexpended balance of $37.17.

2.c. "Erecting Rock Trestle." Work under this head consisted in the construction of a permanent trestle from the new head frame to the rock dump and in making some necessary repairs to the old trestle.

2.d. "Repairing Office and Warehouse." New sills were placed under the structure, and the floors were repaired in places. A new water pipe line was laid to the office, the office was plastered, mop boards placed in all of the rooms, the building equipped with pipe heaters, painted inside and out and a lavatory and closet installed on the second floor. A cess pool was excavated some fifty feet back of the warehouse and the necessary sewerage connections made. This work has been finished and the total expense is $19.96 under the amount estimated.

2.e. "Rebuilding Coal Dock." A loading platform for coaling the locomotive was erected along the railway cut just east of the barn, and a roadway graded to this platform. The unexpended balance here amounts to $18.12.

2.f. "Rebuilding Dry House." Work on the new dry was begun in September, and with the exception of some of the inside fittings, it was finished in October. The new dry is 15 feet longer than the old structure, so as to accommodate the heating plant, and its interior arrangement is much more convenient. The concrete floors have a good drain, the drying rack is now adequate, the showers are partitioned off and the captain and shift bosses have separate quarters, off from the main change room. The heating plant works very satisfactorily and besides furnishing heat to the dry, takes care of the office and is capable of furnishing heat to the shops and power house. The wash troughs and lockers have not been received as yet, but they have been shipped and should be placed by the time that underground work is started, March 1st. The total expense to date is $739.72 under the estimate, and this amount will more than cover the unfinished work.

2.g. "Rebuilding Engine and Boiler House." At the time of making the estimate a frame structure was considered, but later it was deemed advisable to put up a brick building, as the expensive electrical equipment to be housed warranted safe-guarding against fire to this extent. The engine (power) house was built under contract, the successful bidder being Hugh Faucett of Duluth. The work was completed during the month of October and accepted November 1st. The contract price, $1800.00, was a very satisfactory one for a brick building with a 33 x 45 ft. ground plan, and the estimated cost of a frame structure having been $1700.00. Including the concrete floor, which we put in, the total cost of the power house was $2,077.33, or $377.33 over the estimated figure.

"GENERAL REPAIRS."

The only work undertaken and charged to this caption during 1915 was made up of slight repairs to the old Marion "60" shovel, and an item of $308.67 incurred in overhauling the underground motor cars. There is an unexpended balance of $1,321.86 for "General Repairs" and while it will not be necessary to make this expenditure, over one-half of the amount will be used before the two locomotives and twenty-four tram cars are put in first class shape.

"MACHINERY EQUIPMENT."

4.a. "Mine Pumps and Piping." As no work has been done on the mine pumps during the past year, the 1915 charges to this account cover the cost of the new electrical pumps, which are to be installed on the second level when underground operations are resumed in the spring. These pumps are at present under cover, a rough housing near the office having been built over them.

4.b. "Hoisting Plant." Work on the concrete foundations was started the fore part of November, and the machinery, which was not delivered until the middle of that month, was installed and ready for hoisting

operations by the first of December. The cost of placing the concrete foundations under the hoist and erecting that piece of machinery amounted to $375.24, the hoist, including the motor, cost $3,790.00, which brings the total to $4,165.24, or $165.24 over the estimate. The total charge to "Hoisting Plant" has exceeded the estimate by $629.38. This is made up of the above and the proportion of the switch board and electric wiring expense which was not taken into consideration at the time the estimate was prepared.

4.f. "Steam Shovels." The expenditures to date under this heading cover the cost and erection of the Model "28" Marion Shovel, which was purchased in the spring of 1915. This revolving shovel has a 5/8 yard dipper, and there was a question as to its working capacity. It was operated on the dam, gravel, and railway jobs during the past summer, and we are entirely satisfied that it will be adequate for our work in the open pits. A second shovel of the same type has been ordered for March delivery. After meeting all expenses in connection with No. 2 shovel, there should be an unexpended balance of at least $600.00 in this account.

SHAFT AND UNDERGROUND.

Of the 16 sub-headings under this caption, "Pumping Expense" and "Re-opening Mine" are the only two which have been charged with any expense during 1915. The charge to "Re-opening Mine" included the expense incurred during December, when a force of seven men was engaged for two weeks in replacing broken sets on the main level, setting up lining sets at several of the switches, blocking all openings between the underground workings and open pits and draining off the water from the dams, which had been formed by material washed down through the milling chutes.

WASHING PLANT.

6.a. "Washer Building." The clearing and grubbing of the land for the plant site, including the conveyor and receiving bin, was started during the first week of May and was finished by the 20th of the month. A force of from six to ten men were engaged from the first of June until the end of July on the concrete foundations, and the Worden-Allen Company began the erection of the structural steel on the 17th of July. Over 250 yards of concrete were required for the 24 plant piers, 4 belt conveyor piers, and the receiving bin pit, and the mixing was done with a small 1/8 yd. machine, rented from Contractor McKuisick. The concrete job was completed in a most satisfactory manner, and the fact that all bolts were placed so accurately that it was not necessary to do any adjusting, is especially noteworthy. The piers were all carried down below the front line, and to insure against heaving, the bottoms were mushroomed from one to eighteen inches. The Worden-Allen Company finished erecting the structural steel, including the receiving bin and belt conveyor, on the 19th of August, and the riveting, roofing, sheeting, and painting jobs were completed September 6th. All of the work was carefully inspected, and where found unsatisfactory, the necessary alterations or repairs were made. It was necessary to cut out and replace a number of loose rivets and a part of the roofing had to be relaid, owing to the fact that no cement was used in the lap joints. With the exception of housing the belt conveyor, the plant is now completed, and it certainly compares very favorably with the other concentrators in this district. In making the plans for the Crosby Plant, it was not considered necessary to sheet in the conveyor, but later this work was decided upon and the timber, sheeting material and windows were ordered. This material is now on the ground, and the work of placing same will be started when the weather conditions become favorable. The estimate for "Washer Building" has been exceeded by $204.58, and the additional work to be done on the conveyor, including the cost of material, will bring the total overrun to about $650.00.

CROSBY MINE.

6.b. "Machinery Erected." The erector furnished us by the Allis-Chalmers Company started work on the machinery with a force of seven men on August 14th. The gang engaged here varied from four to twelve men during the succeeding seven weeks, or until the work was turned over, the first week in October. Besides the installation of the machinery, which included the motors, screen, logs, settling tanks, tables, and sand pump, these men built the spouting and launders, placed lining plates where necessary, and cut and fitted the piping throughout the mill. The work of erector Warren was most satisfactory at all times, and the completed job met the approval of all the officials of our Company who inspected it. There is an unexpended balance of $272.82 in this account.

6.c. "Pumping Plant." The charges to this item cover the cost of the 1012 feet of 10" pipe and the expense of ditching for and laying same. The suction line, extending from the storage sam to the power house, and the pressure line, running along the railway right of way, from the power house to the pressure tank, were laid during July and August, and the necessary bleeders cut in and connections made during September. This pipe is fitted with Dresser joints and is especially adapted to a rough country, where the contour of the ground is followed closely. The cost of the pressure pumps and the expense of installing them in the power house is also included under "Pumping Plant." With the exception of a few connections to be made at the power house and pressure tank, the work under this account is now completed, and there is an unexpended balance of $1320.83 remaining.

6.d. "Dam and Spillway." The work of clearing and grubbing the dam site was begun the latter part of April, and a force of from ten to twenty men was engaged here until the latter part of September, when the job was finished. In order to insure the dam against seepage, the grubbing was carried down to the solid clay, which necessitated the handling of quantities of boulders, and a ditch 4 x 4' in section was excavated along the center line. Borrow pits were cleared and the revolving shovel used

in loading the fill material into dump wagons. From four to six teams were used on the job during the greater part of two months, the extremely wet weather making working conditions very bad and adding considerably to the cost per yard for handling the dirt. Many large boulders were encountered in the borrow pits, and this added to the cost of the shovel work. The dam is six feet wide on top, with a slope of three to one on the upper and two to one on the lower sides; it is 1800' in length, and has a maximum height of 20 feet. Altogether, 12,556 yards of fill went into the dam, and the average cost per yard amounted to 32¢. The concrete mixer was moved from the plant to the dam August 16th, and work on the concrete spillway was started on the following day. It took 150 yards of concrete for the job, the spillway proper having a width of 12', with four wing walls extending out to the toe of the fill. The water had raised by the end of the year to the bottom flash board, and when the four boards are placed in position, as is the intention when wash operations are inaugurated in April, the water will be raised 4' over the basin and there will be impounded a total of 200,000,000 gallons. Due to the unfavorable weather conditions and the bouldery ground, the estimated figure was exceeded by $174.68, whereas if normal conditions had existed, there would have been an unexpended balance of at least $500.00.

6.e. "Pressure Tank." The contractors, The Chicago Bridge & Iron Company, erected this 25,000 gallon tank during the month of October, and at our request erected the 8" standpipe to connect with the pressure line from the power house. We placed the four 14 yard concrete piers in September. The tank was filled with water and tested for leaks the fore part of November. All charges have been entered against this account and there is an unexpended balance of $23.80.

6.f. "Power Plant." The total charges to date against "Power Plant" amount to $6,170.77 and include the cost of the switch board, generator set, transformers, and the expense of installation, together

with the expense of erecting the sub-station, wiring at the power house and plant, and laying the pipe conduits in the power house floor. The estimated figure has been overrun by $3,670.77, due to the fact that the transformers, sub-station and wiring expense was not included in the estimate under "Power Plant" and no account was taken of it elsewhere.

6.g. "Transmission Line." This line was erected during August and September, and as the poles and material were delivered along the right of way as needed, the work was carried forward with good dispatch. The unexpended balance in this account amounts to $326.33 and the final charges have been made.

6.h. "Telephone Line." The work was carried along with the "Transmission Line," a proportion of the cost of the poles in place being charged to this account. The telephones at the plant and mine are connected and there should be no further expenses under this head. The unexpended balance amounts to $457.54.

6.i. "Temporary Buildings." It was necessary to erect temporary sheds over the motors for the plant, for the tools and powder at the dam, for the tools and concrete at the plant, the underground motors and pumps at the mine, besides building a pumping shanty and a housing over the locomotive. Total charges of $289.73 leaves an unexpended balance of $10.27.

6.j. "Temporary Equipment." Under this head comes the ten six-yard dump cars, purchased from the Hawkins Mine for $500.00, the rental of the concrete mixer, flat car from the Great Northern Railway, and the purchase of a small upright boiler for use at the plant pumping station. There is an unexpended balance of $73.91 in this account.

6.k. "Supervision." The charges to this account include the traveling expenses of Messrs. Duncan, McClure, and Mennie while upon trips of inspection. The unexpended balance is $595.85.

6.l. "Engineering." Engineer Flink's time was divided between the dam and plant jobs, for the greater part of three months, and including the charge for helpers, the expense has amounted to $495.71, or within $4.29 of the sum allowed in the estimate.

6.m. "Preliminary Work." This item includes the preliminary work done, in connection with the investigation of washing plant sites, prior to the selection of the present location. The engineering expense and the cost of testpitting is covered. The estimate was made after the work was completed, so that the account balances.

6.n. "Railway Construction." The work of clearing the right of way for the mile and a quarter railway spur was started the latter part of April, the Marion "60" shovel was moved out to the 1,000' cut the fore part of May, and a temporary track laid and the locomotive run out to the plant site on June 1st. This work was rushed, so that the plant material could be delivered on the date specified in the Worden-Allen Contract. A total of 18,934 yards were taken from the cuts and used in the fills, the greater part of the clay material going into the belt conveyor high line and plant tail track. The cost of moving the material was estimated at 30¢ per yard, and the actual expense amounted to 27.5 ¢. With normal weather conditions the cost would have been still lower, and it would not have been necessary to have handled such a large yardage. The wet clay fills settled and squeezed out on the sides to an appreciable extent, and this necessitated raising the tracks and dumping additional material. The tracks were raised three times and the sand and gravel ballast, obtained from the Harrison pit, LaRue dump and Crosby tail track grade, worked into the clay, and the entire road bed had to be resurfaced. While this extra work added greatly to the construction cost and resulted in bringing the charges to the account over the figure allowed in the estimate, the tracks are now in good shape, and the maintenance expense during the first year's operations should be correspondingly less. The fact

that the tracks were subjected to more or less traffic during the summer and fall, and were kept in good shape, partly covers a maintenance charge, which would otherwise have been necessary during the coming spring.

Of the sub-headings under "Railway Construction" all but (2) "Grading" and (10) "Surfacing" came within, or were very close to, the estimate, and consequently, if the weather conditions had been more favorable, this account would have checked out very nicely.

The following is a detail statement of the charges to "Railway Construction;"

ACCOUNT.	ESTIMATE.	EXPENDED.	UNEXPENDED BALANCE.
1. Clearing and grubbing,	$ 616.00	608.56	7.44
2. Grading,	6,200.00	6,479.50	279.50
3. Culverts,	96.00	88.28	7.72
4. Ties,	1,582.00	1,578.54	3.46
5. Rails,	4,050.00	4,006.21	43.79
6. Frogs and Switches,	177.00	153.79	23.21
7. Track Fast.& Material	623.00	682.17	59.17
8. Ballasting,	1,200.00	1,175.46	24.54
9. Track Laying,	870.00	764.90	105.10
10.Surfacing,	1,100.00	2,483.10	1,383.10
11.Engineering,	432.00	216.80	215.20
TOTAL,	16,946.00	18,237.31	1,291.31

6.p. "One 50-Ton Locomotive." The 50-Ton Locomotive, purchased from Pickands, Mather & Company, cost $5,000.00 at the Virginia Mine, and the charges for transporting it to the Crosby Mine and some necessary repairs amounted to $126.79. As the estimated cost was $5,000.00, the account was exceeded by the above amount. The locomotive will be sent to the Hawkins' Shops in March, and the leaky flues repaired, the side rods straightened, and

bands shrunk on the two cracked driver hubs. Otherwise the engine is in first class condition.

6.q. "Scale Installed." The work of excavating for, and laying the concrete foundations of, the 100 ton railway scales, was completed during the early part of September and cost $760.27. The Fairbanks' erector assembled and placed the steel members in November, and a 11 x 14' weighmaster's house was constructed. A second erector placed the weighing beam after we had made several alterations and adjustments, in accordance with the requirements of the State Warehouse Commission. When the automatic weighing device is installed the scales will be in shape for operating. This self-recording machine, upon which we will have to pay a rental of $25.00 per month, has been ordered. There remains an unexpended balance of $1,797.11 in this account.

6.r. "Lands." The charges under this heading include the purchase price of the 80 acre tract obtained from the Luther Estate and the 80 acres from the Great Northern Company. This land was necessary in connection with our storage basin.

There is an unexpended balance of $24,326.55 in the grand total of E & A No. 283, and while several of the items have run over the amounts estimated, a number of the accounts which have been closed are appreciably under the estimates, and the balance of the charges to be made should not exceed this sum. The $24,326.55 balance does not include the 10% for contingencies, or take into account the credit of insurance on fire loss.

The following is a list of the accidents which occurred during 1915, where the injured party lost time:

DATE.	NAME.	OCCUPATION.	NATIONALITY.	REMARKS.
6/3	John Morano	Laborer	Italian	Working on grade; stumbled and fell against push car, bruising arm. Lost 7-3/4 days.
6/3	Tony Sampano	"	"	Finger squeezed when bolting steam shovel sections. Lost 1½ days.
6/15	Laro Lock	"	Montenegrin.	Excavating for pier and struck head with pick. Lost 1½ days.
6/17	Laro Dretznon	"	"	Dropped track jack handle on foot. Lost 1 day.
6/22	Tom Batricovich	"	"	Carrying trestle timber with other laborers. Fell and struck head on push car, receiving bad cut. Lost 10-3/4 days.
7/20	Jno.Laccoman	"	Italian.	Fell from trestle when dumping dirt cars. Lost 8 days. Bruised leg.
7/20	Emil Tifter	"	Finn	Fell from trestle when dumping dirt cars. Lost 4½ days.
8/24	Andrew Lock	"	Montenegrin.	In landing concentrating table in washing plant caught foot between table and motor. Lost 5 days.
9/6	Lilvia Brignolia	"	Italian	In disconnecting pipe from boiler, chain tongs slipped and Brignolia fell to ground. Lost 5 days.

CROSBY MINE.

COMPARATIVE WAGES AND PRODUCT.

	1915.	1914.	INCREASE.	DECREASE.
PRODUCT	0	0		
AVERAGE NUMBER MEN WORKING				
Surface	34	14	20	
Underground	0	19		19
Total	34	33	1	
AVERAGE WAGES PER DAY				
Surface	2.57	2.87		.30(10.4%)
Underground	2.41	2.86		.45(15. %)
Total	2.57	2.87		.30(10.4%)
WAGES PER MONTH OF 25 DAYS				
Surface	64.25	71.75		7.50
Underground	60.25	71.50		11.25
Total	64.25	71.75		7.50
TOTAL NUMBER OF DAYS				
Surface	11,053¾	4,308	6,745¾	
Underground	127	5,995¼		5,868¼
Total	11,180¾	10,303¼	877½	
AMOUNT FOR LABOR				
Surface	28,369.67	12,374.47	15,995.20	
Underground	305.75	17,147.39		16,841.64
Total	28,675.42	29,521.86		846.44

Not producing during 1915.
Preparing for Wash Ore.

Oct. 1, 1914 - Wage rates reduced 10% from schedule adopted Feb.1,1913.
Aug. 1, 1915 - Wage restored to scale in effect prior to Oct.1,1914.
Average wages 9 mos. from Jan. 1st to Sept. 30th,1914 ..... 2.88
" 10 " from Oct.1st, 1914, to Aug. 1st, 1915 ..... 2.51
Decrease during 10 month period ..... .37
PerCent " " 12.85

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31ST, 1915.

Ishpeming, Michigan,

February 1, 1916.

ENGINEERING DEPARTMENT.

Mr. M. M. Duncan, Agent,

City.

Dear Sir:-

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

LIST OF ANNUAL REPORT MAP BOOKS FOR 1915.

Cleveland-Cliffs Iron Company.
Negaunee, Republic, Mesabi and
Iron River districts.

Cleveland-Cliffs Iron Company.
Ishpeming and North Lake districts.

Cleveland-Cliffs Iron Company.
Gwinn district.

Cleveland-Cliffs Iron Company.
Lands on Marquette Range.

The first three books listed above contain the maps of the Company's mines. The last one contains the maps of the surveys made on the Company's lands upon the iron formation of the Marquette Range. Most of these surveys were brought up to date during the year.

Two sets of these books of maps have been prepared, one for the Cleveland office, which I hand you, and the other to be kept in the vault in this building.

A special book has been prepared for the Lackawanna Steel Company, containing the photographs and maps of the Negaunee mine. This also is handed you.

Special books of the Gwinn, Republic and Mesabi districts have been prepared to be sent to Messrs. Jackson, Bush and Barber.

Mr. Stakel has written the statement as to the staff in this department and also described the surveys. Mr. Brewer has given the information about the Abstract department.

Yours truly,

Chief Engineer.

REPORT OF THE ENGINEERING FORCE EMPLOYED DURING THE YEAR 1915,

AND A BRIEF OUTLINE OF THEIR WORK,

BY C. J. STAKEL, ASSISTANT ENGINEER.

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THE FORCE.

The department for the Ishpeming-Negaunee district consisted of the following engineers at the close of the year: C. J. Stakel, J. F. Hanst, H. O. Moulton, R. J. Chenneour, E. L. Derby, J. E. Hayden and J. K. Osborne. M. F. LaCroix was employed in the Engineering department during the month of January, being then transferred to the Geological department. F. G. Rockwell was a member of the department until September 13th, after which he was transferred to the Gwinn district. He left the employ of the Company on November 13th. John Trosvig, who was formerly employed as an assistant to the engineers, was reinstated on December 1st. Albert Rock was on the pay roll as a helper during the entire year. Charles Feller acted as an axeman and helper from April 27th to the close of the year. In addition to these men, two axemen were employed intermittently during the surface survey season.

The following is a table showing the number of days each man worked, the days lost through illness, vacations, etc, and the percentage of time put in by each man:

NAME.	EIGHT HOUR DAYS WORKED.	DAYS VACATION.	DAYS LOST THROUGH ILLNESS.	TOTAL DAYS EIGHT HOURS.	PERCENTAGE OF DAYS WORKED.
C.J.Stakel	271½	5½		277	98.0%
J.F.Hanst	247¼	24½	4¾	277	89.4
H.O.Moulton	277	0	0	277	100.0
R.J.Chenneour	259½	15	2½	277	93.7
E.L.Derby	261½	14	1½	277	94.4
J.E.Hayden	235½	4½	37 (x)	277	85.0
J.K.Osborne	273½	1½	2	277	98.7
M.F.LaCroix	21¼	¼		22½	96.7
F.G.Rockwell	193	½		193½	99.7
John Trosvig	24			24	100.0
Albert Rock	258½	12	6½	277	93.3

(x). This 37 days includes vacation granted following illness.

NOTE: In compiling the above table, credit was given each man for Sunday work done at the mines, such as shaft plumbings, on the basis of one day's work offsetting one day's vacation.

The following table shows the percentage of time worked by each man for the years 1914 and 1915 and the names arranged in proper sequence:

1914.			1915.		
NAME.	DAYS WORKED.	PERCENTAGE OF TIME WORKED.	NAME.	DAYS WORKED.	PERCENTAGE OF TIME WORKED.
J.F.Hanst	268	97.3%	H.O.Moulton	277	100.0%
Albert Rock	265	96.2	John Trosvig	24	100.0
John Trosvig	207½	94.8	F.G.Rockwell	193	99.7
C.J.Stakel	261	94.7	J.K.Osborne	273½	98.7
H.O.Moulton	258	93.6	C.J.Stakel	271½	98.0
R.J.Chenneour	257½	93.5	M.F.LaCroix	21[illegible]	96.7
M.F.LaCroix	201	93.5	E.L.Derby	261[illegible]	94.4
Arthur Aas	199	90.9	R.J.Chenneour	259½	93.7
E.L.Derby	250	90.8	Albert Rock	258½	93.3
Edward Ham	166	89.9	J.F.Hanst	247½	89.4
J.K.Osborne	247	89.7	J.E.Hayden	235½	85.0
J.E.Hayden	236½	85.8			

NOTE: J.E.Hayden has a low percentage on account of illness.

The following table shows the average percentage of time worked by the engineers employed during the years 1913, 1914 and 1915. The names are arranged in proper sequence and only full time engineers considered:

NAME.	% OF TIME WORKED.
C.J.Stakel	96.5%
H.O.Moulton	96.4
J.K.Osborne	95.5
Albert Rock	94.8
E.L.Derby	94.7
R.J.Chenneour	94.0
J.F.Hanst	92.7
J.E.Hayden	88.5 (x)

(x) Low percentage due to illness.

The following table shows the number of working days lost by each man on account of illness or vacations during the years 1912, 1913, 1914 and 1915:

NAME.	1912. DAYS. VACATION.	1912. DAYS. SICK.	1913. DAYS. VACATION.	1913. DAYS. SICK.	1914. DAYS. VACATION.	1914. DAYS. SICK.	1915. DAYS. VACATION.	1915. DAYS. SICK.
C.J.Stakel	19	0	9	0	14½	0	5½	0
J.F.Hanst	0	0	24	0	2	5½	24½	4¾
C.T.Kriebel		106						
E.C.Weinsheimer	19	1						
R.J.Chenneour	13	0	15	0	16	2	15	2½
H.O.Moulton	8½	0	11½	0	14½	3	0	0
F.G.Rockwell					1	0	½	0
E.G.Sterling	3	1½						
J.K.Osborne	1	2½	2½	2½	25½	3	1½	2
Fred Flink	2½	0						
J.E.Hayden	10½	0	14½	½	17½	21½	4½	37 (x)
M.F.LaCroix	19½	0	20½	14½	14	0	¾	0
E.L.Derby	0	32	1½	1½	25½	0	14	1½
John Trosvig	6¼	0	8½	4½	6	5½	0	0
Albert Rock	3	1½	10	4	2	8½	12	6½
Arthur Aas	9	2	4	2	9½	10½		
W.L.Scanlan	2	0	3½	0				
Edward Ham					18½			

(x). This 37 days includes vacation granted following illness.

The following table shows the number of working days in the past year and the distribution of the department's time for the various properties:

MINES,WATER POWERS,EXPLORATIONS,ETC.	TOTAL DAYS.	% OF TOTAL DAYS.
Angeline mine	65	2.78
Athens mine	130½	5.60
Bunker Hill mine	5½	0.22
Chase mine	18¾	0.85
Crosby mine	6½	0.27
Cliffs Shaft mine	219	9.41
Dexter mine	1	0.04
Gwinn District mines	8¼	0.34
Holmes mine	54	2.31
Imperial mine	2¼	0.10
Jackson mine	77¼	3.31
Lake mine	147¾	6.34
Lucy mine	2	0.08
Lloyd mine	200¾	8.62
Maas mine	128	5.49
Morris mine	98¾	4.24
Negaunee mine	243	10.44
Republic mine	23	0.98
Salisbury mine	47¾	2.52
North Lake explorations	19½	0.82
Spies lease	12¼	0.52
		65.28

MINES, WATER POWERS, EXPLORATIONS, ETC. (CONTINUED).	TOTAL DAYS.	% OF TOTAL DAYS.
		65.28
Canadian Pyrites	3 3/4	0.15
Carbon and Diamond Drill reports	40 1/4	1.73
Miscellaneous Abstracts	94	4.02
Michigan Mineral Land Company	3 1/4	0.13
Republic Iron Company lands	48 1/4	2.55
AuTrain Water Power	2 1/2	0.10
Carp River Water Power	16	0.67
Dead River Water Power	57 1/4	2.44
Section 2, 47-27	27 1/4	1.18
Section 3, 47-27	19 3/4	0.84
Section 4, 47-27	11 1/2	0.49
Section 5, 47-27	18 1/2	0.77
Section 9, 47-27	1/2	0.02
Section 10, 47-27	2 1/4	0.11
Section 11, 47-27	54.	2.30
Section 12, 47-27	56 1/4	2.39
Section 13, 47-27	22 1/4	0.95
Section 14, 47-27	3 1/2	0.15
Section 22, 47-27	6 1/2	0.28
Section 23, 47-27	86 1/2	3.72
Section 24, 47-27	17 1/2	0.75
Section 25, 47-27	1 1/2	0.07
Section 26, 47-27	124 1/4	5.32
Section 27, 47-27	30	1.27
Section 6, 47-26	3	0.12
Section 17, 47-26	23 3/4	1.01
Section 18, 47-26	27 1/2	1.17
Section 19, 47-26	1/2	0.02
		100.00.

It will be noted that the mines requiring most attention are the Cliffs Shaft, Lloyd and Negaunee. The Cliffs Shaft being a hard ore mine, requires the surveying of all contracts, sketching being regarded as too inaccurate. The new system of mining, which consists of opening a tramming level every fifth level and then stoping from raises, entails more work for the Engineering department. Whenever possible surveys are also carried forward permanently on plugs instead of rail points and this again requires more time. The Lloyd mine required more attention than last year because of the development of the Section 6 ore body, where raising and crosscutting is in progress, and the open pit is being stripped. At the Negaunee mine, the number of working places have almost been doubled during the past year. The item "Carbon and Diamond Drill Reports" covers all of Mr. Osborne's time spent on monthly carbon reports, diamond drill inventory and information prepared for Mr. Jopling showing costs of explorations in various districts. That

portion of the table beginning with Section 2, 47-27 and ending with Section 19, 47-26 covers 22.93% of the department's time spent in the cities of Ishpeming and Negaunee and the Tilden district. The surface maps of the two cities were brought up to date, outcrops and geology mapped on Sections 1, 2, 3, 4 and 11, 47-27 and outcrops, geology, culture and topography mapped on Sections 12, 13, 14, 22, 23, 24, 26 and 27, 47-27. Elevations were carried to all survey stations on Sections 12, 13, etc, as enumerated above, and also on Section 25, 47-27 and Section 19, 47-26.

The following table shows the number of days of the department's time spent at the various mines surveyed by the Ishpeming office for the last five days:

EXPLANATION: The 24 days charged to the Bunker Hill mine for 1912 means that either one man spent 24 days, two men spent 12 days, or three men spent 8 days, etc, at that property:

	1911 DAYS.	1912 DAYS.	1913 DAYS.	1914 DAYS.	1915 DAYS.
Angeline mine					65
Athens mine	10	122	190	137	130
Bunker Hill mine	3	24	21	30	5
Chase mine	68	28	62	60	19
Cliffs Shaft mine	389	347	272	301	219
Dexter mine				57	1
Holmes mine					54
Imperial mine	134	45	3	4	2
Jackson mine	60	190	108	11	77
Lucy mine	79	15	42	16	2
Lake mine	182	163	153	140	148
Lloyd mine	175	143	104	128	201
Maas mine	176	205	301	228	128
Moro mine	52	17			
Morris mine	175	226	110	77	99
Negaunee mine	865	752	427	214	243
Salisbury mine	137	137	127	119	48

The following table has been compiled showing the steady decrease in the number of men employed in the Engineering department for the last four years:

1912.		1913.		1914.		1915.	
NAME.	MONTHS.	NAME.	MONTHS.	NAME.	MONTHS.	NAME.	MONTHS.
C.J.Stakel	12	C.J.Stakel	12	C.J.Stakel	12	C.J.Stakel	12
R.D.Skelley	3	H.F.Hanst	12	J.F.Hanst	12	J.F.Hanst	12
J.F.Hanst	12	H.O.Moulton	12	H.O.Moulton	12	H.O.Moulton	12
C.T.Kriebel	7	R.J.Chenneour	12	R.J.Chenneour	12	R.J.Chenneour	12
E.C.Weinsheimer	6	J.K.Osborne	12	J.K.Osborne	12	E.L.Derby	12
R.J.Chenneour	12	W.L.Scanlan	9	J.E.Hayden	12	J.E.Hayden	12
H.O.Moulton	12	J.E.Hayden	12	E.L.Derby	12	J.K.Osborne	12
J.K.Osborne	12	M.F.LaCroix	12	M.F.LaCroix	9	M.F.LaCroix	1
J.E.Hayden	12	E.L.Derby	12	F.G.Rockwell	7	F.G.Rockwell	8
M.F.LaCroix	12	John Trosvig	12	John Trosvig	9½	John Trosvig	1
E.L.Derby	12	Albert Rock	12	Albert Rock	12	Albert Rock	12
E.G.Sterling	12	Edward Ham	7	Edward Ham	8		
Fred Flink	5	Arthur Aas	12	Arthur Aas	9½		
Albert Rock	12						
John Trosvig	12						
Arthur Aas	12						
W.L.Scanlan	8						

From above table the average number of engineers employed per month is as follows:

1912 - 14 5/12
1913 - 12 1/3
1914 - 11 7/12
1915 - 8 5/6.

A detailed description of the work done by each member of the department follows:

C. J. Stakel had general supervision over the office force. The month of January was almost entirely taken up by the annual report, which was finished and taken to the bindery about February 15th. He then devoted almost all of his attention during the following six weeks looking over the three vaults. The one on the main floor had not been systematically gone over for at least four years. The drawers and compartments were rearranged alphabetically as much as possible and still all maps and tracings which are being constantly used were placed so as to be easily accessible. Provision was also made for future explorations and mines. During the course of this work all new drawings were filed and catalogued. A few changes were also made in the basement vaults. During the months of March and April, while Mr. Hayden was sick, he assisted Mr. Rockwell on all the North Lake mines surveys. Mr. Derby and he

also calculated and recorded all of the bench marks established in the Republic mine and along the Michigamme river from the town of Republic to Lake Michigamme. The summer's field work started in the Tilden district on Sections 23 and 26, 47-27 about May 1st. The area on the iron formation was mapped by surveying topography, culture and outcrops. This work was continued until about June 15th when the growing foliage made rapid progress impossible. The division of the mineral rights under Lake Ogden was then taken up and the central thread method finally adopted. During the next two months, Mr. Stakel spent considerable time at the Lake mine with Mr. Osborne making a general resurvey of the sub-levels. The position of the new ventilation raise was spotted on surface and lines given for both raising and sinking crews. Check surveys were also carried into the breasts of the new 4th level main haulage drifts. Mr. Stakel also assisted on the following plumbings, which were done on Sundays during the months of August, September and October:

The Morris mine winze was plumbed three times from the 2nd to the 4th level. "A" and "B" shafts at the Cliffs Shaft mine were plumbed twice from surface to the 15thlevel. Section 16 was plumbed from surface to the 1080' level. In addition to these plumbings, lines were also carried from surface to the 300' level and from surface to the 700' level in the Section 6 shaft at the Lloyd mine. The Angeline new "D" shaft was plumbed from surface to the 4th level. These latter jobs, however, were done on week days.

The surveys for the Dead River Water Power were started the latter part of August. These consisted of laying out the transmission line from the Carp River Maas Mine line and laying out proposed pipe line at the dam site. Mr. Stakel also assisted Mr. Osborne on all the Section 11, 47-27 surveys. The entire South half of this section was surveyed and the outcrops located on the North half. On September 20th, the survey of the Angeline property was started, which took about one and half weeks. The Culture on the N½ of the N½ of Section 15 was mapped and surveys carried underground by plumbing new "D" shaft from surface to the 4th level. During October and November surveys were carried to the Junction Forty and collar of Section 16 shaft.

The Junction Forty was contoured and Section 16 shaft was plumbed and underground surveys carried to the breast of the drift under the above mentioned Forty. The annual report for 1915 was started by taking a few photographs of the buildings under construction, Angeline mine surface and landscape gardening done at the Negaunee and North Lake mines. The mine surface tracings were all posted and photographed. All of the Section 12, 47-27 tracings were then posted. During December, Mr. Stakel also spent a week in connection with the Spies lease. On December 23rd, he left on a vacation to be gone the balance of the year.

J. F. Hanst had charge of the concreting of the Athens shaft. This took up nearly one half of his time. He colored in the 1914 annual report maps of the Crosby and Salisbury mines and the surface maps of the cities of Ishpeming and Negaunee and the North Lake district showing leases, options, mineral rights, etc. A set of point map tracings of the Tilden district was completed and photographed for field use. Mr. Hanst also made a map showing the Iron Development Company's explorations in Iron County for Mr. Prickett. A tracing and a large number of blue prints were prepared for the Arctic Iron Company's law suit. During the month of March, he assisted Mr. Stakel with the vault filing. A map of the Company's lands was prepared showing the lands to be reserved, those that can be sold, water power lands, etc. At intervals of about four months, Mr. Hanst made geological surveys of the Cliffs Shaft mine and then posted the cross-sections and tracings of the various levels. During April and May, when not busy at the Athens shaft, he assisted on the topographical surveys in the Tilden district. He next started mapping the outcrops on the Jackson property. The Geological department had previously attempted to map these exposures, but had considerable difficulty getting the exact location by pacing and compass surveys. For this reason, it was decided to map the exact location of the contacts by transit and stadia. Mr. Hanst was absent during the entire month of July on a vacation. A tracing showing the ownerships along the Dead River transmission line was prepared. He also started

checking up the records in connection with the land offers, but discontinued this when the Angeline mine surface surveys were started. He assisted on all these surveys and then plotted the 50' to the inch maps of the N½ of the N½ of Section 15. The tracings were also completed and photographed and the 200' to the inch map and tracing posted. A map of the Au Train storage basin was made showing the lands acquired, those to be acquired, the outline of the storage basin, and the progress of the lumbering operations. Mr. Hanst finished the contour map of the Junction Forty, which was also traced and photographed. He also made a mounted map and tracing of the Spies lease, showing topography and culture.

H. O. Moulton, who has charge of the surveys in the Cliffs Shaft mine, averaged about ten days a month at this property. The monthly survey takes about five days, the rest of the time being spent giving lines for raises, drifts and drill holes. He assisted Mr. Eaton in preparing figures for the annual ore estimate and also colored in the blue prints of all the levels for the State Tax Commission. Both "A" and "B" shafts were plumbed twice from surface to the 15th level in order to determine the relation between the surface and underground surveys and thereby checking the previous underground plumbings carried down from level to level. Mr. Moulton also did considerable work in the field and office mapping the Company's lands. He finished a tracing of the N½ of the NW¼ of Section 11 and calculated and plotted contour notes taken on Sections 12 and 13, 47-27. These maps were also traced and photographed. He assisted on the surveys of Sections 22, 23, 24 and 26, 47-27 during the spring and fall and also surveyed the outcrops and changes in the fence lines and houses on Sections 2, 3, 4 and 10, 47-27. Mr. Moulton also made the Junction Forty contour surveys, assisted on the Angeline mine surface surveys and has been giving locations for the diamond drill holes at these two properties. The temporary buildings at the Holmes mine were laid out and a contour map made of a portion of the Angeline mine property near the so-called "Happy Hollow", for the proposed development of that ore body. He also ran out the Dead river transmission

line from the Carp river high tension system to the "Hoist" falls. He spent a few days during the year at the Negaunee mine assisting Mr. Chenneour and in the North Lake district assisting Mr. Hayden.

R. J. Chenneour had charge of the engineering work at the Negaunee mine. He averaged about three fourths of his time in connection with that property. The number of contracts in this mine has nearly doubled since the first of the year and the majority of the contracts on the sub-levels are given lines in order to keep the crosscuts parallel, thus resulting in uniform sized pillars for slicing. This requires the engineers making at least one, and sometimes two, trips a week through the working sub-levels. The winze being sunk from the 10th to the 11th level required considerable attention looking after the timbering, the placing of the head sheaves, hoist foundation and pockets. Lines and elevations were chedked monthly in the main haulage drifts being driven on the 9th and 10th levels. The raises going up from the 10th level were lined in from engineers plugs. The Maas and Negaunee annual report maps were colored in and duplicate sets of maps prepared for the State Tax Commission, and the engineering files. He also assisted Mr. Elliott on the yearly ore estimate. He also had charge of the Maas mine development work up until the time the mine started producing ore. This development work was mostly in connection with the sinking of the winze from the 3rd to the 4th level. A new pump was installed on the 3rd level near No.1 shaft, which required his attention. After October 1st, Mr. Chenneour also assisted Mr. Derby on some of the Maas mine surveys. He also did a little work on Sections 17 and 18, 47-26 and drew up a few abstract maps of the Company's lands. In the early part of the year, he also assisted Mr. Moulton on some of the Cliffs Shaft mine surveys.

J. K. Osborne looked after the Lake and Salisbury mines. The Salisbury mine required very little attention, with the exception of the 14th level drift, where lines were given for the tangents and curves. All of the sub-level elevations were changed to sea level and an entire new set of Agent's tracings completed. At the Lake mine, most of the sub-levelx workings were sketched because it was found impossible to keep surveys in them on

account of the crushing of the caps. At intervals of about four months, surveys were carried from the main levels up raises and along the various sub-level drifts in order to correct any errors in plotting due to sketching. Elevations were also taken at frequent intervals on the subs. A check survey was carried from the 4th level down to the 479' sub, which is the ventilation sub-level, and all survey stations were tagged with alumimum markers. On the 4th level, a check survey was also run to the breasts of the two contracts drifting from the North to the South drift in the East loop, which contracts holed shortly before Christmas. Lines were also given, both underground and on surface, for the new ventilation raise put up from the 3rd level. The raise holed as expected. Mr. Osborne also assisted Mr. Brewer for nearly a month making abstract maps. He also prepared tables for Mr. Jopling comparing the footage obtained by the Cleveland-Cliffs Iron Company and outside drill contractors when standpiping and drilling in the Ishpeming, North Lake and Gwinn districts. Some of the underground drill results were tabulated and comparisons were also made between the large and small drilling bits used at the Jackson property. Monthly carbon reports were furnished Mr. Shaddick and an inventory made of the diamond drill equipment. Mr. Osborne made a survey of the South half of Section 11 and mapped the outcrops on the North half of the section. In the Tilden district, he assisted on some of the contour surveys and ran levels over the majority of the coordinate lines on Sections 22, 23, 24, 26 and 27, 47-27. All of these levels checked satisfactorily.

J. E. Hayden had charge of the mines in the North Lake district, being assisted part of the time by Mr. Rockwell. The Chase mine needed but little attention as this property was closed down early in the year. At the Morris mine, most attention was centered on the 4th level. The winze from the 2nd to the 4th level was plumbed three times and lines given twice a month to the contract drifting Southwest. The Lloyd mine required a great deal of surveying. Check surveys were run on both the 3rd and 4th levels from the main shaft East to the Section 6 ore body.

The ventilation and timber shaft on Section 6 holed during April. The 3rd level East holed into 3rd level drift being driven from the main Lloyd shaft. This drift in turn also holed to the ventilation shaft. Lines were given to all the crosscuts on the 3rd level East and all the raises in these crosscuts were lined up. The drifts on the sub-level 100' above the 3rd level East were surveyed and lines given for heading towards the ventilation shaft, which was also holed shortly before Christmas. Some of the crosscuts were sampled and Mr. Hayden also assisted Mr. LaCroix on all the geological surveys in these mines. Mr. Hayden also looked after the new construction work in connection with the Section 6 engine house and pole line. The blue prints of the North Lake district mines were colored in for the State Tax Commission, a duplicate set colored in for the engineering files and Mr. Graff was assisted with the annual ore estimate. The surveys of the area to be stripped over the Section 6 ore body were started during July. The approach and pit proper were laid out in 27' squares and contoured. Slope stakes were set and readings taken on the ledge as it was exposed by the steam shovel. Monthly estimates of the yardage excavated were furnished the contractor. Mr. Hayden also gave locations for drill holes when required on Sections 2 and 3, 47-28 and Section 6, 47-27. He also staked out the locations for the new houses in the North Lake townsite. During the month of March, he devoted his entire time to the Jackson mine abstract maps until he was taken sick on March 13th. He returned to the office on May 1st and finished these abstract maps about May 15th. Near the close of the year, he assisted on the surveys at the Spies lease.

E. L. Derby occupied himself mostly with the maps of the Republic mine and the Republic Iron Company's lands during the first four months of the year. During January, he finished making the Republic mine annual report tracings and colored in the white prints. He next finished the mounted map and tracing of Section 7, 46-29. He also drew up a number of schemes for the proposed division of the mineral rights under Smith's Bay. He next finished the 50' to the inch mounted maps of Sections 7 and 18, 46-29. A

map and profile were prepared showing the proposed diversion of Partridge Brook at Negaunee into the Carp river water power system. He also had charge of the concreting of one section of the Athens shaft. During the month of May, he assisted on the Tilden district surveys. Calculations were also made for the Maas-Negaunee boundary lines and the abstract maps of these two properties posted up to date. This work required about a month. The Dead river water power surveys were started during July. The section line between Sections 9 and 16 was run out and a profile of the river made along this section line. He also made all of the profile drawings for the transmission line. A resurvey of the buildings and fence lines in the City of Negaunee was then started in order to bring our maps up to date. A large number of the iron pin stations in the City of Negaunee were reset in concrete. Mr. Derby took charge of the Maas mine surveys during September. The regular mine and geological surveys were made monthly and considerable extra time spent giving lines for raises and crosscuts. The only important development work in this mine was on the 4th level. During the last four months of the year, he also assisted Mr. Chenneour on practically all of the Negaunee mine surveys.

M. F. LaCroix was employed in this department during the month of January only. He looked after the Lake mine annual report, coloring in the white prints. The State Tax Commission blue prints were prepared and the ore estimate made with Mr. Eaton. He also assisted in finishing the Section 5, 47-27 contour maps.

F. G. Rockwell was employed at the Ishpeming office for eight months, after which he was transferred to the Gwinn district. He assisted Mr. Hayden on all the North Lake district surveys and was responsible for all the surveys for six weeks while Mr. Hayden was sick. Beginning with March 1st, he was also given full charge of the Morris mine surveying. At the Lloyd mine, he ran a check survey on both the 3rd and 4th levels from the main shaft East to the Section 6 ore body. He plotted the contours and finished the tracings of the 50' to the inch maps of the SW¼ of Section

13, 47-27. He assisted Mr. Moulton by plotting some of the Section 12, 47-27 contour notes. During the month of May, he spent two and one half weeks in the Tilden district with the crew mapping the outcrops and topography on Section 26. During the month of July, while Mr. Hanst was on his vacation, he had charge of the concrete work at the Athens shaft. He assisted on the Cliffs Shaft mine plumbings and ran the surface check survey to the concreted iron pins at the collars of "A" and "B" shafts. Mr. Rockwell also assisted on the Dead river water power surveys during the month of September.

John Trosvig was reinstated in this department on December 1st. With the exception of a little time spent at the Cliffs Shaft and Negaunee mines, assisting Messrs. Moulton and Chenneour, he directed all of his attention to the plotting and calculating of the contour notes taken in the Tilden district on Section 26.

Albert Rock was employed as a helper during the entire year. During the months of January, part of February and December, he was kept busy making annual report prints. During the early spring months, he assisted on the underground surveys at various mines. The rest of the year he divided his time assisting the engineers on the surface and mine surveys.

Charles Feller was employed by the department since May 1st. He has been assisting the engineers as an axeman and helper.

Two other axemen were hired while the surveys in the Tilden district were in progress.

MINE SURVEYS, MAPPING AND CALCULATIONS.

ANGELINE MINE.

This property was bought by the Company on September 15th. Surface surveys were started immediately. Seven concreted iron pins were set, beginning at a point near the office and ending near the head frame at the so-called "Happy Hollow" location. Four more concreted stations were set in the mine location near the Salisbury mine. A line of iron pins was established along the old railway grade, beginning at the timber shaft and

running Easterly to the Eastern limits of Section 15. Another line of pins was established along the top of the hill between the Angeline and Salisbury properties, extending from the Salisbury mine coal dock to the East line of Section 15. Still another set of iron pins was set in the mine location at the Southwest corner of the property. From these various survey stations the culture was mapped. Elevations were also carried to the concreted stations and iron pins along the railway grade. Fifty feet to the inch mounted maps of the N½ of the N½ of Section 15 were made, traced and photographed. The 200' to the inch map was also posted. Locations were given for diamond drill holes when requested by the Geological department. A contour map was also prepared for Mr. Eaton showing the area overlying the ore body at "Happy Hollow". The Lake Angeline triangulation system was tied into the Cleveland-Cliffs Iron Company's surveys at eight different places. By calculation the difference in course between the Cleveland-Cliffs Iron Company's Maas coordinate system and the Pittsburg & Lake Angeline Iron Company's system was found to be only 0°4'16". Underground surveys were also carried down to the 4th level by plumbing new "D" shaft from surface. A survey was then carried from this shaft to the bottom of a raise leading up into sub-levels in the Middle Deposit. Four old Lake Angeline plugs were found and read into on the 4th level. The underground survey was then continued up the raise and via three of the sub-levels to the foot of the vertical timber raise. A wire was hung in the raise and checked from both the surface and underground survey stations. The result was a discrepancy of less than a half foot for coordinates.

ATHENS MINE.

At this property, where sinking is in progress, Mr. Hanst, assisted by Mr. Derby and Mr. Rockwell, has been in charge of the concrete work in the shaft.

CHASE MINE.

The usual monthly surveys and reports were made at this property. The annual report was finished during January and copies of the level maps furnished the State Tax Commission.

CROSBY MINE.

The annual report tracings were photographed and white prints colored in.

CLIFFS SHAFT MINE.

The routine engineering, which consists of monthly surveys, giving lines for drifts, raises and drill holes, was attended to. The geological surveys were made at intervals of four months and the main level maps and cross-sections posted. The estimate mounted maps were posted and the yearly ore estimate made for Mr. Eaton. A set of maps showing the ore available on all the main levels was furnished the State Tax Commission. During February, check surveys were made on the 5th, 6th, 7th, 8th, 9th, 10th and 15th levels "A" shaft and the 1st, 6th, 7th, 8th, 9th, 10th and 15th levels "B" shaft. These surveys were carried through drifts opened up during the year 1914 and their purpose was to check the monthly surveys. On the surface of this property, four concreted iron pins were set between "A" and "B" shafts. Three careful surveys were carried to these pins from triangulation station "B" shaft, upon which all of the City of Ishpeming surveys are based. "A" and "B" shafts were plumbed twice from surface to the 15th level. The calculations of these surveys were based on the concreted corners and the result was that the 15th level at "B" shaft checked fairly well with the surface, but the "A" shaft surveys did not check by 0.75. Additional plumbings and calculations will have to be made before the exact relation between the surface and 15th level surveys can be determined. The majority of the survey points in this mine are now on wooden plugs, the miners having been instructed to drill a plug hole in the back whenever possible at all turns in the drifts.

GWINN DISTRICT MINES.

The only work done by this department is in connection with the annual report. The maps were photographed and printed and then sent to Gwinn to be finished.

HOLMES MINE.

A survey was carried from the Cliffs Shaft property across the Junction Forty to the collar of Section 16 shaft. All of the corners of the above forty were read into again, except the Northwest corner, which is buried underneath Washington street. The previous coordinates of these corners were checked very closely by this second survey. Five concreted iron pins were established on the forty proper and three more near the collar of Section 16 shaft. The entire forty was resurveyed and contoured and locations given for the standpipes and drill holes. A tracing was made of the proposed lay out of the railway tracks, buildings, etc, near the proposed shaft site. Section 16 shaft was plumbed twice on Sunday, October 10th, from surface to the 1080' level, and two surveys run from the shaft to the breast of the drift under the Junction Forty. The Lake Superior Iron Company's engineers survey stations were used whenever possible on the above surveys. The exact check between the Cleveland-Cliffs Iron Company and the Lake Superior Iron Company surveys have not been calculated but the difference in the plotting of the same drifts on the maps is inappreciable.

IMPERIAL MINE.

Figures were prepared showing the present value of the property in case the fee was purchased and an estimate made with reference to reopening the mine.

JACKSON MINE.

All of the outcrops on Section 1 were mapped and plotted. The South Jackson pit was surveyed at the close of the shipping season. The majority of the iron pins on this section have been reset in concrete.

LAKE MINE.

The monthly surveys and reports required about three days a month. The annual report work, the State Tax Commission maps and annual ore estimate were finished during January. Lines were given for the 3rd level ventilation raise and its location staked out on surface. The raise holed as expected. During the months of July and August, nearly all of the workings places on the sub-levels were surveyed in order to check the position of the drifts on our maps, as determined by the monthly Brunton sketching surveys. It is impossible to make accurate monthly surveys without using considerable time because the timbers on the sub-levels are constantly crushing, thereby damaging the survey stations. The 480' ventilation sub-level was resurveyed and the stations tagged. On the 4th level, a check survey was also carried from the main rock drift East and Southeast to the breasts of contracts Nos.36 and 68, which drove the new motor drift, splitting up the East loop. Elevations were also carried along the various sub-levels and rail readings taken about 100' apart. An entirely new set of Lake mine tracings was made for Mr. Eaton. A detailed map on a scale of 1" equals 8' of the area around No.4 shaft, showing the buildings, trestles, tracks, etc, was made, to be used in planning a new location for the ore crushing plant.

LLOYD MINE.

The Lloyd mine, being in progress of development, required a great deal of attention. The lay out of the drifts and raises for the Section 6 ore body was drawn up. The 3rd level, which was also opened up from raises at the East end, was checked with regard to coordinates and elevations and lines given to No,24 contract drifting West in order to hole into contract No.10 drifting East from the main shaft. A check survey was also carried from this shaft East to the breast of the 3rd level motor drift. The ventilation raise holed into the shaft sunk from surface, the Southwest corner of the raise cribbing and the Southwest corner of the shaft timbering agreeing within 3". After the 300' level in this shaft was opened up, plumb lines were suspended from surface and plugs