THE CLEVELAND - CLIFFS IRON COMPANY

Ore Mining Department

ANNUAL REPORT OF GENERAL MANAGER

For Year Ending December 31, 1946

#2017

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THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1946

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Ishpeming, Michigan
March 4th, 1947

MAR 12 1947

Mr. E. B. Greene, President,
1460 Union Commerce Bld.
Cleveland, Ohio

Dear Sir:-

The report which follows is a summary of the Mining Department operations for 1946. As is customary, all Superintendents and Heads of Departments will submit detailed reports for their own mines and departments.

Maps and estimates for the Michigan Mines for the State Appraiser were sent to Cleveland to be relayed to the Lansing office of the State Tax Commission. Ore estimates for the Minnesota mines are reviewed by the Minnesota taxing authorities at various times during the year by appointment.

The year 1946 was marked by the first all out strike of all production employees of all iron ore properties in the Lake Superior Region since 1895. The strike ran from February 8th to May 22nd.

ADMINISTRATIVE STAFF

There were few changes in the supervisory staff. James Westwater was transferred from the Princeton Mine to the Mather Mine with the idea of eventually putting him in charge of the Section 1,47-27 development program. We shifted four mining captains late in the year. Captain Wilfred Mallett was transferred from the Athens to the Lloyd, Capt. Tom Tippett from the Lloyd to the Negaunee, Capt. Wilfred Tippett from the Negaunee to the Cambria Jackson, and Captain John Tregoning from the Cambria Jackson to the Athens. Hugo Korpinen was taken from the Engineering Department and made an Operating Engineer to study and plan the sub level caving and block caving systems of mining. Most of his time was spent at the Athens Mine. A. T. Soder was put in charge of the Atkins Mine operation on the eastern Mesaba Range. William E. Bertholf, a geologist with a doctor's degree from the University of Chicago, joined the Geological Department on November 1st.

Ernest Keast, Asst. Chief Mechanical Engineer retired on May 1st due to age and poor health. He has, however, been retained as a consultant for Negaunee Mine Company Section 1 shaft and surface layout. His regular work is divided between Folke Johnson and Wilfred Tousignant.

ECONOMIES

Because of the increasing cost of supplies and higher wage scale in effect in 1946, every department was urged to cut costs by increasing efficiency. Many cost items the Mining Department had carried for years were eliminated. We closed the North Lake and Gwinn Association Club Houses, the latter being turned over to the Forsyth Township School District by W. G. Mather. We revised and

raised certain rates at the Ishpeming Hospital. Donations for Firemen's Tournaments, gifts to bowling and baseball teams, garden prizes, etc., were eliminated. We stopped the payment of half the Village Marshal's salary at Gwinn. We eliminated the subsidy for the Negrinelli bus service. Most of the day shift policemen were laid off. In the main office, six clerks doing special work were laid off with Dan Sadler's approval. The Central Laboratory crew was trimmed nearly one third by a change in the method of determining the chemical analysis of the shipments to the docks. In 1945 the average monthly cost of running the Laboratory for the last seven months of the year, which we call the seven shipping months, ran $11,335.00. The comparative cost for 1946, in spite of the wage increase and the increasing cost of chemicals, was reduced to $8,670.00 per month.

Quite a number of men who had reached retirement age were laid off and no replacements hired.

Changes in underground mining methods contributed to lower costs. In the Mesaba open pits the moving of the Holman washing plant and change over from truck haulage to conveyor belt haulage will further reduce costs.

LABOR SUPPLY

The labor supply was tight early in the year. Because of the strike threat returning service men did not seek employment as if they were hired they would lose their employment benefits for the duration of the strike. As a result very few new men were hired before June 1st.

Because of the closing of the Princeton and the depleting ore reserves at the Negaunee and Lloyd, we finished the year with about the same number of men employed in the Michigan underground mines. This is clearly shown by the following tabulation:

COMPARISON OF EMPLOYMENT

Underground Mines	1st Half Jan. 1946	Last Half Dec. 1946
Athens	328	350
Cliffs Shaft	409	430
Cambria Jackson	181	208
Gen.Storehouse and Shops	146	128
Lloyd	206	159
Maas	359	389
Mather	219	339
Negaunee	285	271
Princeton	146	5
Spies	81	98
Total	2360	2377

	Oct.1945	Oct. 1946
Tilden	32	28

On the Mesaba Range, because of seasonal operations, employment for the month of October 1945 and October 1946 are compared:

Open Pits-Minnesota	October 1945	October 1946
Atkins	-	72
Canisteo	122	159
Holman	214	253
Hill Trumbull	164	192
Total	500	676

In January, in Marquette County, 159 returned veterans were employed. By December this figure had increased to 439.

PRODUCTION

Production from all our mines was cut by the strike. The figures for the past four years follow:

Year	Michigan Mines	Minnesota Mines	Total
1943	3,953,526*	2,541,933	6,495,459
1944	3,496,534*	2,400,481	5,897,015
1945	3,542,802*	2,376,286	5,919,088
1946	2,702,751*	1,678,941	4,381,692

* These figures do not include previous year's stockpile overrun. The overrun tonnage is included if the stocked ore is loaded out in the same year.

The Princeton Mine on the Marquette Range was abandoned in 1946.

To show how the underground mines have increased their efficiency a comparison of the tons per man per day, including both surface and underground and supervisory force for the past three years is shown:

	TOTAL TONS PER MAN PER DAY		
	1946	1945	1944
Athens	5.04	4.86	4.43
Cliffs Shaft	4.40	4.55	4.29
Cambria Jackson	6.94	6.05	5.55
Lloyd	6.31	5.40	5.19
Maas	5.86	5.29	5.10
Mather	6.71	-	-
Negaunee	7.01	7.62	7.46

The Cliffs Shaft and Negaunee Mines are the only two properties showing lower tons per man for 1946. At the Cliffs Shaft the explanation lies in the fact that due to a large production during the war years development work fell far behind and we are now making an extra effort to provide a proper balance between the developing and depleting contracts. It has been a long established rule at the

Cliffs Shaft Mine unless at least half of all the contract miners in the Cliffs Shaft are on development program, ore will be mined faster than it can be put in sight. At the Negaunee Mine the restricted ore reserves are compelling us to withdraw mining gangs, which is naturally causing a loss in production and upsetting the normal balance of producers and company account men. As production falls off, the total tons per man per day decreases out of proportion.

ORE RESERVES

MICHIGAN MINES

	12-31-45	12-31-46	Increase Decrease
Standard Ores	21,955,914	21,772,280	183,634
High Sulphur Ores	5,983,798	6,123,395	139,597

Decrease in standard ore tonnage due to not including 227,222 tons below the 8th Level Lloyd Mine. Also omitted from the 1946 estimate is approximately half a million tons of Princeton Mine ore. Mines showing increases in reserves are the Cambria Jackson, Cliffs Shaft, Maas, Mather and Spies properties. Decreases occurred at the Athens, Lloyd and Negaunee Mines.

YEAR END FIGURES FOR MESABA RANGE MINES

	12-31-45	12-31-46	Increase Decrease
Atkins		1,544,071	1,544,071
Canisteo	5,535,714	7,005,000	1,469,286
Hill Trumbull	2,803,876	2,551,000	252,876
Holman Cliffs	8,686,911	8,407,887	279,024

The Canisteo shows a very healthy increase which is very gratifying since we have purchased that property.

SAFETY DEPARTMENT

The year 1946 was the first in the history of the Company (except 1932 when all mines were closed most of the year) in which we had no fatality. The last fatal accident occurred on March 26, 1945. Our severity rating was the lowest in years. Last year (1945) our record was good. The record for 1946 was still better.

FATAL ACCIDENT RECORD

Year	Number Men Employed	Number of Fatalities	Fatality Rate
1901-1905	7,729*	41	5.30
1906-1910	13,028	66	5.06
1911-1915	13,332	35	2,70
1916-1920	18,348	43	2.36
1921-1925	12,282	20	1.61
1926-1930	10,438	72	6.90
1931-1935	5,298	11	2.05
1936-1940	12,691	12	0.94
1941	3,570	5	1.40
1942	3,562	2	0.56
1943	3,609	4	1.11
1944	3,584	3	0.84
1945	3,078	1	0.32
1946	2,791	0	0.00

The following table indicating number of days worked per fatality and ore produced per fatality provides interesting reading:

NUMBER OF MAN SHIFTS WORKED & TONS OF ORE PRODUCED PER FATALITY

Year	Number of Fatalities	Number man days worked per fatality	Number tons of ore mined per fatality
1931	3	165,137	529,680
1932	-	189,000	486,750
1933	2	94,689	398,357
1934	4	80,477	451,046
1935	2	196,883	1,136,215
1936	2	283,945	1,850,898
1937	1	765,702	5,216,879
1938	3	163,434	385,954
1939	1	564,433	3,713,389
1940	5	142,878	1,156,387
1941	5	182,340	1,456,528
1942	2	512,356	3,808,258
1943	4	269,351	1,624,315
1944	3	331,090	1,995,787
1945	1	915,666	5,970,577
1946	0	747,979*	4,416,253**
16 year average	2.375	272,685	1,689,249

* Man shifts worked.
** Amount of ore mined.

FREQUENCY RATE

Year	Number man days worked	Number non-fatal accidents	Fatalities	Frequency Rate
1943	1,077,402	171	4	20.30
1944	993,272	121	3	15.61
1945	915,666	107	1	14.74
1946	747,079	101	0	16.899

The rate for 1946 compared with 1944 and 1945 seems high but our rating is about the average for the industry. Our severity rates, which are shown in another tabulation that follows, are lower than the average for the industry, which indicates we are giving our employees more supervision and protection than the average employer. The frequency rate is all out of proportion with our severity record, which indicates very clearly we are reporting more slight accidents than most of the other employers in the Lake Superior Country.

SEVERITY RATE

Year	Non-fatal days lost	Days lost due to fatalities	Severity Rate
1943	10,355	24,000*	3.986
1944	7,759	18,000	3.242
1945	7,624	6,000	1,860
1946	7,994	0	1,337

* Since 1942 the National Safety Council and the U. S. Bureau of Mines methods for determining ratings, used 6,000 days lost for each fatality.

Another comparison of interest is taken from available statistics of the National Safety Council:

COMPARISON OF FREQUENCY-SEVERITY RATINGS
Taken from available statistics of the National Safety Council

	Frequency	Severity
1945 National rating - all mining	49.47	9.01
1945 National rating - underground metal mining	26.20	6.27
1945 National rating - open cut metal mining	17.11	3.35
1945 Lake Superior District - all mines	21.49	5.04
1946 C.C.I. compensable accidents	16.90	1.34
1946 C.C.I. all accidents	37.81	1.388
1946 C.C.I. open cut mining	24.43	2.708
1946 C.C.I. top slicing	50.10	1.265
1946 C.C.I. sub level caving	52.89	1.470
1946 C.C.I. stoping	45.27	1.34

LABOR MATTERS

Strike

The strike commencing February 8, 1946 at all of our properties, was general in all underground mines and open pits in the entire Lake Superior area. The strike called by the United Steelworkers of America, CIO, was part of the union's national policy to obtain a wage increase of 25¢ per hour.

The calling of the strike was a breach of contract between the Union and the Company. The Company made no commitments with the union relative to doing maintenance work during the strike. If we had the strike might have been considered an agreed walkout. The Company took the position every employee had the right to work if he chose and the company should not lock out men who desired to work as the price of obtaining an agreement from the union that it would refrain from intimidating and coercing maintenance men from doing the

necessary maintenance work to safeguard the company's properties, Mass picketing, in many cases by persons never employed by our company, and intimidation incited by an influx of outside union leaders and goons, led to the obtaining by the company of a temporary Circuit Court injunction prohibiting union members from unlawful picketing and interfering with the company's mining operations, particularly maintenance work. More or less disorder, tipping of cars, tire slashing, picketing of homes, breaking windows, etc., continued in spite of the injunction.

On March 21st the company notified the union in writing the labor contract was terminated by virtue of the breach of contract by the union. Our employees were notified the mines would operate upon their return to work and we agreed to pay an increase of 10¢ per hour subject to any necessary government approval.

The next day large numbers, in the aggregate about 25%, of the employees of the Mather, Cliffs Shaft, Athens, Maas and Negaunee Mines returned to work. At the Mather about three quarters of the total force reported.

Then, as already stated, strikers led by goons imported from outside the State, held mass demonstrations at various mines, concentrating largely, however, at the Mather.

By Wednesday, March 27th, it was evident the back to work movement was sagging, due entirely to lack of protection by the Sheriff's department. Although State Police were also on the scene, they took the position they did not have the authority to enforce injunctions and were permitted only to make arrests in case the Sheriff called upon them for aid, and that the State Police can only function in case violence occurs. However, the mere fact the State Police are on the job always has a salutary effect on any crowd.

The State Labor Mediation Board also tried to intervene on March 27th. Robert Lomasney of Detroit, a member of the Labor Mediation Board, after contacting the Union and Company officials, made no headway in settling any dispute.

On Friday, March 29th, at a public meeting in The Mather Inn, Company spokesmen explained the position of the Company and stressed the bad competitive position of underground mines compared with open pits. On April 1st the CIO-USA filed formal charges against the company claiming unfair labor practices.

In the meantime, some of the Mather Mine employees continued to report for work, having to run the gauntlet each day because a group of strikers continued illegal picketing.

On April 8th the Company cited forty-one union members for violating the injunction, charging them with violence and the defendants were ordered by the Circuit Judge to appear in court.

On April 10th the Union officials refused to take part in a strike conciliation conference requested by James Greenfield, Michigan State conciliator and John Luecke, conciliator for the U.S.Department of Labor.

About the middle of April two conferences were held with Phillip Murray, President of the CIO at his request. On April 30th and early in May, special sessions of the Circuit Court convened to hear the cases of the forty-one men cited for violence. After the first day the trial was postponed. On May 13th the National Labor Relations Board started its hearings in Negaunee on unfair labor practices.

In the meantime, officials of our company and the union representatives were holding conferences which finally resulted in dismissing all of the Circuit Court cases and the union agreed to withdraw the charge of unfair labor practices. After 15 weeks the strike ended on May 22nd, the company granting a wage increase of 18½¢ per hour and in addition on the Mesaba Range 9¼¢ per hour increase retroactive to January 1st, 1946. The above basis of settlement was general for all mining companies in the Lake Superior District. The underground mines resumed production shortly afterwards. Fortunately, because of the continued loyalty of our supervisory staff, all of our underground mines with the exception of the Princeton, were able to resume operations immediately.

On the Mesaba Range operations ceased on February 8th and from then on to the end of the strike period there were no public demonstrations. We had no back to work movement in Minnesota. Because of the strike, mining operations were delayed considerably. The Canisteo and Holman resumed production of ore on June 24th but the Hill Trumbull did not produce any ore until July 2nd.

ELECTRIC POWER

The electric power situation became critical in July of 1946. We entered the year with an estimated 20,502,000 KWH in storage, which is less than 50% of our storage capacity. Precipitation during the year was the lowest that has been experienced during the past sixteen years, and as a result the run-off was below normal so our water power plants were able to produce only about three quarters of the power requirements. It was necessary for the Cliffs Power & Light Company to purchase approximately 20,500,000 KWH to supply its customers. In spite of these heavy purchases from the Paper Mill and Wisconsin Michigan Power Company, at the end of the year we had only approximately 10,525,000 KWH in storage. This represents almost exactly one quarter of our storage capacity.

We were also forced, under the circumstances, to assume a portion of the load in the City of Marquette, which further aggravated the power situation. On the date of this report, we have just about enough storage left, together with purchased power, to run our operations until April 1st. We will have to have an early breakup and get considerable runoff after the middle of March in order to prevent considerable loss of production because of shortage of power.

There isn't the slightest doubt but what the Cliffs Power & Light Co. will have to make some arrangements for getting additional power very promptly in order to prevent a possible curtailment of operations in the near future. While it is true that the Princeton Mine is closed and the Lloyd may be closed by the end of 1947 and we are quite sure the Mary Charlotte will suspend operations about April 1st, nevertheless the increasing load from the Mather, the opening up

of "B" shaft, Mather Mine, the increasing load at the Maas,Cambria Jackson and Athens, and also the probable expansion and bringing into production of properties by Jones & Laughlin, makes it absolutely necessary the Cliffs Power & Light Company get some other source of power. We have either to make a firm commitment to get from 8,000 to 10,000 KWH from the Wisconsin Michigan Power Company or build a steam generating plant or possibly consider the purchase of diesel powered equipment for generating additional power.

Yours very truly

Manager

CJS:DP

THE CLEVELAND-CLIFFS IRON COMPANY
MINING DEPARTMENT
COMPARATIVE FIGURES FOR 1946 AND 1945 OF THE SEVEN PRINCIPLE PRODUCING MINES
YEAR 1946

MINE	PRODUCTION	COST OF PRODUCTION PER TON	COST OF PRODUCTION AMOUNT	TOTAL COST PER TON	TOTAL COST AMOUNT	IDLE EXPENSE A/C MINE STRIKE
Athens	367,361	2.811	1,032,758.37	3.248	1,193,082.48	98,611.32
Cliff Shaft	401,939	3.051	1,226,072.33	3.485	1,400,491.65	133,652.58
Cambria-Jackson.	296,660	2.240	664,579.50	2.501	741,846.00	67,351.60
Lloyd	247,853	2.244	556,296.35	2.526	626,077.50	51,253.44
Maas	476,348	2.596	1,236,566.24	3.046	1,451,132.64	128,114.23
Mather	339,433	2.484	843,446.90	3.017	1,024,080.72	101,323.57
Negaunee	416,021	2.063	858,410.51	2.311	961,528.56	97,436.54
Total	2,545,615	2.521	6,418,130.20	2.906	7,398,239.55	677,743.28
			YEAR 1945			
Athens	438,427	2.589	1,135,286.97	3.070	1,345,800.22	
Cliff Shaft	550,169	2.665	1,466,927.65	3.095	1,703,184.88	
Cambria-Jackson.	315,514	2.201	694,576.84	2.475	781,025.40	
Lloyd	326,633	2.323	758,916.85	2.632	859,616.55	
Maas	558,633	2.523	1,409,368.60	3.034	1,695,161.36	
Negaunee	654,447	1,786	1,169,012.21	2.042	1,336,189.85	
Princeton	269,041	2.116	569,429.10	3.917	1,053,935.60	
Total	3,112,864	2.314	7,203,518.22	2.819	8,774,913.86	
1946						
Decrease in Product	567,249					
Increase in Cost		.207		.087		
Percent	18.2%	8.9%		3.1%		

NOTE: The mines were idle from February 8th to May 22nd 1946 due to work stoppage account of Union strike.
Wages were increased $18\frac{1}{2}¢$ per hour effective May 22nd 1946 or approximately 19.6%.
Idle expense due to strike period not included in operating costs.

JSM:RN
3/4/47
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THE CLEVELAND-CLIFFS IRON COMPANY
MINING DEPARTMENT
A COMPARISON OF MINING DEPARTMENT MICHIGAN ASSESSED VALUATIONS AND TOTAL TAXES PAID FROM YEAR 1929

YEAR	THE C.C.I.CO.	THE NEGAUNEE MINE CO.	THE ATHENS IRON MINING	THE C.P.&LCO.	TOTAL FOUR COMPANIES		CHANGES FROM PREVIOUS YEAR
			ASSESSED VALUATION				
1929 -	$13,291,521	5,284,600	2,586,500	1,318,198	22,480,819		
1930 -	14,169,590	4,884,400	2,436,500	1,370,445	22,860,935	I	380,116
1931 -	13,867,696	4,635,700	2,536,500	1,539,428	22,579,324	I	218,389
1932 -	12,815,645	4,185,700	2,226,500	1,447,936	20,715,781	D	1,863,543
1933 -	9,850,359	3,554,400	2,036,500	1,419,565	16,860,824	D	3,654,957
1934 -	10,002,373	3,196,400	2,077,800	1,418,887	16,695,460	D	165,364
1935 -	10,062,288	3,057,770	1,929,520	1,424,711	16,474,289	D	221,171
1936 -	10,263,100	3,107,500	1,929,520	1,424,281	16,724,401	I	250,112
1937 -	11,589,306	3,350,000	2,242,900	1,442,555	18,624,761	I	1,900,360
1938 -	12,959,542	3,124,100	2,532,900	1,447,843	20,064,385	I	1,439,624
1939 -	13,090,541	3,267,300	2,683,400	1,981,982	21,023,223	I	958,838
1940 -	12,185,132	3,692,700	2,683,400	2,003,335	20,564,567	D	458,656
1941 -	11,202,237	4,644,430	2,683,400	2,004,379	20,534,446	D	30,121
1942 -	10,628,886	5,461,800	2,759,000	2,016,245	20,865,931	I	331,485
1943 -	11,936,427	5,418,800	2,785,300	2,134,715	22,275,242	I	1,409,311
1944 -	12,326,490	5,022,010	2,868,550	2,134,755	22,351,805	I	76,563
1945 -	11,949,265	4,809,060	2,446,740	2,135,750	21,340,815	D	1,010,990
1946 -	11,423,395	4,170,610	2,327,690	2,136,050	20,957,745	D	383,070
			TAXES PAID				
1929 -	$476,740.79	199,695.33	97,739.13	55,233.01	829,398.26		
1930 -	522,901.50	190,689.79	95,122.50	61,352.11	870,064.90	I	40,666.64
1931 -	507,175.34	183,218.38	100,251.06	65,344.18	855,988.96	D	14,075.95
1932 -	377,700.32	120,527.71	65,264.22	46,897.77	610,390.02	D	245,598.94
1933 -	261,765.08	99,599.60	57,065.71	36,067.26	454,497.65	D	155,892.37
1934 -	267,327.80	86,527.53	56,246.84	31,256.06	441,358.23	D	13,139.42
1935 -	279,734.41	95,226.14	60,089.81	29,817.75	464,868.11	I	23,509.88
1936 -	302,207.99	107,061.43	66,447.06	30,066.37	505,782.85	I	40,914.74
1937 -	345,790.20	120,097.50	80,366.44	30,024.80	576,278.94	I	70,496.09
1938 -	415,719.34	118,534.83	96,103.47	30,227.17	660,584.81	I	84,305.87
1939 -	415,979.65	120,806.75	99,217.45	37,997.17	674,001.02	I	13,416.21
1940 -	376,744.89	130,696.88	95,075.43	39,698.46	642.215.63	D	31,785.39
1941 -	340,282.83	156,845.98	90,003.76	39,846.19	626,978.76	D	15,236.87
1942 -	321,091.31	182,845.08	91,057.97	37,686.66	632,681.02	I	5,702.26
1943 -	380,652.40	202,371.63	107,251.69	40,623.07	730,898.79	I	98,217.77
1944 -	436,214.77	200,703.60	121,015.20	40,577.13	798,510.70	I	67,611.91
1945 -	425,599.58	191,565.47	104,255.07	40,964.14	762,384.26	D	36,126.44
1946 -	417,575.92	168,599.05	103,779.44	43,785.56	733,739.97	D	28,644.29

NOTES:- The 15 Mill Tax Amendment went into effect in year 1933.

The Michigan State Sales Tax became effective July 1933.

The 1933 drop in CCICo. due to Inland Steel Co. taking over Morris Mine.

HJC:MVH
1-23-48

STATEMENT SHOWING COMPARATIVE COST FOR ALL EXPLOSIVES USED AT HARD ORE MINES

	1943	1944	1945	1946
PRODUCT - Tons	634,628	587,051	550,169	401,939
POWDER				
Pounds - Gelamite "2X"	625,100	585,750	523,450	360,550
60% Gelatine	11,000		350	7,550
Total Pounds Powder	636,100	585,750	523,800	368,100
Total Cost	73,151.25	67,367.00	60,549.00	45,329.42
Fuse - Feet	1,029,300	836,561	791,194	561,500
Caps - Number	154,000	136,500	124,160	86,865
Duplex Shot Wire	48,710	26,480	7,760	11,115
Electric Caps	14,224	15,498	12,358	23,500
Fuse Lighters	47,500	35,000	35,000	347
Connecting Wire		637	637	11,900
Powder Bags	15,000	35,000	11,700	8,300
Total Cost-Fuse, Caps, Etc..	10,729.02	9,562.74	8,323.06	6,584.20
Total Cost-All Explosives ..	83,880.27	76,929.74	68,872.06	51,913.62
Average Price per Pound-Powder ..	.1150	.1150	.1150	.1231
Cost per ton - Powder	.1152	.1148	.1100	.1127
Cost per ton - Fuse, etc.	.0169	.0163	.0151	.0164
Cost per ton - All Explosives ...	.1321	.1311	.1251	.1291
Pounds Powder per ton of Ore	1.0020	.9980	.952	.916

1946 The Mine was idle from February 8th to May 22th, 1946 due to work stoppage account of Union strike.
The production decreased 148,230 tons ore 27% compared with 1945.
The average price per pound for Powder increased 7% over 1945.
The cost per ton for all explosives increased 3.1% over 1945.

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STATEMENT SHOWING COMPARATIVE COST OF ALL EXPLOSIVES USED AT SOFT ORE MINES

	1943	1944	1945	1946
PRODUCT - Tons	3,178,907	2,700,228	2,562,695	2,143,676
POWDER				
Pounds - 40%			150	100
50%		815		
60%	58,100	74,070	37,457	33,125
1X and 2X Hercomite..	1,345292	1,092,650	1,093,650	896,138
Total Pounds - Powder	1,403,392	1,168,535	1,094,659	929,363
Total Cost - Powder .$	161,384.48	134,423.51	125,861.91	113,896.57
Fuse - Feet	5,296,582	4,190,851	3,824,987	3,082,459
Caps - Number	726,184	599,138	541,726	421,489
Leading Wire - Feet	1,885	4,000	4,500	17,750
Connecting Wire -Pounds	65	172	72	62
Tamping Bags -Number	157,700	96,450	86,295	62,350
Sealing Compound - Pints				
Powder Bags	204	93	127	137
Fuse Lighters	137,200	121,084	105,700	96,900
Master Fuse Lighters	10,441	1,548	2,000	1,000
Electric Exploders	10,716	11,619	4,074	9,381
Total Cost, Fuse, Caps, etc$	39,381.05	31,530.09	28,557.13	25,792.30
Total Cost, All Explosives $	200,765.53	165,953.60	154,419.04	139,688.87
Average Price per Pound-Powder $	.1150	.1150	.1150	.1226
Cost per Ton - Powder ..... $	.0508	.0498	.0491	.0531
Cost per Ton-Fuse,Caps, etc .. $	.0124	.0117	.0112	.0121
Cost per Ton - All Expl.. $	.0632	.0615	.0603	.0652
Pounds of Powder per ton of Ore	.4414	.4328	.4271	.4335

1946 The mines included in 1946 figures are, Athens, Maas, Negaunee, Lloyd, Mather and Cambria-Jackson. The mines were idle from February 8th to May 22th 1946 due to work stoppage account of Union strike.
The average price per pound for powder increased $.0076 over 1945 6.6% compared with 1945.
The cost per ton for all explosives increased $.0065 or 1.5% compared with 1945.

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STATEMENT SHOWING COMPARATIVE COST FOR ALL MINE TIMBER USED IN SOFT ORE MINES

	1943	1944	1945	1946
PRODUCT - Tons	3,178,907	2,700,228	2,562,695	2,143,676
TIMBER				
Feet - 6-8"	751,812	533,365	345,704	339,912
8-10"	311,432	266,988	179,170	191,462
10-12"	584,188	495,134	390,086	345,818
12-14"	347,562	274,828	233,952	160,846
14-16"	27,876	21,906	16,714	5,237
Treated Timber	741	250	8,389	9,806
Total Feet	2,023,611	1,592,471	1,174,015	1,052,081
Total Cost .....$	199,569.46	174,030.56	136,629.67	126,217.36
LAGGING				
Feet - 5	9,933			
7	8,815,982	7,508,090	6,458,823	4,828,872
Total Feet	8,825,915	7,508,090	6,458,823	4,828,872
Cost .....$	90,857.37	106,325.33	90,743.61	68,795.03
Poles - Feet	6,488,241	5,616,789	5,479,330	3,485,770
Poles - Cost .....$	117,610.72	113,484.62	115,326.82	80,753.58
Wire Fencing - Rods	1,686	1,147	208	63
Wire Fencing - Cost .....$	1,720.97	1,159.38	240.12	73.29
Grand Total Cost .....$	409,758.52	394,999.89	342,940.22	275,839.26
Average Cost per Foot-Timber .....$	.0986	.1093	.1164	.1199
" " " 100' - Lagging....$	1.065	1.416	1.405	1.424
" " " 100' - Poles .....$	1.812	2.020	2.104	2.316
" " " Rod - Fencing ....$	1.021	1.011	1.150	1.16
Feet of Timber Per Ton of Ore	.637	.590	.458	.491
" " Lagging " " "	2,682	2,780	2,520	2.252
" " Poles " " "	2.041	2.080	2.138	1.626
" " Fencing " " "	.0087	.007	.0013	
Cost Per Ton for Timber .....$	.0628	.0644	.0533	.0589
" " " Lagging .....$	.0286	.0394	.0354	.0321
" " " Poles .....$	.0370	.0420	.0450	.0376
" " " Fencing .....$	.0005	.0005	.0001	
Total Cost Per Ton .....$	.1289	.1463	.1338	.1286

NOTE: 1946 The Mines included in 1946 figures are, Athens, Maas, Negaunee, Lloyd Mather and Cambria-Jackson. The Mines were idle from February 8th to May 22th, 1946 due to work stoppage account of Union strike.
The production decreased 419919 tons or 16.4% compared with 1945.
The total cost per ton for all timber decreased $.0052 or 4% compared with 1945.

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STATEMENT SHOWING TOTAL COST OF SUPPLIES CHARGED TO "COST OF ORE AT MINE"

SOFT ORE MINES

	1943		1944		1945		1946	
PRODUCT - Tons	3,178,907		2,700,228		2,562,695		2,143,676	
CLASSIFICATION	AMOUNT	PER TON	AMOUNT	PER TON	AMOUNT	PER TON	AMOUNT	PER TON
General Supplies	127,302.86	.0400	137,163.65	.0507	118,680.10	.046	130,768.63	.061
Iron and Steel	49,137.31	.0155	52,197.63	.0198	38,150.87	.015	48,990.40	.023
Machinery	71,498.54	.0225	61,542.27	.0228	56,165.00	.022	111,045.43	.052
Explosives	202,625.24	.0637	167982.88	.0622	155,417.06	.061	139,771.78	.065
Lumber and Timber	447,172.36	.1407	432,768.85	.1601	373,091.09	.145	300,772.30	.140
Fuel	29,523.80	.0093	34,429.02	.0127	30,192.55	.012	24,354.23	.011
Electric Power	499,761.56	.1572	494,302.75	.1831	452,656.12	.177	363,012.67	.169
Miscellaneous	192,730.29	.0606	185,608.31	.0686	163,071.12	.063	57,565.92	.028
Total	1,619,751.96	.5095	1,565,995.36	.5800	1,387,423.91	.541	1,176,281.36	.549

HARD ORE MINES

PRODUCT- Tons	634,628		587,051		550,169		401,939	
CLASSIFICATION								
General Supplies	39,810.89	.063	40,688.16	.069	37,900.25	.068	36,551.28	.092
Iron & Steel	37,082.42	.058	39,443.60	.068	33,933.08	.062	25,785.43	.064
Machinery	24,381.96	.039	23,556.93	.040	17,083.10	.031	42,003.20	.104
Explosives	83,880.27	.132	76,929.74	.131	68,872.06	.125	51,913.62	.129
Lumber and Timber	11,464.17	.018	15,980.43	.027	15,546.68	.028	12,306.75	.031
Fuel	5,921.98	.009	5,988.68	.010	6,111.06	.012	3,205.94	.008
Electric Power	107,603.42	.170	111,649.01	.190	102,385.23	.186	74,927.89	.186
Miscellaneous	64,266.13	.101	60,069.89	.103	69,252.06	.126	5,154.82	.014
Total	374,412.24	.590	374,306.44	.638	351,083.52	.638	251,848.93	.628

NOTES: Soft Ore Mines included in statement above, Athens, Maas, Negaunee, Lloyd, Mather and Cambria-Jackson.

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THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT
LABOR SUMMARY -- ALL COMPANIES

	1943		1944		1945		1946	
PRODUCTION - TONS		6,524,441		5,958,102		5,926,724		4,402,437
	DAYS	AMOUNT	DAYS	AMOUNT	DAYS	AMOUNT	DAYS	AMOUNT
Surface	399,687	$2,993,417.97	384,372	$2,879,649.20	359,951	$2,874,020.12	321,987	$3,025,895.78
Cost per Ton		.459		.483		.485		.687
Underground	614,254 3/4	5,069,232.61	546,173	4,510,435.55	495,916	4,539,430.56	361,865¼	3,749,800.17
Cost per Ton		.777		.757		.766		.852
Superintendence & General Roll...	61,983 1/2	525,218.87	62,007	523,995.29	61,504 1/2	585,781.08	55,709 3/4	596,572.89
Cost per Ton		.080		.088		.099		.136
GRAND TOTAL	1,075,925 1/4	8,587,869.45	992,552	7,814,080.04	917,371 1/2	7,999,231.76	739,562	7,372,268.84
COST PER TON		1.316		1.328		1.350		1.675
Average Rate Per Day		7.98		7.97		8.72		9.97
Tons Per Man Per Day		6.06		6.00		6.46		5.95

NOTES: The above is the total of all wages and salaries for employees of the Mining Department, including the Cliffs Power & Light Company.

The Mines were idle from February 8th to May 22nd, 1946, due to work stoppage account of Union strike.

WAGES:

Wages were increased 18½¢ per hour, effective May 22nd, 1946, or approximately 19.6%.

WORKING SCHEDULE - 1946 - MICHIGAN PROPERTIES:

The Athens, Cliffs Shaft, Lloyd, Maas, Mather and Negaunee Mines operated 2-8 hour shifts 6 days per week.

The Cambria-Jackson Mine operated 2-8 hour shifts 5 days, and 1-8 hour shift on Saturdays until June 23rd. Effective June 24th this mine started operating 2-8 hour shifts 6 days per week.

MINNESOTA PROPERTIES:

Holman-Cliffs Mine - Operations began on May 22, 1946 on a two shift per day basis. Effective August 19, 1946, the mine went to three shifts per day, five days per week. Operations closed November 5th, 1946.

Canisteo Mine - Operations were started May 22, 1946 on a two shift per day basis. Effective September 20th, the mine went to three shifts per day, five days per week. Operations closed November 5, 1946.

Hill - Trumbull Mine - Operations were started July 1, 1946 on a two shift per day basis. Effective July 15th, the mine went to three shifts per day, five days per week. Operations closed October 31st, 1946.

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COMPARISON OF TOTAL DAYS WORKED AND TONS OF ORE MINED FOR THE YEARS 1946 AND 1945

	1946 DAYS	1945 DAYS	1946 DAYS	1945 DAYS
NON-PRODUCTIVE UNITS:				
Miscellaneous Payroll	12,195½	15,859½		
Shops and Storehouse	3,856½	4,685¼		
C. C. I. Co. Miscellaneous & General	51,516½	54,846¾		
Negaunee Mine Co. Miscellaneous & General		2,181¼		
Athens Iron Mng. Co. Miscellaneous & General		2,323¼		
Mesaba-Cliffs Mining Company	50,728	43,863½		
Canisteo Mining Company		16,517		
The Cliffs Power & Light Company	17,041¼	15,879¾		
General Roll - Undistributed	49,288½	38,606		
Work Stoppage - account of strike	22,667¼			
Total Deductions	207,293½	194,763¼		
Grand Total - All Operations	739,563¼	917,371½		
Net Operating Mines	532,269¾	722,608¼	532,269¾	722,608¼
Total Tons	4,402,437	5,926,724		
Tons per Man per Day	8.27	8.20		
OPEN PIT PRODUCTION	TONS			
Tilden Mine	101,968	197,476	4,514¼	6,587¾
Canisteo Mine	547,398	659,836	18,176½	20,867
Hill-Trumbull Mine	590,040	836,685	24,690½	33,721¼
Holman-Cliffs Mine	534,503	879,765	24,178¼	35,140
Total	1,773,909	2,573,962	71,559½	96,316
Open Pit - Tons per Man per Day	24.79	26.72		
Net Days - Underground Mines			460,710¼	626,292¼
Net Tons - Underground Mines	2,628,528	3,352,762		
Underground Mines -Tons per Man per Day.	5.71	5.35		

PERCENTAGE OF TOTAL PRODUCTION

	1946 TONS	1946 PER CENT	1945 TONS	1945 PER CENT
Underground Mines	2,628,528	59.71	3,352,762	56.57
Open Pit Mines	1,773,909	40.29	2,573,962	43.43
Total	4,402,437		5,926,724	

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STATEMENT SHOWING PENALTY COST OF OVERTIME
WORKED BY EMPLOYEES DURING YEAR 1946
AND EFFECT THE PENALTY COST HAD ON THE YEAR'S PRODUCTION COST

	MICHIGAN PROPERTIES	MINNESOTA PROPERTIES	TOTAL
YEAR 1946			
January	26,195.65	2,101.04	
February	9,091.98	670.50	
March	1,372.19	76.32	
April	1,783.91	57.89	
May	2,850.22	2,034.48	
June	45,041.14	3,573.00	
July	38,163.59	3,839.12	
August	37,602.22	5,141.16	
September	41,227.68	7,325.10	
October	39,896.13	5,057.97	
November	43,973.46	3,636.16	
December	34,329.76	2,399.13	
Total 1946	321,527.93	35,911.87	357,439.80
Total 1945	334,726.06	71,587.55	406,313.61
PRODUCTION			
Tons - Year 1946	2,693,474	1,642,184	4,335,658
Tons - Year 1945	3,542,802	2,376,286	5,919,088
EFFECT THE PENALTY COST HAD ON YEAR'S PRODUCTION COST			
Increased 1946 by	.1193	.0219	.0937
Increased 1945 by	.0945	.0299	.0686

NOTE: --DECREASE IN PRODUCTION

The Mines were idle from February 8th to May 22nd 1946, due to work stoppage account of strike. Wages were increased 18½¢ per hour, effective May 22nd, or approximately 19.6%, which increased the penalty cost of overtime.

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CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1946

1. GENERAL:

The Budget Estimate of Production for the Cliffs Shaft Mine for the year 1946 was set and revised to a final figure of 402,091 tons of ore. The mine actually produced 401,939 tons of lump and crushed ore combined. Compared to 1945 this production is nearly 150,000 tons smaller. The most significant factor responsible for the drop in production was the strike which started at midnight on February 7th and ended May 22nd after a loss of 88 operating days. The mine operated a total of 217 days. During the production period there was an average of 86.7 mining contracts operating in the mine of which 12½ or 14.4% were engaged in development drifting or raising.

The Cliffs Shaft Mine shipped a total of 403,350 tons of ore during the year. Stockpile shipments did not cease until the 27th of November. All of the lump ore stockpile was shipped but there was 12,470 tons of crushed ore left on stockpile at the end of November. Current year overrun was 3,769 tons on stockpiled ore and 12,010 tons on pocket shipments or 4% on the pocket shipments. The skip weight factor was kept at 5.10 tons per skip throughout 1946.

No changes were made in the screen ratio during 1946. The separation was calculated at 27% crushed and 73% lump ore. Production figures show yearly totals at 294,264 tons of lump and 107,675 tons of crushed or 73.21% and 26.79% respectively.

Several improvements and additions to the surface plant were made during 1946. The brake engines purchased in 1945 were installed on the hoists. These are auxiliary brakes for use in connection with the Lilly controller. In order to save the expense and trouble of starting the big compressors on Sundays and holidays for operating these brakes, a 5 H.P. Westinghouse compressor was purchased and installed in the Engine House. An aftercooler was ordered for the Engine House but this will not be delivered until early summer of 1947.

A new 75 H.P. boiler equipped with stoker was installed in the Main Dry to take the place of the old unit which was worn out. To do this job a small addition was made to the south end of the dry building. One of the used stoker engines from the Princeton Mine was reconditioned as a spare for the heating plant in the Shop building. Underneath the carpenter shop room in the Shop building a storage room was made by cleaning out the rock fill under that portion of the building. A unit heater was installed in the forging room of the Drill Shop.

For the shafthouses, steel was ordered to construct new pockets and skip dumps. These will be erected in 1947. A new surface discharge line was put in "A" Shaft to carry the underground water from the top of the pump column down to the drainage ditch in the timber yard. This is a 24" riveted pipe that was salvaged from the Oliver Iron Mining Co. Angeline pumping plant.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1946

1. GENERAL: (Cont'd)

In the Crusher Building a new pan conveyor reduction gear was installed. Shop repairs to the pan conveyor totalled $1,457.84 during the year. The only other major equipment change in the crusher building was the change to a different type rebuilt hoist for the crushed ore stocking car.

Twenty-five wooden idler sheave stands were removed and replaced by steel pipe frames. All of the ropes now run on rubber-lined sheaves.

One of the Bucyrus Erie 80-B electric shovels at the Tilden Mine was moved, in late fall, to the Cliffs Shaft Mine where it will be used for lump ore stockpile loading.

As Underground equipment we purchased, during 1946, three DA-35 Automatic drifters, six DA-35 hand-cranked drifters, four D-25 drifters, two D-89 Denver Automatic drifters, one D-89 hand-cranked drifter, five R-58 stopers for a total of 21 drilling machines. We also purchased and installed one 5 H.P. Westinghouse Air Compressor in the pumphouse for charging the pumps. As modernization of our development program progressed, we bought another Jumbo Rig with track and ordered a second Eimco Shovel Model-40. From the Princeton Mine we purchased a six-ton trolley locomotive. For the car repair department we bought a new DC-arc welding unit. We also purchased 4 oil circuit breakers for the A.C. distribution system.

The Jeffrey Fan purchased in late 1945 was not installed because the motor did not arrive until the middle of 1946 and it wasn't until late 1946 that we felt we could spare a mining crew to prepare the fan site. The Worthington plunger pump was installed and working by the end of September.

Central Shop construction and repairs of significance consisted of 6 armatures repaired at a cost of $2311.96, 1 drill rig truck constructed at a cost of $765.91, 4 pan conveyors repaired for $1457.84, 1 pull-back hoist for crushed ore stocking car rebuilt at a cost of $679.76 and reconditioning of double deck cage unit at a cost of $2667.45.

The microseismic listening station on the 11th level "B" Shaft was operated most of the year with no significant changes noted in the remaining pillars or roof arch as far as strain is concerned. No additional pillars were mined in the area in 1946 but floor was mined continuously. At least one additional pillar will be mined after the ore in the floor is all mined.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1946

2. PRODUCTION, SHIPMENTS, & INVENTORIES:

a. Production by Grades:

Grade	Tons	% of Total
Cliffs Shaft Lump	246,716	
Cliffs Shaft Crushed	89,887	
Total	336,603	83.7
Bancroft Lump	34,865	
Bancroft Crushed	13,133	
Total	47,998	11.9
Section 10 Lump	12,683	
Section 10 Crushed	4,655	
Total	17,338	4.4
GRAND TOTAL FEE & LEASE ORE	401,939	100.0

Production by grades for the past ten years follows:

Year	Lump Ore Tons	Crushed Ore Tons	Run-of-Mine Ore - Tons	Total Tons
1937	368,768	171,562	3,237	543,567
1938	222,672	102,361	2,128	327,161
1939	259,517	123,883	3,858	387,258
1940	371,745	177,469	3,384	552,598
1941	464,802	162,132	31,813	658,747
1942	225,759	56,510	431,261	713,530
1943	200,616	50,732	383,280	634,628
1944	443,123	137,701	6,227	587,051
1945	430,193	119,976		550,169
1946	294,264	107,675		401,939

The percentage of lumps and fines since 1933 is shown by the following figures:

	Lump		Crushed	
Year	Tons	% of Total	Tons	% of Total
1933	39,101	69.89	16,838	30.11
1934	156,776	70.23	66,469	29.77
1935	189,883	70.61	79,038	29.39
1936	315,996	69.18	140,764	30.82
1937	368,768	68.24	171,562	31.76
1938	222,672	68.51	102,361	31.49
1939	259,517	67.69	123,883	32.31
1940	371,745	67.68	177,469	32.32
1941	464,802	74.14	162,132	25.86
1942	225,759	79.98	56,510	20.02
1943	200,616	79.82	50,732	20.18
1944	443,123	76.29	137,701	23.71
1945	430,193	78.19	119,976	21.81
1946	294,264	73.21	107,675	26.79

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1946

2. PRODUCTION, ETC.: (Cont'd)

The last change made in the revolving trommel was December 1, 1945 when we had 2 of the three screen sections equipped with two inch holes and the remaining section with one and one-half inch holes. The product was divided into 73% lump and 27% crushed ore throughout 1946. The decrease of 4.98% in the percentage of lump ore was brought about deliberately with the idea of improving the quality of the lump product.

The division of the product between fee ore and Bancroft and Section 10 Lease ore for the past ten years is shown by the table below:

Year	Cliffs Shaft Ore (Fee)	% of Total	Bancroft Ore (Lease)	% of Total	Sec. 10 Ore (Lease)	% of Total
1937	451,170 tons	83.0	92,397 tons	17.0		
1938	277,602 "	84.8	49,559 "	15.2		
1939	323,647 "	83.6	63,611 "	16.4		
1940	479,060 "	86.7	73,538 "	13.3		
1941	555,525 "	84.3	103,222 "	15.7		
1942	629,661 "	88.2	83,869 "	11.8		
1943	563,006 "	88.7	69,943 "	11.0	1,679 tons	0.3
1944	506,520 "	86.3	64,742 "	11.0	15,789 "	2.7
1945	463,897 "	84.3	64,664 "	11.8	21,608 "	3.9
1946	336,603 "	83.7	47,998 "	11.9	17,338 "	4.4

Bancroft Lease production remained at a nearly constant percentage but Section 10 Lease production climbed 0.5% over 1945. As mentioned in the report for 1945, the Section 10 Lease production is expected to increase more sharply in 1947 because more stoping places have been made ready.

All of the ore produced to date from the Bancroft Lease and Section 10 Lease since they were acquired by the Company is shown by years in the following table:

	Bancroft Ore Tons	Section 10 Ore Tons
From the Years 1925 to 1935	370,312	
1936	73,746	
1937	92,397	
1938	49,559	
1939	63,611	
1940	73,538	
1941	103,222	
1942	83,869	
1943	69,943	1,679
1944	64,742	15,789
1945	64,664	21,608
1946	47,998	17,338
Total	1,157,601	56,414

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1946

2. PRODUCTION; ETC.:

b. Shipments:

Grade	Pocket Tons	Stockpile Tons	Total Tons	Total Last Year
Cliffs Shaft Lump	188,912	68,375	257,287	364,959
Cliffs Shaft Crushed	67,901	12,367	80,268	154,993
Bancroft Lump	28,701	7,050	35,751	49,319
Bancroft Crushed	10,022	3,277	13,299	14,654
Section 10 Lump	10,782	1,618	12,400	17,207
Section 10 Crushed	3,733	612	4,345	5,012
Total 1946	310,051	93,299	403,350	606,144
Total 1945	375,874	230,270	606,144	
Decrease	65,823	136,971	202,794	

Shipments for the last ten years are tabulated below:

	CLIFFS SHAFT GRADE			BANCROFT GRADE			SEC. 10 GRADE			Grand
Year	Lump	Crushed	Mine Run	Lump	Crushed	Mine Run	Lump	Crushed	Mine Run	Total
1937	301,654	125,953		59,153	25,843	3,237				515,840
1938	95,983	42,240	171	19,254	3,416	1,957				163,021
1939	310,673	176,302	430	54,927	45,610	3,428				591,370
1940	358,099	179,018	55	44,913	26,477	3,329				611,891
1941	373,951	150,730	14,381	58,253	23,549	17,382				638,246
1942	230,566°	57,985	375,540	27,086	616	55,771				747,564
1943	177,951	30,182	328,139	12,829	380	53,640			1,501	604,622
1944	417,769	89,043	137	46,349	24,084	4,246	9,542	3,134	1,844	596,148
1945	364,959	154,993		49,319	14,654		17,207	5,012		606,144
1946	257,287	80,268		35,751	13,279		12,400	4,345		403,330

(°) Contains 4,541 tons of Incline Pit Lump.

c. Stockpile Balances:

Ore in stock as of December 31, 1946:

Cliffs Shaft Lump	20,721
Cliffs Shaft Crushed	21,300
Bancroft Lump	2,200
Bancroft Crushed	1,294
Section 10 Lump	875
Section 10 Crushed	554
Total	46,944

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2. PRODUCTION, ETC.: (Cont'd)

Stockpile balances at the end of the year are shown for the past ten years in the following table:

Balance in stock - Dec. 31,	1937	109,799 tons
	1938	273,939 "
	1939	76,540 "
	1940	47,208 "
	1941	81,533 "
	1942	60,562 "
	1943	90,568 "
	1944	95,663 "
	1945	48,355 "
	1946	46,944 "

d. Division of Product by Levels:

Level	"A" Shaft Tons	"B" Shaft Tons	Total Tons
1st	361	28,775	29,136
2nd	9,322	10,440	19,762
3rd	9,078	7,598	16,676
4th	21,151	5,073	26,224
5th	18,697	14,376	33,073
6th	5,758	12,974	18,732
7th	17,581	28,876	46,457
8th	38,817	839	39,656
9th	42,437	12,344	54,781
10th	39,736	11,858	51,594
11th	20,813	-	20,813
12th	17,194	12,156	29,350
13th	-	-	-
14th	-	8,164	8,164
15th		7,521	7,521
Total	240,945	160,994	401,939
Rock			17,356
Total Ore & Rock			419,295

The ten year table below shows where the ore has been broken and the percentage from each shaft:

Year	"A" Shaft Tons	%	"B" Shaft Tons	%	Total
1937	358,930	66.2	184,637	33.8	543,567
1938	228,370	69.9	98,791	30.1	327,161
1939	254,133	65.5	133,125	34.5	387,258
1940	372,428	67.4	180,170	32.6	552,598
1941	408,342	62.0	250,405	38.0	658,747
1942	445,460	62.4	268,070	37.6	713,530
1943	391,455	61.6	243,173	38.4	634,628
1944	382,934	65.2	204,117	34.8	587,051
1945	374,864	68.1	175,305	31.9	550,169
1946	240,945	59.9	160,994	40.1	401,939

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2. PRODUCTION, ETC.: (Cont'd)

The foregoing table shows a decrease in "A" Shaft production and an increase in "B" Shaft production that amounts to about 8%. This is the highest production for 10 years from "B" Shaft. It can be explained only on the basis that most of the contracts in "B" Shaft are engaged in mining floor or back. Obviously, such a tendency cannot be expected to continue because eventually the number of contracts or places will diminish in "B" Shaft territory.

The following table shows how the product was hoisted from "A" and "B" Shafts during 1946. With nearly 60% of the ore mined in "A" Shaft but only 48% of it hoisted from "A" Shaft, it is obvious that a considerable portion of the "A" Shaft ore was either tributary to "B" Shaft haulage system or was transferred to "B" Shaft. The connecting drift between "A" and "B" Shafts on the 10th level will be completed by the end of April. This drift will make it possible for us to send ore from one shaft to the other depending on which has the most abundant supply.

1946 Product as Hoisted

Month	"A" Shaft Tons	"B" Shaft Tons	Total Tons
January	20,795	20,851	41,646
February	4,324	4,634	8,958
March	1,106	-	1,106
April	-	-	-
May	5,378	5,950	11,328
June	20,523	23,254	43,777
July	22,279	23,720	45,999
August	22,557	25,487	48,044
September	22,269	24,507	46,776
October	23,927	27,145	51,072
November	19,706	23,483	43,189
December	21,283	22,982	44,265
Total without Overrun	184,147	202,013	386,160
Pocket Overrun	5,728	6,282	12,010
Stockpile "	1,800	1,969	3,769
Grand Total Tons	191,675	210,264	401,939
% of Total	47.7	52.3	100.00

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2. PRODUCTION, ETC.: (Cont'd)

e. Production by Months:

		CLIFFS SHAFT		BANCROFT		SECTION 10		
Month	Optg. Days	Lump	Crushed	Lump	Crushed	Lump	Crushed	Total
Jan.	26	26,211	9,495	3,655	1,292	778	264	41,695
Feb.	6	5,248	1,936	1,094	409	209	65	8,961
March	0	542	208	257	99	-	-	1,106
April	0	-	-	-	-	-	-	-
May	8	7,025	2,226	1,471	551	229	83	11,585
June	25	27,348	10,098	5,151	1,911	1,743	632	46,883
July	26	29,562	10,293	5,007	1,870	1,114	410	48,256
Aug.	26	31,822	12,050	3,774	1,373	1,443	493	50,955
Sept.	24	30,006	11,478	3,316	1,393	1,489	591	48,273
Oct.	27	31,891	12,074	4,063	1,643	1,982	772	52,425
Nov.	25	26,477	9,659	3,418	1,263	2,047	749	43,613
Dec.	24	26,898	10,370	3,592	1,329	1,633	596	44,418
Current Years Stkpl. Overrun		3,686	-	67	-	16	-	3,769
Total	217	246,716	89,887	34,865	13,133	12,683	4,655	401,939

f. Ore Statement:

Grade	On Hand Jan. 1, 1946	Output for Year	Prior Years Stockpile Overrun	Total	Shipments	Balance On Hand	Inc. or Dec. in Output
C. S. Lump	31,292	246,716	-	278,008	257,287	20,721	
C. S. Crushed	11,681	89,887	-	101,568	80,268	21,300	
Banc. Lump	3,086	34,865	-	37,951	35,751	2,200	
Banc. Crushed	1,460	13,133	-	14,593	13,299	1,294	
Sec. 10 Lump	592	12,683	-	13,275	12,400	875	
Sec. 10 Crushed	244	4,655	-	4,899	4,345	554	
Total 1946	48,355	401,939	-	477,294	403,330	46,944	148,230
Total 1945	95,663	550,169	8,667	654,499	606,144	48,355	34,971

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2. PRODUCTION, ETC.: (Cont'd)

g. Delays:

Date		Time Lost	Tons Lost	Remarks
Jan.	5	1 hr.	200	Dummy rope on Top Tram broke.
	23	¾ "	75	Chunks in "A" Shaft.
	24	2 "	300	Trouble in Engine House.
Feb.	2	7 "	500	"A" Shaft hoist switchboard burned out.
		3 "	200	Axle on Top Tram broke - "B" Shaft.
	4	2½ "	300	Oil switch on Lump Ore stocking car control burned out.
	7	1½ "	200	Top Tram car went through "dummy" at Crusher.
	8-28	18 days	35039	Idle on account of Strike.
March	-	26 "	48000	" " " " "
April	-	26 "	48000	" " " " "
May	-	18 "	34415	18 days idle due to Strike.
June	10	1¾ hr.	250	Picking belt motor failed.
	24	2 "	400	Large chunks.
	28	3 "	400	"A" Shaft skip caught in pocket.
July	22	1½ "	300	Broken picking belt.
	27	1 "	150	" " "
Aug.	8	1½ "	150	Engine House switchboard out of order.
	14	13 "	2000	V-J Day.
Sept.	27	2½ "	300	"B" Shaft skip out of runners.
Oct.	14	2 "	200	"A" Shaft 8th level pocket door fell out.
	18	1½ "	200	Wet dirt.
	22	1 "	100	Air lift broke - "B" Shaft.
	30	2 "	200	Chain broke on safety catches at "B" Shaft.
Nov.	6	1½ "	200	Chunks in Crusher.
	15-30	-	4637	Deer Season.
	22	1 "	100	Large chunks.
Dec.	7	3 "	300	Air lift in "B" Shaft broke - Surface.
	11	2 "	150	Skip wheel fell off - "A" Shaft.
	19	1¾ "	100	Large chunks - "B" Shaft.
Total 1946		-	176341	
Total 1945		60¼ hrs.	8925	

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3. ANALYSIS:

a. Average Analysis of 1946 Output:

	Iron	Phos.	Silica
Cliffs Shaft Lump	62.32	.109	5.87
Cliffs Shaft Crushed	52.55	.111	16.76
Bancroft Lump	62.28	.113	5.47
Bancroft Crushed	53.17	.114	15.28
Section 10 Lump	60.62	.117	7.20
Section 10 Crushed	52.02	.109	16.57

The analyses of the Lump Ore grades are considerably improved over the output for 1945. Crushed Ore grades, on the contrary, either dropped or remained about the same as in 1945. Because of the latter situation, I suspect that the improvement in the analysis of the Lump ores is due to the fact that a somewhat larger portion of the Lump was shipped directly from pocket than in preceding years. There is a better chance to clean the pocket shipments of ore ——— ? therefore the analysis shows some improvement.

c. Complete Analysis of 1946 Ores as Shipped From Mine:

Grade		Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss
Lump Ore	(x)	62.00	.107	6.20	.27	2.06	.65	.67	.011	.89
Crushed Ore	(x)	52.30	.100	17.00	.33	3.10	1.20	.99	.012	1.80
Lump Ore thru Maas Crusher	(x)	59.90	.118	8.14	.28	2.43	1.08	.83	.013	1.13

(x) Cliffs Shaft, Bancroft & Section 10 ores combined

d. Analysis of Ore in Stock Dec. 31, 1946:

		Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Cliffs Shaft Lump	Dried	61.06	.122	7.12	.27	2.26	.65	.67	.011	.89	-
	Natural	60.75	.121	7.08	.27	2.25	.65	.67	.011	.89	.51
Cliffs S. Crushed	Dried	52.25	.116	17.63	.33	2.80	1.21	.99	.012	1.80	-
	Natural	51.30	.114	17.31	.32	2.75	1.19	.97	.012	1.77	1.86
Banc.&Sec.10 Lump	Dried	58.91	.116	8.32	.34	2.80	1.45	1.06	.013	.90	-
	Natural	58.66	.116	8.29	.34	2.79	1.44	1.06	.013	.90	.42
Banc. & Sec. 10 Crushed	Dried	51.63	.108	18.21	.33	3.10	1.20	.99	.012	1.80	-
	Natural	50.69	.107	17.88	.32	3.04	1.18	.97	.012	1.77	1.86

e. Analysis of Ore Reserves: (Run-of-Mine Ore)

		Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Cliffs Shaft Ore	Dried	57.45	.107	9.88	.46	2.34	1.21	1.04	.019	1.89	-
	Natural	56.97	.106	9.80	.46	2.32	1.20	1.03	.019	1.87	.85
Bancroft & Sec. 10 Ore	Dried	57.59	.135	10.00	.51	2.39	1.16	.98	.019	1.85	-
	Natural	57.16	.126	9.93	.51	2.37	1.15	.97	.019	1.84	.75

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4. ESTIMATE OF ORE RESERVES:

Assumptions: Factor used is 8, 9 and 10 cu. ft. per ton of ore in place.
The factor 9 is most commonly used.
10% deduction for rock and loss in mining.

Ore in Sight December 31, 1946:

Available Ore in Bancroft Area "A" Shaft

	Developed		Prospective	
	Floors	Pillars	Breasts	Total
Level	Tons	Tons	Tons	Tons
2nd			2,000	2,000
3rd		800		800
4th	7,500			7,500
8th		9,300		9,300
9th	9,800	6,400		16,200
10th	37,300	106,900	2,000	146,200
11th	107,300	4,600	2,000	113,900
12th	2,200	2,900	2,000	7,100
Total	164,100	130,900	8,000	303,000

Summary:

Bancroft Ore Available	303,000
Less December Production	4,921
Gross Tonnage as of Dec. 31, 1946	298,079
Less 10% for Mining & Rock	30,300
Net Total Bancroft Ore Available	267,779

Section 10 Lease

	Developed		Prospective	
	Floors	Pillars	Breasts	Total
Level	Tons	Tons	Tons	Tons
1st		10,600		10,600
2nd	4,200			4,200
4th			4,000	4,000
5th	8,200	33,480		41,600
6th	33,400		2,000	35,400
7th			2,000	2,000
8th		98,000		98,000
9th	89,800			89,800
Total	135,600	142,000	8,000	285,600

Summary:

Section 10 Ore Available	285,600
Less December Production	2,229
Gross Tonnage as of Dec. 31, 1946	283,371
Less 10% for Mining & Rock	28,560
Net Total Section 10 Ore Available	254,811
Net Total Bancroft & Section 10 Lease	522,590

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4. ESTIMATE OF ORE RESERVES: (Cont'd)

Available Cliffs Shaft Ore "A" Shaft

Level	Developed Floors Tons	Developed Pillars Tons	Prospective Breasts Tons	Total Tons
1st		5,200		5,200
2nd	4,200	1,200		5,400
3rd	6,000	1,100	2,000	9,100
4th	8,700		8,000	16,700
5th	13,800	3,700	6,000	23,500
6th	39,700	47,100	10,000	96,800
7th	93,500	9,900	8,000	100,500
8th	66,900	3,200	4,000	74,100
9th	142,600	1,800	6,000	150,400
10th	57,100	118,700	2,000	157,800
11th	68,200	110,100	2,000	180,300
12th	36,000	79,800		115,800
15th	29,000			29,000
Total	545,700	381,800	48,000	975,500

Available Cliffs Shaft Ore "B" Shaft

Level	Developed Floors Tons	Developed Pillars Tons	Prospective Breasts Tons	Total Tons
1st	52,000	14,900	2,000	68,900
2nd	36,800	1,300	2,000	40,100
3rd	2,200	23,500	2,000	27,700
4th			6,000	6,000
5th	20,400		4,000	24,400
6th	5,400		4,000	9,400
7th	13,700			13,700
8th	28,600	5,700	4,000	38,300
9th	11,400		4,000	15,400
10th	31,100			31,100
11th	21,300	3,000		24,300
12th	4,600		2,000	6,600
13th	5,500			5,500
14th	5,900		2,000	7,900
15th	15,000	15,200		30,200
Total	253,900	63,600	32,000	349,500

Section 9 Development

Level	Developed Floors Tons	Developed Pillars Tons	Prospective Breasts Tons	Total Tons
9th		11,600	2,000	13,600
10th	2,900	13,200		16,100
Total	2,900	24,800	2,000	29,700

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4. ESTIMATE OF ORE RESERVES: (Cont'd)

Summary:

Cliffs Shaft Ore Available "A" Shaft	975,500
Cliffs Shaft Ore Available "B" Shaft	349,500
Cliffs Shaft Ore Available Section 9	29,700
Total	1,354,700
Less December Production	37,268
Gross Tonnage as of Dec. 31, 1946	1,317,432
Less 10% for Mining & Rock	135,470
Net Total Fee Ore Available	1,181,962

Recapitulation:

Net Cliffs Shaft Ore Available	1,181,962
Net Bancroft Ore Available	267,779
Net Section 10 Ore Available	254,811
Grand Total	1,704,552

Ore reserves for the past two years are shown for comparison:

	Dec. 31, 1946	Dec. 31, 1945
Cliffs Shaft Ore Available	1,181,962 tons	1,206,720 tons
Banc. & Sec. 10 Ore Available	522,590 "	478,840 "
Total	1,704,552 "	1,685,560 "
Increase for year 1946	18,992 "	

New Ore Developed in 1946 401,939 & 18,992 = 420,931 tons

The following table shows the variations in ore reserves in "A" and "B" Shafts since 1930:

Net Available Ore in Sight

Year	Sec. 10 Ore Tons	Bancroft Ore Tons	Cliffs Shaft Ore "A" Shaft Tons	Cliffs Shaft Ore "B" Shaft Tons
1930		179,200	1,071,900	255,600
1931		182,600	1,099,778	255,922
1932		210,864	1,055,384	245,483
1933		198,916	995,211	227,565
1934		204,730	1,091,100	251,087
1935		210,429	1,090,540	232,345
1936		246,659	1,055,621	289,828
1937		252,050	1,099,090	303,762
1938		243,512	1,105,663	307,991
1939		246,726	1,139,349	283,644
1940		231,402	1,105,158	288,482
1941		232,298	1,047,360	288,650
1942		257,758	977,345	278,567
1943	17,043	267,301	898,787	297,362
1944	107,904	272,351	834,801	305,530
1945	191,458	287,382	879,956	326,764
1946	254,811	267,779	851,107	330,855

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4. ESTIMATE OF ORE RESERVES: (Cont'd)

The information contained in the foregoing tables shows a net increase in ore reserves of 18,992 tons. This is due to the increased reserves shown in the Section 10 Lease. There is a strong probability that the development of the Section 10 Lease will continue to show up reserves in excess of the decreases occurring in the remainder of the mine, for the next year or two.

In the following table the reserves are up for the 3rd consecutive year. As pointed out in last year's report, the 1945 increase is largely due to the change in method of figuring the estimate whereby only one deduction of 10% is made.

Total Ore Available in Mine at the End of Each Year:

1946	1,704,552 Tons
1945	1,685,560 "
1944	1,520,586 "
1943	1,480,493 "
1942	1,513,670 "
1941	1,568,308 "
1940	1,625,042 "
1939	1,669,719 "
1938	1,657,166 "
1937	1,654,902 "
1936	1,592,108 "
1935	1,533,314 "
1934	1,546,917 "
1933	1,421,692 "
1932	1,511,731 "
1931	1,541,050 "
1930	1,506,700 "
1929	1,388,216 "
1928	1,358,000 "
1927	1,392,000 "
1926	1,436,000 "
1925	1,444,000 "
1924	1,453,000 "
1923	1,361,000 "
1922	1,364,000 "
1921	1,386,000 "
1920	1,404,000 "

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5. LABOR AND WAGES:

a. General:

The number of surface employees was cut drastically in 1946 in order to reduce the costs as far as possible of labor not directly engaged in handling the ore. We had a relatively small amount of ore in stockpile in 1946 which made it possible to get along with a smaller surface crew than in preceding years. The number of men employed underground increased as veterans returned and some new men were employed. It will be necessary to employ even more men underground in the future if we expect to meet the commitments for 1947 and at the same time keep development at a sufficiently accelerated pace to offset the neglect of this work occasioned by the war years.

The tables below contain statistics for the 8½ months operating period and do not include the men or costs of the idle period during the strike.

b. Comparative Statement of Wages and Product:

	1946	1945
PRODUCT	401,939	587,051
No. of Shifts & Hours	2 8-hr.	2 8-hr.
No. of Days Operated	217	303
Average Number of Men Employed		
Surface	90	107
Underground	315	293
Total	405	400
Average Wages Per Day		
Surface	8.96	7.59
Underground	9.84	8.37
Total	9.60	8.16
Product Per May Per Day		
Surface	17.76	17.16
Underground	5.85	6.19
Total	4.40	4.55
Labor Cost Per Ton		
Surface	.518	.442
Underground	1.670	1.353
Total	2.188	1.795

Labor cost increase in 1946 is a reflection of several interrelated factors that cannot be accurately evaluated. The primary cause of increase was the wage increase of $.18½ per hour. In addition to this, there is a somewhat higher vacation pay expense. We also had an increased percentage of development work with a corresponding drop in tons per man per day.

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5. LABOR AND WAGES: (Cont'd)

Penalty costs are shown below for the entire year including the strike or idle time. We have made no exact division of the penalty earnings during the idle months but it approximates $600.00 to $800 for the 3½ months. Discounting this sum there still remains a substantial increase in penalty earnings. The decrease in absenteeism from a total of 8,710 lost days in 1945 to 4,591 lost days in 8 months of operation in 1946, accounts for much of the higher penalty time earnings in 1946 as compared to 1945. Naturally the increase in wages also affects the total.

1946	$63,136.83
1945	56,994.10
Increase	$ 6,142.73

Surface and underground labor costs per ton for the past ten years are as follows:

Year	Surface Labor	Underground Labor	Total Labor
1946	.518	1.670	2.188 (°)
1945	.442	1.353	1.795
1944	.405	1.404	1.809
1943	.396	1.399	1.795
1942	.301	1.170	1.471
1941	.297	1.173	1.470
1940	.241	.936	1.177
1939	.253	1.033	1.286
1938	.310	1.110	1.420
1937	.267	.985	1.252

(°) Costs for 8½ operating months.

	Shifts	Earnings	Avg. Wages 1946	Avg. Wages 1945
Contract Miners				
Dev. in Rock	1,557	18,613.81	11.95	9.86
Dev. in Ore	1,966	21,437.75	10.90	8.76
Stoping	15,853	158,804.97	10.02	8.67
Total Contract Miners	19,376	198,856.53	10.26	8.74
Contract Trammers	378	5,610.18	14.84	13.00
Total Contract Labor	19,754	204,466.71	10.35	8.84

	1946	1945
Total Number of Days		
Surface	22,637¾	32,059
Underground	68,674	88,839
Total	91,311¾	120,898
Amount For Labor		
Surface	208,071.88	243,395.32
Underground	671,408.49	744,094.41
Total	879,480.37	987,489.73

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5. LABOR AND WAGES: (Cont'd)

Proportion of Surface to Underground Men	
1946	1 to 3.54
1945	1 to 2.74
1944	1 to 3.20
1943	1 to 3.19
1942	1 to 3.36
1941	1 to 3.32
1940	1 to 3.43
1939	1 to 3.73
1938	1 to 3.22
1937	1 to 3.15

6. SURFACE:

a. Buildings and Repairs:

The following figures show cost of repairs to mine buildings for the years 1942 - 1946:

	1946	1945	1944	1943	1942
Office & Warehouse	67.57	537.42	1200.83	1611.05	1759.49
Shops	1726.31	1679.64	719.73	1786.50	1519.98
Shaft House	1380.98	567.28	822.60	956.90	384.67
Engine House	1717.91	1052.36	553.86	1078.09	860.22
Dry House	1352.63	1569.07	2597.53	1125.87	3713.75
Coal Dock & Trestle	279.96	419.37	258.24	821.71	96.67
Crusher Building	145.77	878.57	628.19	4390.68	2903.35
Miscellaneous	342.65	967.27	3997.94	1086.06	614.12
Total	7013.78	7670.98	10778.92	12856.86	11852.25

The total cost for buildings and repairs decreased $657.20 as compared to 1945.

Shop building expense consisted of general repairs, painting and the excavation of a basement room under the Carpenter Shop. Shafthouse expense increased as compared to 1945 by more than 100%. Quite extensive repairs were made to stairways and floors including the concrete floor at the collar of the shaft in "A" Shafthouse. Engine house expense also increased from a re-vamping of the lighting system and the steam heating system as well as repairs to the roof on the west side.

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7. UNDERGROUND:

a. Development:

1. Section 10 Lease:

Although some production was carried on in the Section 10 Lease during 1946, most of the work consisted of development of the major ore body located south of the "A" Shaft workings. On the average, we had 6 gangs working on the Section 10 Lease. Three of these were engaged in stoping ore and the other 3 in drifting and raising in order to open up the ore veins for future production. We perhaps would have had more development drifting, at least on the 8th level of the Section 10 Lease, if we had been able to drain the Moro Mine during 1946. We were not able to get the new pump working satisfactorily until September and consequently we did not drill the drainage hole from the Section 10 drift on the 10th level into the Moro workings. This will be done in 1947 and the program of drainage may be completed in early 1948.

Three diamond drill holes were drilled on the Section 10 Lease during 1946. Hole No. 563 started from Cliffs Shaft workings on the 6th level at coordinates 1262 S - 978 E. This hole was drilled at an angle of —29° on a course S 5° E. Some ore was discovered in this hole on the Cliffs Shaft side of the boundary but on the Section 10 Lease it encountered nothing but lean ore and slaty conglomerate or black chert and soft ore jasper. This hole was started from a drift that cuts through a syncline of slate hanging wall. It was our intention to explore the ground below and south of this syncline for ore occurrences whether they be on Cliffs Shaft fee lands or on the Section 10 Lease. On the 8th level two holes were drilled namely, 564 and 566. The first of these was located at 1675 S - 2319 E and the second was located at 1632 S - 2140 E. Both of the holes were drilled horizontally south from the 8th level drift with the intention of exploring the portion of the Section 10 Lease south of the main body of ore which had been exposed by the drift opening. In Hole No. 564, 55' of first class ore was discovered just south of the 1800 S coordinate line. This in turn was followed by slate and then alternating soft ore jasper and dike. From a consideration of the relationships shown on the map, it looks as though this ore is an extension of the old Moro body which occurs approximately 400' east of this piece of ore. No ore was discovered in Hole 566. All of the material encountered was either sideritic chert or soft ore jasper or dike. The occurrance of slate in Hole 564 and footwall material in Hole 566 suggests that there is a fault in the area between these two holes. Generally speaking, the structures pitch to the west and any slate occurring in the easternmost hole should be expected to be found more widespread in the area to the west unless faulted out.

In the past two annual reports the known ore occurrences of the Section 10 Lease were divided in 3 categories for purpose of convenience in discussion. They are No. 1: The syncline between the 1st and 3rd levels in the area 300' south from the north boundary of the

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

1. Section 10 Lease: (Cont'd)

Section 10 Lease between the coordinates 0 and 600 E. No. 2: The anticlinal structure between 1600 E and 3000 E lying adjacent to the Cliffs Shaft fee property along its south boundary. No. 3: The main ore bearing syncline which constitutes the westward extension of the Moro Mine structure. During 1946, two crews worked in the No. 1 area namely, Contracts No. 1 and No. 58. The latter of these two mined a small amount of ore at coordinates 1300 S - 700 E on the 1st level elevation. This floor stoping completed the extraction of all the known available ore in the eastern end of the synclinal structure. Southward dipping slate hanging wall and northward dipping dike footwall pinched out the ore body to the south. There may be ore beneath this dike footwall and we do have positive knowledge through diamond drilling that ore exists down to the 3rd level elevation in the syncline 600' to 800' west of Contract 58. We have tentative plans for driving a drift under this territory on the 5th level elevation in order to mine the ore from the 3rd level to the 1st level. Originally, we had thought to reach this ore on the 3rd level elevation from the "A" Shaft territory but this would necessitate a transfer of the ore to the 5th level for hoisting purposes. In the event that some of the ore extends below the 3rd level elevation, a 3rd level drift would be unable to make such ore available for mining. Therefore, it is probably wiser to do our drifting on the 5th level in the "B" Shaft territory, extending south the drift that now ends at coordinates 620 S - 380 W. Contract No. 1 worked in the same ore vein as Contract 58 but in a location about 500' west of Contract 58. This crew breast stoped west on the 1145' sub-level. The ore vein is overlain by slate hanging wall that dips south at an angle of about 40° Dike constitutes the footwall of this ore vein and it also dips south.

The No. 2 area adjoining the "A" Shaft workings was developed, to some extent, by Contract No. 2 which breast stoped southeast to coordinates 1370 S - 2320 E on the 4th level elevation. At the same time this work was going on, Contract 21 completed a raise from the 5th level to the 4th level elevation at coordinates 1415 S - 2280 E. All of this work proves that the No. 2 area which is an anticlinal structure has an ore vein that is continuous with the north limb of the main Section 10 syncline ore body. No rock limits have been encountered by No. 2 Contract except the slate hanging wall which lies on top of the ore at the 2nd level elevation. The ore body in which Contract No. 2 mined is at least 120' wide at the 4th level elevation.

Five crews worked in the No. 3 area which is the north limb of the so-called main Section 10 syncline. On the 5th level, Contract No. 21, as mentioned in the paragraph above, put up a raise from the 5th to the 4th level. Contract No. 80 drifted west from the top of their raise at the 5th level and thereby connected to a drift being driven east by No. 96 Contract. As soon as this connection was

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

1. Section 10 Lease: (Cont'd)

established, Contract No. 80 started drifting east in the ore vein, finally extending it to coordinates 1515 S - 2370 E. Contract No. 96 also drifted on the 5th level but they developed the ore vein to the west stopping at coordinates 1390 S - 1720 E. Some jasper was encountered in this drifting but by and large, most of the work performed by all three of these contracts was in first class ore. The average width of the ore body at this elevation should prove to be in excess of 50'. One crew, No. 25, started breast stoping on the 5th level elevation in the last month of 1946 near the juncture of the east and west drifts. They have not developed enough area to actually prove the width of the ore vein but so far only the hanging wall limit has been established. In the latter part of the year, Contract No. 80 was moved to the 7th level elevation where they started a breast stope operation at coordinates 1550 S - 2220 E. At this elevation the ore vein is bounded on the south side by slate hanging wall which dips to the south at an angle of about 60°. The north limit of the ore vein has not been determined. In the latter half of the year 1946, Contracts 74 and 96 had completed two raises and started two others from the 8th level elevation. All of them are located in the drift which extends longitudinally through the west portion of the ore vein. The first completed one is at coordinates 1510 S - 1950 E and the second one at 1475 S - 1850 E. The other two raises were started at coordinates 1440 S - 1750 E and 1405 S - 1650 E. All of these raises are to connect the 8th and 5th levels and all of them have been in ore as far as they have been completed to date. Some additional drift will have to be driven on the 5th level in order to connect with the last two raises mentioned above.

In the coming year we plan to drive an additional 200' of drift on the 10th level in the Section 10 Lease. This will be advanced southeast toward the Moro Mine workings and from the breast of this drift we expect to drill a drainage hole to the Moro Mine. On the 8th level we plan to drift east along the footwall contact as long as the ore vein persists in that direction. From this drift we think we can put up raises to encounter the ore shown in old diamond drill hole No. 392 drilled from the 5th level, Southeast Vein. It may also be possible to extend these raises high enough to connect with the workings of 45 Contract in the Southeast Vein at the 4th level elevation.

2. "B" SHAFT PILLAR AREA:

In April of 1945, 86 Contract was moved to the 11th level in an area which had been selected for the purpose of testing the strength of the roof arch. No absolute criteria are known on which to base the ultimate size of any single stope in the Cliffs Shaft Mine or the size and number of supporting pillars to be left in the mine.

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

2. "B" Shaft Pillar Area:

Dr. Leonard Obert of the Bureau of Mines has contended that the majority of the Cliffs Shaft stopes were kept too small and the number and size of pillars too large. In order to demonstrate this contention, he asked if we had any area in the mine where we could remove some pillars without danger to any of the active working areas. The place selected was on the 11th level about 1200' west of "B" Shaft on the north limb of the "B" Shaft syncline. This area is about 200' in diameter and contains about a dozen pillars. It was considered to have been worked out approximately 20 years ago and therefore to have been depleted of all ore reserves. The stopes are overlain by slate and conglomerate that grades into massive quartzite which extends several hundred feet to ledge. During 1945, three pillars were removed from this area while the Bureau of Mines conducted listening tests with Geophone equipment. The Geophone records indicated a loosening of some small shells of rock in the backs of the stope after removal of these pillars but as soon as this material was barred down no future movement was indicated by the Geophones. Ultimately, we expect to remove at least one more pillar and we have every reason to believe that such pillar removal has not increased the stress on the roof arch to a degree that even remotely approaches the possibility of general rupture strain of this roof arch. We also discovered that there was a great deal of ore that could be mined from the floor of this stope area and during 1946, Contract 86 was engaged exclusively in floor stoping which will be continued until such reserves have been completely depleted before any further pillar removal is attempted. By the end of 1946 we had mined approximately 11,800 tons of ore from this area which was supposed to have been depleted years ago.

3. Cliffs Shaft and Bancroft Lease:

The table below shows the number and percentages by months of developing gangs in the mine.

Month	Total Number of Gangs	Gangs Developing	% Developing in Mine
January	82	33	40.2
February	81	36	44.4
May	80	28	35.0
June	86	36	41.8
July	86	36	41.9
August	89	39	43.8
September	89	37	41.5
October	88	40	45.4
November	89	41	46.1
December	92	42	45.6
Monthly Average	86.2	36.8	42.7
Year 1945	84.2	38.5	45.7
Year 1944			49.8
Year 1943			54.9
Year 1942			53.5
Year 1941			61.0
Year 1940			54.5

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

From the table above it may be seen that the average number of developing crews again decreased. This is possibly the lowest percentage of crews working on development in the history of the mine. Some of these development crews were double mining gangs some of them employing as many as 3 miners to the crew. Of the total average number of gangs working in the mine during the year 12.25 crews or 14.2% did direct development work such as drifting and raising. They were credited with a total of 4,430' of footage in rock and ore which is at the rate of 30.1' per gang per operating month. In 1945 we had 11.9 crews which drifted or raised for a total of 5,122' or about 35.8' per gang per operating month. The decrease in footage cannot be considered as a decrease in efficiency however, because some of these development crews spent a large part of the year engaged in stripping drifts in order to improve the haulage system. It is difficult to properly credit such crews with footage equivalents and therefore the total footage shown for the year is smaller than it would have been if these crews were all engaged in driving virgin drifts or raises.

No new ore-bearing areas were discovered in the mine during 1946 by either diamond drilling or exploratory mining. With the exception of a possible extension to the west of the "B" Shaft ore-bearing horizon on either the north or south limb of the "B" Shaft syncline, it is unlikely that there are any new ore-bearing areas within the limits of the Cliffs Shaft Mine which we do not already know about. From the standpoint of reserves the most promising areas are the Section 10 Lease and the portion of the mine in the extreme east end of the "A" Shaft workings between the 10th and 4th levels. In the latter area, Contracts 31, 61, 81 and 101 continued to develop ore veins by drifts, raises and breast stopes.

The diamond drill exploration, which was started in 1945 in the upper levels of the "B" Shaft Section 9 territory, was completed in the early part of 1946. The last hole drilled was No. 568 on the 3rd level elevation. No ore was discovered on the 3rd level and only one additional run of ore was encountered on the 1st level elevation in Hole 565. Any further diamond drill exploration of the Section 9 territory seems futile in the light of present knowledge of that area. We probably will do some exploratory mining trying to follow the narrow ore veins which have been encountered with the hope that some of these may attain sufficient width to supply a commercially stopable tonnage.

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

"A" SHAFT
1st Level

In the last 3 months of 1946, Contract No. 30, located on the 1st level at coordinates 310 S - 665 E, breast stoped east in a vein of ore that dips about 5° to the south beneath slate hanging wall. This is part of the Main Vein and the work carried on by Contract 30 is merely an extension of old workings. Some of the floor from this area can be mined in the future although the territory in general is underlain by second level stopes.

2nd Level

In the Bancroft Lease, Contract No. 29 spent the entire year developing the ore vein originally discovered by Diamond Drill Holes 524 and 526. The largest run of ore was in Hole 524 and the mining crew drifted due north along the course of this hole a total distance of 120' in order to open up the ore vein. In spite of the long run of ore in the drill hole, the drift encountered no stopable body of ore. On the contrary, the ore vein was scarcely wider than the drift, bounded on the east side by slate hanging wall which dips to the east at an angle of about 50° and on the west side by dike which also dips to the east. At the end of the drift at coordinates 530 N - 1235 E, the slate and dike converge with the result that the ore body is pinched out completely. In the latter part of the year, Contract 29 resumed breast stoping at coordinates 440 N - 1200 E. This stope was advanced to the north on dike footwall which dips east at an angle of approximately 40°. Although mining development to date seems to belie the encouraging results of diamond drill exploration in this territory, we do believe that some additional ore reserves will be exposed for stoping purposes.

About 700' southwest of Contract 29, Contract No. 5 completed a raise in the first part of 1946 by holing to the 2nd level in an old stope at coordinates 50 S - 785 E. Ore mined from the floor of the 2nd level stope has been removed through this raise since its completion. We also expect to remove ore through this same raise from the back of an old stope on the 2nd level approximately 150' west of the top of the raise.

3rd Level

There were 2 crews that did development work on the 3rd level during the past year. Contract No. 9 completed the raise started in 1944 by Contract 74 and holed to the 3rd level at coordinates 150 S - 1075 E. This 3rd level stope was full of rock all the way to the 2nd level. It will be necessary to remove this rock before ore in the floor of old 2nd level stopes directly above this territory can be made available for mining. There might also be a pillar available on the 2nd level which can be taken out through this raise. The other contract which did development work was No. 27 Contract located about 400' west of this area. This crew advanced a breast stope east at an elevation about 25' below the 3rd level and made one cross cut south near the

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

western end of their east-west stope. The ore mined in this stope is mixed with some jasper and sometimes it drops to second grade ore as far as quality is concerned. All of the stope development is below old 3rd level stopes which are rock-filled to the 2nd level. Consequently, enough ore must be left in the back of 27 stope to carry the rock fill.

4th Level

At the approximate location of 200 S - 500 E, Contract No. 57 mined some floor from their breast stope but they also advanced the breast of their workings southeast and then south thereby forming a pillar when they holed to the southernmost stope of their working territory. The ore vein seems to have no definite dip but is mostly horizontal. It consists of magnetite ore limited in the back by siderite but in the most northerly of the two stopes the ore extends down toward the 5th level an unknown depth. We have plans for putting up a new raise into this most northern stope from the 5th level.

Aside from Contract No. 2, whose work was discussed under Section 10, the only other contract that did development work was No. 92 located at coordinates 200 S - 1400 E. Starting on the 4th level in the raise which connects the 5th and 3rd levels in the area under discussion, Contract No. 92 cut out a breast stope approximately 50' square to the east and north of the raise. The ore vein dips about 20° to the north under slate hanging wall and is limited on the footwall side by dike the dip of which seems to be approximately 40° to the north.

5th Level

There were 7 crews engaged in development work on the 5th level elevation during the past year. Four of these namely, 21, 25, 80 and 96 worked in the Section 10 area. Their work is discussed under that section in a previous portion of the report. On the Cliffs Shaft fee lands, Contract No. 45 spent a portion of the year doing depleting work by mining floor in the Southeast Vein at coordinates 1200 S - 2730 E but they also did some development work about 50' east of this floor-stoping operation by putting up a raise stope towards the southeast. This raise stope was advanced under slate hanging wall and above dike footwall both of which dip to the north. The ore vein is about 30' thick in this area and continues undiminished to the east for an unknown distance.

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

Due east of "A" Shaft 500', Contract No. 66 established a connection between the 5th level stopes and the top of a raise put up from the 8th level. After thus providing ventilation and a traveling road this crew cut out around the top of the raise and breast stoped west in a vein of ore that dips nearly vertically, bounded on the south side by slate hanging wall and on the north side by dike. Directly overhead, the ore grades rapidly into very lean jasper. Ultimate extent of this ore vein to the west and also to the east has not been established by any exploration although there are good possibilities that the ore might continue for another 100' in either direction.

Contract 104 completed a raise between the 5th and 3rd levels at coordinates 750 S - 680 E. This raise started in sideritic chert and jasper but entered ore approximately 30' below the floor of the 3rd level. We expect to mine ore from the floor of old 3rd level workings tributary to this raise. There also are some pillars which can be mined in this same general area.

6th Level

Contract No. 51 worked all year in the area located at approximately 220 S - 2570 E. This gang mined some floor from stopes originally cut at an elevation slightly above the 6th level but they also advanced a breast stope west to connect to a raise put up from the 8th level by Contract No. 5 at coordinates 210 S - 2530 E. The ore around the raise is mixed with some jasper and because the quality was poor, Contract 51 was moved back to their more easterly raise where they have started to mine floor. In addition to the ore in the floor, we think that some reserves will be exposed by breast stoping to the south and west.

At coordinates 400 S - 2800 E, Contract No. 67 spent the entire year breast stoping or raise stoping in a vein of ore that strikes east and west and dips about 55° south under slate hanging wall. In the first part of the year they advanced the breast stope to the west and then from this position, raise stoped due north to connect with old workings at the 6th level elevation. After removing the bench from this raise stope, 67 Contract will be able to resume breast stoping in the ore exposed at the west breast. If the ore vein continues to parallel the hanging wall there is a possibility that this crew will be able to make an advance of 200' to the northwest before encountering old workings.

In the extreme northeast portion of the 6th level, Contract 31 eas engaged in development work throughout the entire year. This crew started their operations on the 7th level by connecting a drift to 61 stope at coordinates 200 N - 3540 E. On the 7th level they also cut out a small stope north of these coordinates around the top of their raise which extends down to the 8th level. After this, 31 Contract resumed raising to the east and advanced this development to the 6th level elevation where they cut out a small stope in a body

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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

of first class ore at coordinates 260 N - 3600 E. The ore vein strikes slightly north of east and is bounded on the north and south sides by vertical dike. We plan to have 31 Contract follow this ore to the southwest. If the ore does not persist all the way to permit connection with the old drift shown on the map, such a connection will be established by drifting through rock if necessary. This will provide a traveling road and good ventilation into the area where the ore exists on the 6th level, thereby permiting further development on that elevation and above.

7th Level

700' east of "A" Shaft in the Main Vein, Contract No. 98 raised from the 7th to the 6th level at coordinates 415 S - 1490 E. This raise was put up in ore but encountered rock just above the 6th level elevation and was therefore stopped. For all practical purposes, the crew removed all the ore which they developed by stripping the raise to a size slightly larger than normal. We had hoped to find a stopable body of ore in the area where ore was shown in old drill hole No. 54 on the 6th level. The ore vein developed by this crew proved disappointing in this regard. Contract 98 also put up a small raise stope to the north at coordinates 470 S - 1550 E. This stope also exhausted the ore pocket and for the remainder of the year Contract 98 was engaged in mining floor of old workings.

In the northeast part of the mine, Contract No. 61 mined ore from both ends of their east-west stope although the major portion of their activity was in the eastern end of this ore vein at coordinates 150 N - 3575 E. At this location they started a cross cut to the north and advanced a breast stope to the east. Good ore remains to be mined in the face of both these stopes and Contract 61 is expected to continue developing this ore vein by breast stoping. The ore vein is bounded on the north and south sides by vertical dike, the thickness of the northern dike being approximately 30' whereas the thickness of the southern dike has not been established. We know that there is ore on the north side of the north dike but we are not sure of the existence of ore south of the southern dike although we have good reason to believe that this dike is the narrower of the two.

The development work performed by Contract's 74 and 96 in the Section 10 Exploration was discussed under another section of this report.

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

Aside from the Section 10 crews on the 8th level there were 6 gangs that did development work during the year 1946. These were namely, 41, 50, 54, 11, 26 and 81. The first of these worked in 4 different locations on the 8th level. In the first part of the year, Contract 41 drifted east from coordinates 240 S - 1710 E in order to explore for the ore shown in old diamond drill hole No. 260. The drift encountered this ore which is of excellent quality and it also holed to an old drift headed southwest from Contract 54 stope. Ultimately, this ore will be removed by mining from 54 stope. At the completion of this drift, Contract 41 was moved to a location just east of "A" Shaft where they stripped the main haulage drift in order to provide more room for motor trains. All of this work was in footwall siderite and dike. After completing the stripping operation, Contract 41 was moved to the extreme northeast part of the 8th level where they drifted 140' northeast from coordinates 70 N - 3480 E. This drift was extended through jasper and some ore in order to reach a location from which a new raise could be put up to 61 stope on the 7th level. In the very last part of the year, Contract 41 drove 125' of drift northeast starting at coordinates 460 S - 2650 E. The primary purpose of driving this drift, which incidently discovered some good ore along its course, was to eliminate the track haulage from the stope located at coordinates 330 S between 2680 E and 2780 E. By removing the haulage from this latter stope we made the ore available in the floor for mining by Contract 95 which had nearly completed ore removal from their stope to the west of this territory.

Contract 50 started the year by putting up a short section of raise to coordinates 150 S - 3470 E. This raise had been started in the previous year with the intention of connecting the 8th level to the east end 4th level workings. We stopped the raise early in 1946 because there was some question of hazard from water contained in old No. 3 mine workings that come within about 70' of this raise. Contract 50 was then moved to coordinates 240 S - 1400 E where they put up a raise from the 8th level to the 5th level. This raise holed to the floor of old 76 stope on the 5th level and will be used to remove the ore mined from the floor of this stope area.

In the early part of the year, Contract 54 did depleting work on the 7th level and mined floor on the 8th level at coord inates 210 S - 1900 E. From this latter floor-stoping area in the last part of the year, Contract 54 breast stoped west into virgin ground that consists of first class specular hematite ore. Test hole drilling has established the fact that this ore is part of the same vein discovered by 41 Contract where they drifted east to cut old drill hole No. 260.

In the latter part of 1946, Contract No. 11 was engaged in stripping a raise which starts on the 8th level at coordinates 630 S - 3290 E. This raise extends to the 6th level and thence by drift east to connect with the bottom of the old Incline Mine. A large proportion of the air which ventilates the Cliffs Shaft Mine passes through this raise.

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

In order to improve the general ventilation of the mine, a fan was purchased under E & A CC-150. This fan is to be installed at the bottom of the Incline Mine in order to increase the air flow. In order to accomplish this it was necessary to increase the size of the raise and drift leading from the bottom of the Incline Mine to the 8th level. Contract No. 11 was delegated to do this work.

Contract No. 26 completed the raise started by No. 5 Contract at coordinates 200 S - 2470 E. This is the raise that holed to the breast of 51 stope on the 6th level. We had anticipated encountering ore before holing to the 6th level but this did not prove to be the case although the territory to the west of this raise has not been explored. After the completion of the above-mentioned raise, Contract 26 put up another raise from the 8th level to the 7th level at coordinates 130 N - 3550 E.

In August of 1946, Contract 81 started as a new gang attempting to develop the ore encountered in the raise which connects the 10th with the 6th level in the area located by coordinates 150 N - 3250 E. By the end of the year this crew had succeeded in opening up a body of ore slightly below the 8th level elevation. The ore vein is believed to strike east and west and is bounded on the north side by dike. No rock limits have been encountered on the south side of the small stope which this crew had opened up by the end of the year.

9th Level

In the Bancroft Vein at coordinates 125 N - 1920 E, Contract 69 breast stoped south from the traveling road raise to connect with old stopes from which the floor had been mined to an elevation about 10' below the 9th level. We believe there is ore to be mined west of this territory as well as in the floor of the new stope. Certainly a great deal of ore can be mined from the floor of the old workings before we reach the elevation of the 10th level.

In the east end of the "A" Shaft workings at coordinates 725 S - 2900 E, Contract 68 increased the size of the stope in which they are working by breast stoping west at an elevation midway between the 9th and 10th levels. They also drifted southwest a distance of 75', mining a vein of ore about 10' wide that is overlain by dike and bounded on both ribs by dike. In other words, the drift removed all of the minable ore from this vein. There does not seem to be much possibility of extending the breast stope much further west because lean jasper is now exposed in the breast. Future activity of 68 Contract will be limited to mining floor of the raise stope that connects this area with the 11th level.

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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

Contract 101 connected two raises at the 9th level elevation by driving 75' of drift. Half of this drift was driven in ore and the last half in jasper. After establishing the connection which provided ventilation and a traveling road, this crew started to stope around the most easterly raise at coordinates 300 N - 3475 E. On the north side, this stope is limited by steeply dipping slate and on the south side by dike which is nearly vertical in its attitude. Good ore remains to be mined to the east and Contract 101 will continue to develop the vein along the strike by breast stoping in that direction.

10th Level

There were 4 crews that worked on the Bancroft Lease at the 10th level elevation during 1946. Contract No. 10 breast stoped approximately 70' east to coordinates 0 S - 2140 E. The ore vein in this territory is horizontal in its attitude but it is bounded on the south side by a vertical fault that juxtaposes dike footwall against the ore.

About 400' east of the area discussed above, Contract 53 did some depleting work by mining floor but they also advanced a breast stope north a distance of 30' to coordinates 90 N - 2500 E. Good ore remains on both sides and in the breast of this latter stope but not all of it can be mined because it will be necessary to establish pillars in line with pillars on the sublevel above.

At coordinates 160 N - 2330 E, Contract 84 stripped both sides of the old 10th level drift forming a stope about 30' wide. This ore was being scraped up an inclined bench to a raise which would discharge it on the 10th level. Because of this inconvenient method of handling the ore, Contract 84 was moved to the 11th level. The ore remaining in the 10th level floor will be mined and removed through a raise and transfer drift that we plan to develop on the 11th level.

Contract No. 89 breast stoped south and west at coordinates 340 N - 1900 E. The ore vein in this territory strikes east and west and apparently is either faulted or folded because the southern part of the ore vein has a nearly horizontal attitude whereas the northern part of the ore vein dips very steeply to the north underneath slate hanging wall. The north portion of the ore vein consists of conglomeritic ore whereas the southern part is made up of specular hematite or slate ore. The limitations of the conglomerate ore seem to be well established but the extent of the flat portion of the ore body has not been well defined.

Just east of the east boundary of the Bancroft Lease at coordinates 250 N - 2680 E, Contract 91 put up a short raise from the 10th level to the floor of old 91 stope about 20' above the 10th level. A considerable portion of the floor of this old stope consists of first class ore which dips north extending down to the 11th level.

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7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

In the main part of the Cliffs Shaft workings there was one crew that did development work on the 10th level, namely, Contract No. 3. Actually, this crew worked at an elevation about 25' below the 10th level where they advanced their breast stope east to coordinates 730 S - 2120 E. The stope area is overlain by slate hanging wall and underlain by old 11th level stopes.

11th Level

In the Bancroft Vein, Contract No. 84 spent the major portion of the year breast stoping both to the east and west in a vein of ore that dips north under slate hanging wall. The approximate location of this activity was at 260 N - 2200 E. In the last part of the year we started a drift southeast from the east breast of this stope, which we plan to use as a transfer drift enabling us to mine the ore in the floor of the 10th level where Contract 84 had been mining in the first month of 1946.

East of the Bancroft boundary at coordinates 270 N - 2740 E, Contract 62 breast stoped through first class ore lying between dike footwall on the south and slate hanging wall on the north. The vein dips about 80° to the north. The dike and slate are converging to the east and if this condition persists, the ore vein will disappear. We know, however, that formation extends hundreds of feet to the east above this point on the 10th level elevation. A short raise was put up by Contract 62 to the 10th level floor at coordinates 240 N - 2690 E. The ore mined in 91 stope above the 10th level is removed through this raise and transferred through 62 stope on the 11th level ultimately finding its way to the chute on the 15th level.

In the Main Vein, Contract No. 7 spent the entire year raise stoping between the 11th and 10th levels. Actually, the raise stope had advanced above the 10th level by the end of 1946. Site of this activity is 410 S - 2300 E. Some good ore remains in the back and both ribs of this raise stope. Ultimately, it is expected that the stope will hole to old 9th level workings.

12th Level

Contract 79 did development work in the first part of the year when they raise stoped from the 12th level at coordinates 700 S - 2230 E. This raise stope holed to the floor of 11th level workings which 79 crew continued to mine in the succeeding months of the year.

"B" SHAFT
1st Level & Subs above the 1st Level

On the 1165' sublevel, Contract No. 17 breast stoped west to connect with old workings at coordinates 730 S - 20 E. This is a conglomerate ore vein that strikes east and west and dips north about 25°

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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

under slate hanging wall. Through most of this area the ore vein is underlain by a seam of slate which separates the conglomeritic ore from the specular ore that in some places, occurs underneath this territory.

2nd Level

At the extreme west end of the South limb of the "B" Shaft syncline, Contract No. 38 breast stoped east a total of 90' in a vein of ore that strikes nearly east and west and dips north under slate hanging wall. Eventually, this stope will connect to old workings from which the floor has been mined. The ore vein continues to the west but is scarcely more than drift wide and therefore, there is little hope of developing any stoping ore in that direction.

4th Level

Contract No. 13 spent the entire year breast stoping east to coordinates 230 S - 130 W. The second class ore mined by this contract is limited in the back and ribs by jasper. Actually, there is no well-defined boundary between the second class ore and jasper which makes it very difficult to mine a uniform product from the stope. Because of this situation, it may be that Contract 13 will be moved, in the ensuing year, to a new location.

5th Level

Late in 1945 we recognized that Contract 33, on the 4th level, needed a new raise near the breast of their east-west stope. In order to provide such a raise it was necessary to drift on the 5th level and Contract 63 started this work in the latter part of 1945. During 1946 they continued to drift east from coordinates 560 S - 350 W. Most of the ground penetrated by the drift consists of ore similar to that mined in 33 stope which the drift parallels. By the end of the year the drift had been advanced a total of 210' and a raise had been completed up to 33 stope at coordinates 580 S - 200 W.

6th Level

In the first part of 1946, Contract No. 90 worked on the 8th level but in the last part of the year this crew spent a couple months on the 6th level drifting west to coordinates 700 S - 1375 W. This drift is an extension of an old drift in the hanging wall ore vein. The ore is about 10' thick, strikes east and west and dips north about 65° under slate hanging wall. Aside from serving as an exploratory drift, we intend to use this drift as a means of getting at the ore which we know to exist in the back of a raise put up by 14 Contract from the 10th to the 6th levels at coordinates 850 S - 1590 W.

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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease: (Cont'd)

8th Level

The development work that Contract 90 performed in the early part of 1946 consisted of breast stoping north to coordinates 70 N - 110 W. This cross cut development exhausted all the ore reserves in that area which necessitated the removal of the mining crew.

9th Level

At coordinates 100 N - 720 W, Contract No. 36 put up a number of small raise stopes from a sublevel below the 9th level elevation to a sublevel slightly above the 9th level elevation. By the end of the year, however, they had nearly completed the mining of the known ore reserves in this North Vein.

Contract 88 spent 5 weeks developing in the Section 9 deposit where they advanced two drift headings; one at coordinates 820 S - 4260 W, the other at 840 S - 4290 W. Aside from the diamond drilling on the 1st and 3rd level elevation, this constituted the only activity in the Section 9 area for the entire year. Some ore remains to be mined where 88 Contract was engaged in their development work and there are ore veins of a small size on the 1st level elevation which should be developed. Any work performed in the Section 9 deposit would have to be classified as distinctly exploratory rather than development work.

10th Level

On the 10th level, Contract No. 28 put in the entire year of 1946 improving the haulage roads by stripping drifts. One of these was the footwall drift located in the area at coordinates 650 S - 1100 W. The other is the drift leading west from "B" Shaft. None of these drifts were large enough to permit the passage of our 76 cu. ft. steel cars and inasmuch as the small cars were wearing out, we felt it better to strip the drifts and utilize the larger cars rather than invest money in additional small cars.

12th Level

At coordinates 50 S - 975 W, Contract No. 40 put up two raise stopes to the northeast and then connected these 2 raise stopes by a cross cut. The ore vein being mined by this crew strikes northwest-southeast and dips southwest. It is bounded on both foot and hanging by dike. Additional ore can be mined from the ore vein either by raise stoping at points to the southeast or by stripping the southeast rib of the present raise stope.

14th Level

In the latter part of 1946, Contract 37 did development work by advancing a breast stope east to coordinates 250 S - 1390 W. Some good ore remains in the floor of this stope but the back is overlain by jasper capping.

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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft, Bancroft and Section 10 Lease:

The following table shows the gangs that did development work during 1946. The tonnage after each is the amount broken by these crews in development and allocated to the proper level by estimate.

	Contract Number	Mine Tally Ore	Mine Tally Rock	Shifts Mining	Shifts Barring While Developing
"A" SHAFT					
1st Level	30	347		42½	4
2nd "	29	1,846	745	261	
3rd "	5	413	133	31	
4th "	2	3,958		213	
	5	-	265	31	
	27	2,927		211	6
	57	3,692		194	
	91	51		23	
	92	3,126	250	157	40
5th "	21	520	77	150	
	25	265		24	
	45	632		30	
	66	4,304	5	202	3
	80	1,861	5	248	
	96	1,173	15	222	
	104	372	806	144	
6th "	11	158	1,224	73	
	51	4,937		217½	
	98	434	31	68	9
7th "	31	2,734	92	197	
	61	4,814	20	188½	1
	67	3,805		205½	10
	80	1.030		36	
	81	964	36	96	
8th "	26	148	214	161	
	41	3,458	1,757	641	
	50		806	186	
	54	2,586		125	
	74	1,352	46	179	5
	79	148	663	31	
	96	2,698		85	
9th "	101	2,474	275	213	4
10th "	10	3,636	5	183	32
	68	2,191		198	4
	69	4,524	92	124	4
	89	3,963	46	210	
11th "	3	3,501		117	53
	7	209		213½	2
	53	3,045	204	98	2
	62	5,569	56	204	10
12th "	84	3,631		189	
Total "A" Shaft		87,496	7,868	6,422½	189

CLIFFS SHAFT MINE
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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft, Bancroft and Section 10 Lease: (Cont'd)

	Contract Number	Mine Tally Ore	Rock	Shifts Mining	Shifts Barring While Developing
"B" SHAFT					
1st Level	1	2,907		172	
	17	5,049	10	176	3
2nd "	38	5,852		149½	
4th "	13	4,871		190	27
5th "	63	3,057	449	435	
6th "	90	-		44	
7th "	88	270		32	
8th "	90	806		79	
9th "	36	4,294	71	215½	
10th "	28	-	8,632	378¾	
12th "	40	5,047		212	2
Total "B" Shaft		32,153	9,162	2,083¾	32
Grand Total Developing		119,649	17,030	8,506¼	221

The contract sheet tonnage, exclusive of overrun, equals 385,927 tons. The 119,649 tons mined by developing gangs is 31% of the total.

The table below gives the mine tally production totals without overrun for the past six years:

1941	642,327	Tons
1942	(1) 690,266	"
1943	629,555	"
1944	569,871	"
1945	535,454	"
1946	386,160	"
Total	3,453,633	"

(1) Actual tally is 694,807 tons which includes 4,541 tons of Incline Lump.

Developing gangs have mined the following tonnages during the past six years:

1941	281,542	Tons
1942	310,365	"
1943	252,869	"
1944	206,926	"
1945	184,510	"
1946	119,649	"
Total	1,355,861	"

From 1941 to 1947, developing gangs mined 1,355,861 tons (39.3%) per the contract sheet tally and depleting gangs mined 2,095,438 tons (60.7%) making a total of 3,451,299 tons. Total mine tally by skip count for the same period is 3,453,633 tons without overrun.

CLIFFS SHAFT MINE
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YEAR 1946

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft, Bancroft and Section 10 Lease: (Cont'd)

The following table gives the average number of development gangs, the tonnage mine by them, the shifts involved and the tons per gang per shift for the past six years:

Year	Avg. No. of Gangs on Ore Development	Tonnage Mine Tally	Shifts Worked	Tons Per Gang Per Shift
1946	36.8	119,649	8,727¼	13.71
1945	38.5	184,510	11,395	16.19
1944	48.1	206,926	14,786½	13.99
1943	56.2	252,869	16,836½	15.02
1942	55.4	310,365	16,946½	18.31
1941	61.0	281,542	12,611	22.32

b. Stoping:

	Contract Number	Location by Coordinates at Approx. Center of Operations	Character of Work
"A" SHAFT			
2nd Level	30	275 S - 670 E	Mining Floors
	34	80 S - 540 E	" "
3rd Level	5	30 S - 800 E	" "
	12	350 S - 1400 E	" "
4th Level	8	350 S - 3300 E	" "
	9	0 S - 1180 E	Mining Floors & Pillar
	92	190 S - 1410 E	Mining Floors
5th Level	22	140 S - 1240 E	" "
	45	1200 S - 2720 E	" "
7th Level	20	170 S - 2130 E	Mining Pillar
	61	120 N - 3425 E	Mining Back
	66	100 S - 2600 E	Mining Floors
	98	500 S - 1570 E	" "
8th Level	6	1200 S - 1920 E	" "
	15	225 S - 2810 E	Mining Back
	52	300 S - 2330 E	Mining Floors
	54	200 S - 1970 E	" "
	59	500 S - 1820 E	" "
	82	130 S - 1825 E	" "
	95	330 S - 2460 E	" "
9th Level	16	300 N - 1600 E	" "
	46	650 S - 1390 E	" "
	55	1075 S - 2650 E	" "
	64	250 N - 2900 E	" "
	65	1030 S - 2290 E	" "
	78	20 N - 3040 E	" "
10th Level	4	500 S - 1900 E	" "
	15	590 S - 1730 E	" "
	23	90 N - 2560 E	" "
	35	550 S - 2950 E	" "
	69	150 N - 1910 E	" "
	70	150 N - 2520 E	" "
	91	240 N - 2700 E	" "

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YEAR 1946

7. UNDERGROUND: (Cont'd)

b. Stoping: (Cont'd)

	Contract Number	Location by Coordinates at Approx. Center of Operations	Character of Work
"A" SHAFT			
11th Level	3	740 S - 2100 E	Mining Floor
	53	0 S - 2530 E	" "
	84	160 N - 2325 E	" "
12th Level	24	675 S - 2330 E	" "
	39	570 S - 2000 E	" "
	60	650 S - 2690 E	" "
	79	680 S - 2230 E	" "
	83	650 S - 2500 E	" "
"B" SHAFT			
1st Level	1	1260 S - 200 E	Mining Floor
	17	775 S - 280 E	" "
	18	900 S - 400 E	" "
	38	900 S - 1325 W	Mining Sides of Drift
	58	875 S - 100 W	Mining Floor
	75	1200 S - 150 W	" "
	85	1150 S - 100 E	" "
2nd Level	58	1240 S - 750 E	" "
	73	430 S - 300 W	Mining Back
3rd Level	72	430 S - 350 W	Mining Floor
5th Level	32	90 S - 260 W	Mining Pillar
	33	600 S - 330 W	Mining Floor
	42	50 S - 25 W	Mining Back
	49	800 S - 1275 W	Mining Floor
	71	420 S - 670 W	" "
7th Level	19	600 S - 1240 W	" "
	56	490 S - 770 W	" "
	87	30 S - 420 W	Mining Back
	100	650 S - 950 W	Mining Floor
9th Level	77	220 S - 525 W	" "
10th Level	93	380 S - 800 W	" "
	14	740 S - 1460 W	Mining Floor & Back
12th Level	86	100 S - 1175 W	Mining " & Pillar
14th Level	43	420 S - 1475 W	Mining Floor
	48	290 S - 1630 W	Mining Floor & Back
15th Level	37	240 S - 1450 W	Mining Floor & Back

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YEAR 1946

7. UNDERGROUND: (Cont'd)

b. Stoping: (Cont'd)

The table below shows the ore broken by the stoping gangs mining developed reserves:

	Contract Number	Mine Tally Ore	Mine Tally Rock	Shifts Mining	Shifts Barring While Depleting
"A" SHAFT					
2nd Level	30	1,214		120	45
	34	5,891	36	190	25
3rd "	5	2,917	1,566	124	18
	12	5,386	5	154	111
4th "	8	3,351		118	
	9	3,203		164	76
	92	-		12	
5th "	22	3,024		177	
	45	5,799		185½	
7th "	20	342		176	11
	61	-		4	22
	66	199		12	
	98	2,784		126	11
8th "	6	4,519		213	4
	15	1,709		51	2
	52	1,520		49	1
	54	3,983	5	83	
	59	5,176		201	16
	82	6,003	117	215	
	95	3,973		204	3
9th "	16	4,386	23	191¾	19
	46	3,478	20	175	33
	55	9,565	15	196	20
	64	4,697	5	200	4
	65	4,034	56	185	10
	78	12,112		209	8
10th "	4	1,290	117	61	
	15	4,337		157	7
	23	7,048	219	205	12
	35	2,611	20	207	10
	69	2,560		89	
	70	5,513	143	211	
	91	479		22	
11th "	3	-	31	14	17
	53	4,085	143	117	
	84	153		26	
12th "	24	3,901		213	3
	39	6,202		181	29
	60	-		16	20
	79	2,948	51	153	12
	83	3,458		201	3
Total "A" Shaft		143,850	2,572	5,608¼	552

CLIFFS SHAFT MINE
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YEAR 1946

7. UNDERGROUND: (Cont'd)

b. Stoping: (Cont'd)

	Contract Number	Mine Tally Ore	Mine Tally Rock	Shifts Mining	Shifts Barring While Depleting
"B" SHAFT					
1st Level	1	923	13	45	
	17	928		33	
	18	4,335	120	162	23
	38	1,219	43	65	
	58	4,927		138	
	75	2,739		188½	18
	85	4,603	76	211	6
2nd "	58	2,081	5	69	3
	73	2,091		116½	53
3rd "	72	7,295	36	211	5
5th "	33	6,449	5	212½	
	71	4,297		208	8
6th "	32	209		6	
	42	5,113		189	9
	49	7,135	61	196	4
7th "	19	5,819	61	197	10
	56	7,171		190	
	87	7,505		210	7
	100	6,961	219	181	7
9th "	77	7,558		197	
10th "	14	4,462	133	199½	
	93	6,923	41	189	11
12th "	86	6,625	66	149½	8
14th "	43	3,820		179½	14
	48	4,019		211	
15th "	37	7,221		157	48
Total "B" Shaft		122,428	879	4,111	234
Grand Total Depleting		266,278	3,451	9,719¼	786

The mine tally from the contract sheets was 385,927 tons of which the depleting gangs broke 69%.

The following table gives a six year comparison:

Year	Avg. No. of Gangs Stoping	Tonnage Mine Tally	Shifts Worked	Tons Per Gang Per Shift
1946	49	266,278	10,505¼	25.35
1945	46	350,312	13,619¼	25.72
1944	48	364,650	13,984	26.07
1943	46	377,262	13,569½	27.80
1942	48	379,801	14,250	26.65
1941	40	357,135	13,961	25.58

CLIFFS SHAFT MINE
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YEAR 1946

7. UNDERGROUND: (Cont'd)

c. Drifting and Raising: (Cont'd)

Year	Rock Drifts and Raises	Ore Drifts and Raises	Total
1946	1,873'	2,557'	4,430'
1945	1,969'	3,153'	5,122'
1944	3,814'	4,108'	7,922'
1943	5,180'	4,059'	9,239'
1942	2,855'	3,166'	6,021'
1941	2,196'	3,411'	5,607'
1940	1,756'	3,242'	4,998'
1939	2,130'	2,270'	4,400'
1938	2,337'	1,955'	4,292'
1937	4,292'	2,895'	7,187'

d. Explosives, Drilling and Blasting:

The pounds of powder used per ton of ore dropped about .04 lbs. per ton in 1946 compared to 1945. The average cost of powder increased .80 per cwt. over 1945 but in spite of this, the cost per ton of ore for powder rose only .0016 per ton. Part of the reason for the maintenance of low powder cost may be due to the higher percentage of depleting crews but mainly, it must be attributed to the use of Hercomite rather than Gelamite. Gelamite powder increased in cost proportionately more than the Hercomites.

The table below shows the lowest consumption of powder per foot of rock development in the last five years. This encouraging picture we also regard as a token that the Hercomite is a satisfactory explosive for use in the Cliffs Shaft Mine.

Year	Pounds of Powder Per Foot of Rock Development	
1942	19.91	(½ Gelamite & ½ Gelatin)
1943	17.8	Gelamite
1944	18.7	Gelamite
1945	21.6	Gelamite
1946	17.0	Hercomite 2X

The following table gives kinds and percentages of ore broken during 1945 and 1946.

	1945	1946
Specular Ore	52.2	51.8
Slate Ore	12.6	10.2
Steel Ore	28.3	30.7
Magnetite Ore	4.8	5.0
Conglomerate Ore	2.1	2.3
	100.0%	100.0%

CLIFFS SHAFT MINE
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YEAR 1946

7. UNDERGROUND: (Cont'd)

d. Explosives, Drilling and Blasting: (Cont'd)

Statement of Explosives Used: (Stoping and Development in Ore)

	Quantity	Average Price	Amount 1946	Amount 1945
Gelamite No. 1 - Cwt.	3,950	10.180	401.97	55705.50
Hercomite 2 X - Cwt.	332,300	12.325	40956.31	
60% Gelatin, L.F. - Lbs.				34.50
Total Powder	336,250	12.299	41358.28	55740.00
Fuse - Ft.	547,850	6.329 M	3467.47	4526.84
No. 6 Caps	85,015	12.940 M	1100.04	1490.40
Electric Caps	7,155	11.530 C	825.15	696.21
Fuse Lighters	21,000	7.374 M	154.86	222.07
No. 18 Shot Wire - Ft.	5,250	13.750 M	72.18	72.39
Tamping Bags	9,800	6.000 M	58.80	61.57
Connecting Wire - Lbs.	215	.550	118.75	168.66
Miscellaneous			84.20	19.20
Total Fuse, Etc.			5881.45	7257.34
Total Stoping & Dev. in Ore			47239.73	62997.34
Product - Tons			401,939	550,169
Lbs. Powder Per Ton Ore			.8365	.8764
Cost Per Ton For Powder			.1029	.1013
Cost Per Ton For Fuse, Etc.			.0146	.0132
Cost Per Ton For All Explosives			.1175	.1145
(Development in Rock)				
Gelamite No. 1 - Cwt.	3,600	11.500	414.00	4803.25
Hercomite 2 X - Cwt.	28,250	12.590	3557.14	
60% Gelatin, L.F. - Lbs.				5.75
Total Powder	31,850	12.470	3971.14	4809.00
Fuse - Ft.	13,650	6.104 M	83.32	80.43
No. 6 Caps	1,850	13.220 M	24.46	24.34
Electric Caps	3,960	10.424 C	412.82	659.88
Fuse Lighters	2,500	6.750 M	16.88	14.18
No. 18 Shot Wire - Ft.	3,050	15.260 M	46.57	45.60
Tamping Bags	2,100	6.000 M	12.60	3.93
Connecting Wire - Lbs.	132	.587	77.60	172.46
Miscellaneous			28.50	64.90
Total Fuse, Etc.			702.75	1065.72
Total Rock Development			4673.89	5874.72
Feet Rock Development			1,873	1,969
Cost Per Ft. Rock Development			2.495	2.983
GRAND TOTAL ALL EXPLOSIVES			51913.72	68872.06
AVERAGE COST PER LB. FOR POWDER			.123	.115

CLIFFS SHAFT MINE
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8. COST OF OPERATING:

a. Comparative Mining Costs:

	1946	1945
Product - Tons	401,939	550,169
Underground Costs	2.298	1.950
Surface Costs	.330	.338
General Mine Expense	.423	.377
Cost of Production	3.051	2.665
Taxes	.310	.325
Depreciation	.006	.021
Loading and Shipping	.084	.084
Total Cost at Mine	3.485	3.095
Budget Estimate at Mine	3.480	3.082
No. of Days Operating	217	303
No. of Shifts and Hours	2-8 hr.	2-8 hr.
Average Daily Product	1852	1816

CLIFFS SHAFT MINE
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8. COST OF OPERATING: (Cont'd)

b. Detailed Cost Comparison
Details of Accounts

	Total 1946		Total 1945	
Underground Costs	Amount	Per Ton	Amount	Per Ton
Exploring in Mine	13040.59	.032	21659.60	.039
Development in Rock	49505.48	.123	44866.47	.082
Development in Ore	53922.56	.134	52728.71	.096
Stoping	470533.52	1.172	574876.85	1.045
Timbering	23854.40	.059	27552.58	.050
Tramming	110534.22	.275	102878.88	.187
Ventilation	595.60	.002	1420.59	.002
Pumping	25784.80	.064	33798.81	.061
Comp. & Air Pipes	37766.30	.094	48364.11	.088
Back Filling	1723.65	.004	3746.87	.007
Underground Suptce.	32587.85	.082	41465.08	.075
Comp. & Power Drills	13990.82	.034	11009.17	.020
Scrapers & Mech. Loaders	50602.02	.126	61955.82	.113
Elec. Tram Equipment	33895.11	.084	40089.43	.073
Pumping Machinery	5285.91	.013	6380.19	.012
Total Undg. Costs	923622.83	2.298	1072793.16	1.950
Surface Costs				
Hoisting	31399.26	.077	37881.44	.068
Stocking Ore	14580.61	.036	23469.37	.043
Screening,Crushing at Mine	30632.47	.076	42335.96	.076
Dry House	14708.24	.037	15642.38	.029
General Surface Expense	13055.80	.033	18605.65	.034
Hoisting Equipment	9650.92	.024	16539.03	.030
Shaft	2862.17	.007	6774.62	.012
Top Tram Equipment	2769.78	.007	5268.84	.010
Docks,Trestles & Pockets	5948.71	.015	12133.16	.022
Mine Buildings	7013.78	.018	7670.98	.014
Total Surface Costs	132621.74	.330	186321.43	.338
General Mine Expenses				
Mining Engineering	3997.82	.010	4581.04	.008
Mech. & Elec. Engineering	1673.04	.004	2556.47	.005
Analysis and Grading	18487.35	.046	28139.25	.051
Safety Department	2322.83	.006	2661.78	.005
Tel. & Safety Devices	5461.37	.014	8057.94	.015
Local & Gen. Welfare	3880.34	.010	5562.36	.010
Spec. Exp. Pens. & All.	6613.32	.017	12234.04	.022
Ishpeming Office	23279.61	.057	27886.08	.050
Mine Office	20179.60	.050	25381.74	.046
Insurance	5627.37	.014	7487.08	.014
Personal Injury	24801.53	.062	26941.72	.049
Social Security Taxes	18253.30	.045	22055.66	.040
Employees Vacation Pay	35250.28	.088	34267.90	.062
Total Gen. Mine Exp.	169827.76	.423	207813.06	.377
Cost of Production	1226072.33	3.051	1466927.65	2.665

CLIFFS SHAFT MINE
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8. COST OF OPERATING: (Cont'd)

b. Detailed Cost Comparison
Details of Accounts

	LABOR				SUPPLIES			
	1946		1945		1946		1945	
Underground Costs	Amount	Per Ton	Amount	Per Ton	Amount	Per Ton	Amount	Per Ton
Exploring in Mine	9516.87	.024	13238.81	.024	3523.72	.008	8420.79	.015
Development in Rock	42521.61	.106	36203.46	.065	6983.87	.017	8663.01	.016
Development in Ore	44270.37	.110	42187.72	.077	9652.19	.024	10540.99	.019
Stoping	400496.72	.996	472773.68	.859	70036.80	.175	102103.17	.187
Timbering	14015.99	.035	15753.49	.029	9838.41	.025	11799.09	.021
Tramming	104484.35	.260	93904.22	.171	6049.87	.015	8974.66	.016
Ventilation	337.98	.001	331.11	.001	257.62	-	1087.48	.002
Pumping	10569.28	.026	10436.48	.019	15215.52	.038	23362.33	.042
Comp. & Air Pipes	5812.30	.015	6413.71	.012	31954.00	.079	41950.40	.077
Back Filling	1723.65	.004	3685.71	.007	-	-	61.16	-
Underground Suptce.	32485.26	.081	41336.18	.075	102.59	-	128.90	-
Comp. & Power Drills	674.27	.001	2315.23	.004	13316.55	.033	8693.94	.016
Scrapers & Mech. Loaders	19749.87	.049	23256.46	.042	30852.15	.078	38699.36	.070
Elec. Tram Equipment	22344.78	.056	23559.69	.043	11550.33	.029	16529.74	.030
Pumping Machinery	3533.87	.009	3079.85	.006	1752.04	.004	3300.34	.006
Total Undg. Costs	712537.17	1.773	788477.80	1.433	211085.66	.525	284315.36	.517
Surface Costs								
Hoisting	16915.24	.042	18354.49	.033	14484.02	.036	19526.95	.034
Stocking Ore	12939.47	.032	20305.53	.037	1641.14	.004	3163.84	.006
Screening,Crushing-Mine	24502.50	.061	31482.90	.057	6129.97	.015	10853.06	.020
Dry House	10727.32	.027	10364.14	.019	3980.92	.010	5278.24	.010
General Surface Expense	12081.78	.030	16423.90	.030	974.02	.002	2181.75	.004
Hoisting Equipment	5781.61	.014	6481.08	.012	3869.31	.010	10057.95	.018
Shaft	2383.87	.006	4043.64	.007	478.30	.001	2730.98	.005
Top Tram Equipment	1634.52	.004	3233.18	.006	1135.26	.003	2035.66	.004
Docks, Trestles & Pckts.	3629.86	.009	7061.74	.013	2318.85	.006	5071.42	.009
Mine Buildings	5126.63	.013	5592.76	.010	1887.15	.005	2078.22	.004
Total Surface Costs	95722.80	.238	123343.36	.224	36898.94	.092	62978.07	.114
General Mine Expenses								
Mining Engineering	3195.57	.008	3202.04	.006	802.25	.002	1379.00	.003
Mech. & Elec. Engr.	1124.95	.003	1806.03	.003	548.09	.001	750.44	.001
Analysis & Grading	16491.01	.042	21313.97	.040	1996.34	.005	6825.28	.012
Safety Department	1888.72	.005	33.70	-	434.11	.001	2628.08	.005
Tel. & Safety Devices	1245.27	.003	1863.19	.003	4216.10	.011	6194.75	.011
Local & Gen. Welfare	1902.53	.005	-	-	1977.81	.005	5562.36	.010
Spec. Exp. Pens. & All.	1857.36	.005	867.26	.001	4755.96	.013	11366.78	.021
Ishpeming Office	13467.93	.034	-	-	9811.68	.024	27886.08	.051
Mine Office	17255.20	.044	21660.22	.039	2924.40	.007	3721.52	.007
Insurance	-	-	-	-	5627.37	.014	7487.08	.014
Personal Injury	799.33	.002	-	-	24002.20	.060	26941.72	.048
Social Security Taxes	-	-	-	-	18253.30	.045	22055.66	.040
Employees Vacation Pay	35250.28	.088	34267.90	.063	-	-	-	-
Total Gen. Mine Exp.	94478.15	.235	85014.31	.155	75349.61	.188	122798.75	.223
Cost of Production	902738.12	2.246	996835.47	1.812	323344.21	.805	470092.18	.854
Taxes	-	-	-	-	124622.16	.310	178544.98	.325
Total Cost	902738.12	2.246	996835.47	1.812	447966.37	1.115	648637.16	1.179
		66.8%		60.6%		33.2%		39.4%

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8. COST OF OPERATING: (Cont'd)

b. The following cost sheet is inserted to show charges incurred during idle strike period from February 7, 1946 to May 22, 1946.

	LABOR	SUPPLIES	TOTAL
Underground Costs			
Exploring in Mine	569.51	113.23	682.74
Stoping	2339.32	2193.84	4533.16
Timbering	372.38	203.92	576.30
Tramming	153.88	281.07	434.95
Ventilation	2.00	14.60	16.60
Pumping	2549.47	6285.90	8835.37
Compressors & Air Pipes	344.70	1374.50	1719.20
Underground Superintendence	11032.77	14.25	11047.02
Compressors & Power Drills	3.23	84.79	88.02
Scrapers & Mech. Loaders	469.84	429.04	898.88
Electric Tram Equipment	407.28	1557.77	1965.05
Pumping Machinery	105.00	20.63	125.63
Total Underground Costs	18349.38	12573.54	30922.92
Surface Costs			
Hoisting	1618.72	965.30	2584.02
Stocking Ore	129.71	255.88	385.59
Screening, Crushing At Mine	297.08	167.00	464.08
Dry House	954.74	1220.27	2175.01
General Surface Expense	3540.02	376.37	3916.39
Hoisting Equipment	184.09	310.27	494.36
Top Tram Equipment	16.45	76.81	93.26
Mine Buildings	20.07	243.98	264.05
Total Surface Costs	6760.88	3615.88	10376.76
General Mine Expenses			
Mining Engineering	825.71	175.20	1000.91
Mech. & Elec. Engineering	331.61	309.00	640.61
Analysis & Grading	1602.24	299.52	1901.76
Safety Department	599.00	103.51	702.51
Telephones & Safety Devices	62.64	483.69	546.33
Local & General Welfare	587.00	684.00	1271.00
Spec. Expense,Pensions & Allow.	862.85	1830.55	2693.40
Ishpeming Office	3984.00	3389.00	7373.00
Mine Office	5193.71	1047.93	6241.64
Insurance	-	2143.06	2143.06
Personal Injury	266.00	4233.37	4499.37
Social Security Taxes	-	2339.30	2339.30
Employees Vacation Pay	10250.00	-	10250.00
Total General Mine Expenses	24564.76	17038.13	41602.89
Cost of Production	49675.02	33227.55	82902.57
Taxes	-	50750.00	50750.00
Total Cost	49675.02	83977.55	133652.57

CLIFFS SHAFT MINE
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YEAR 1946

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

The cost of production for 1946 increased .386 over 1945 cost of production. An analysis of this increase reveals that the major portion of it was the result of the $.18½ per hour wage increase granted May 22nd, 1946. However, supply costs were reduced in 1946 by .049 per ton and labor costs increased .434 per ton. Approximately .340 cents of this labor increase is attributable directly to the wage increase. The remainder must be explained on the basis of increased non-productive activity in the underground category and in the general mine expense category. In 1945 we operated with a manpower shortage and this manpower was concentrated on the essential tonnage producing activities. In 1946 we were able to put more of the men on development and other jobs that are necessary in the long run but not directly productive of ore tonnage. From the standpoint of being comparable, 1946 is more nearly a counterpart of 1944 with the exception of the strike and wage increase.

In the ensuing pages, those categories will be discussed that show appreciable divergences in costs not attributable to the wage increase.

Exploring in Mine

	1946	1945
Labor for Undg. Drilling	$ 6,222.61	$ 9,633.96
Prop. of D.D. Supt.'s Time	929.84	384.92
Carbon Loss	341.98	469.58
Bortz Loss	2,482.07	5,874.78
Pipe and Fittings	121.58	269.35
Drill Equipment and Repairs	229.20	1,469.48
Rental of Drill Equipment	675.00	1,132.50
Miscellaneous Supplies	181.53	271.78
Compressor Expense	645.00	1,050.00
Credit on Bortz Bits	1,937.18	1,520.28
Blank Bits & Shells	552.17	-
Fuel & Trucking	3.82	-
Diamond Setters	864.31	-
Total	11,311.93	19,036.07
Geological Expense for Drill	825.72	647.15
Analysis Expense	217.07	453.59
Total Underground Drilling Cost	12,354.72	20,136.81
Geological Dept. Exp. for Mine Mapping	1,368.61	1,522.79
Total as Per Cost Sheet (1946 total includes $682.74 of Idle Period Exp.)	13,723.33	21,659.60
Feet drilled underground with carbon	2,997	4,820
Cost Per Foot	4.122	4.177

For 4½ months out of the total of 8½ operating months, only one diamond drill crew worked in the Cliffs Shaft Mine. The cost per foot of drilling decreased $0.052 per foot in spite of the fact that some idle expense is included in the cost per foot figures.

CLIFFS SHAFT MINE
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8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Exploring in Mine: (Cont'd)

The table below gives the footage and percentage of each type of material drilled by the diamond drills during 1945 and 1946.

	1945		1946	
Soft Ore Jasper			162'	5.4%
Ore	230'	4.8%	160'	5.3%
Dike	2,182'	45.3%	907'	30.3%
Slate	793'	16.5%	511'	17.1%
Cong. & Lean Ore	246'	5.1%	298'	9.9%
Quartzite	484'	10.0%	587'	19.6%
Siderite	231'	4.8%	292'	9.7%
Jasper	654'	13.5%	80'	2.7%
Total	4,820'	100.0%	2,997'	100.0%

There is $7,988.09 of unexpended balance in E & A account CC-93. No work was done under this surface exploration authorization in Section 9 - 47 - 27 during 1946, but when crews are available it is likely that some additional work will be carried on in Section 9.

Development in Rock

Comparative costs for the past five years are shown below:

		Labor Cost		Supply Cost		Total Cost	
Year	Footage	Total	Per Ft.	Total	Per Ft.	Total	Per Ft.
1946	1,873	42,521.61	22.70	6,983.87	3.73	49,505.48	26.43
1945	1,969	36,203.46	18.39	8,663.01	4.40	44,866.47	22.79
1944	3,814	76,810.49	20.14	16,081.03	4.21	92,891.52	24.35
1943	5,180	90,353.18	17.44	19,488.14	3.76	109,841.32	21.20
1942	2,855	44,755.36	15.68	11,351.66	3.97	56,107.02	19.65

A good deal of stripping work was done in rock during 1946. From the cost standpoint this was charged to development in rock but in many cases it was impossible to credit the contracts with any footage. Therefore, the cost per foot is higher than in preceeding years.

The table below shows footage in different categories for the last five years:

	1946	1945	1944	1943	1942
Rock Raises	550'	493'	1678'	1124'	1152'
10' x 10' Main Haulage Drifts	1176'	1304'	1533'	2855'	1140'
8' x 8' Main Haulage Drifts	147'	172'	603'	1201'	563'
Total	1873'	1969'	3814'	5180'	2855'

CLIFFS SHAFT MINE
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YEAR 1946

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Development in Rock: (Cont'd)

The next table helps to explain unit cost per foot, because the type of material has a marked effect on costs.

	Jasper or Lean Ore	Siderite	Dike or Slate	Total
Rock Raises	160'	22'	368'	550'
10' x 10' Rock Drifts	52'	562'	562'	1176'
8' x 8' Rock Drifts	28'	-	119'	147'
Total	240'	584'	1049'	1873'

Development in Ore and Stoping

These two accounts are combined in this discussion because there is no accurate separation of costs into these two categories on the cost sheet.

Comparative costs for the last two years follows:

Year	Labor Cost	Supply Cost	Total Cost
1946	444,768.09	79,687.99	524,456.08
1945	514,961.40	112,644.16	627,605.56

The detailed cost for the two years are shown below:

	1946		1945	
Labor	Total	Cost Per Ton	Total	Cost Per Ton
Miner's Labor	176,910.67	.440	208,792.89	.380
Other Labor	267,857.42	.667	306,168.51	.556
Total	444,768.09	1.107	514,961.40	.936
Supplies				
General	2,266.04	.006	2,604.08	.005
Iron and Steel	14,150.14	.035	19,263.42	.035
Oils	586.90	.001	760.45	.001
Machinery	3,018.19	.008	1,531.06	.003
Explosives	47,351.67	.118	62,997.34	.115
Lumber	340.33	.001	42.04	-
Electric Power	5,241.69	.013	7,302.52	.013
Sundries & Clearing Acct.	2,347.70	.006	18,143.25	.033
Shop Expense Accounts	4,385.33	.011	-	-
Total	79,687.99	.199	112,644.16	.205
Total Labor & Supplies	524,456.08	1.306	627,605.56	1.141
Tons Hoisted	401,939		550,169	

The increase in the above detailed account occurs entirely in the labor cost which rose almost exactly the percentage to be expected from the wage increase.

CLIFFS SHAFT MINE
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YEAR 1946

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Tramming

	Labor		Supplies		Total	
Year	Total	Per Ton	Total	Per Ton	Total	Per Ton
1946	104,484.35	.260	6,049.87	.015	110,534.22	.275
1945	93,904.22	.171	8,974.66	.016	102,878.88	.187
Increase	10,580.13	.089			7,655.34	.088
Decrease			2,924.79	.001		

The tramming costs are higher in 1946 compared to 1945 because of a change in the method of distributing the miner's helpers time. In 1946, a better timekeeping system made it possible to determine the tramming costs more accurately. The development in ore and stoping accounts should, of course, be charged with proportionately less of the miner's helpers time and probably would have been higher than shown if the old method had still been employed.

Pumping

Costs in this category remained nearly constant.

The average number of gallons of water pumped per minute for each month during the last five years is given in the table below:

Month	1946	1945	1944	1943	1942
January	785	826	663	613	624
February	750	804	694	603	612
March	744	808	750	644	613
April	786	913	751	720	652
May	766	835	815	762	662
June	783	907	829	838	663
July	787	909	840	861	657
August	735	848	882	798	642
September	769	861	995	731	633
October	714	834	998	686	676
November	732	828	962	688	653
December	664	799	1033	674	631
Avg. For Year	758	846	831	710	642

Compressors, Air Pipes & Power Drills

Costs did not change appreciably in this category.

During 1946, we purchased 21 drills at a cost of $10,574.94 and 2 Cleveland Mine Rigs at a cost of $4,956.02. The table below shows the types and makes of machines purchased in the last five years.

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8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Compressors, Air Pipes & Power Drills: (Cont'd)

	1946	1945	1944	1943	1942
R-58 Stoping Machine	5	-	1	-	-
DA-35 Automatic Ingersoll-Rand Drifters	3	1	-	-	-
DA-35 Ingersoll-Rand Drifters	6	6	6	11	5
D-12 Automatic Cleveland Drifters	-	2	-	-	-
D-12 Cleveland Drifters	-	1	3	6	2
D-25 Cleveland Drifters	4	-	-	-	-
Automatic Gardner-Denver Drifters	2	-	-	-	-
Gardner-Denver Drifters	1	1	1	-	2
JB-4 Ingersoll-Rand Blockholers	-	-	2	3	-
Total	21	11	13	20	9

Scrapers & Mechanical Loaders

There was little change in the cost of scrapers and mechanical loaders but the table of detailed costs is shown below to show quantities of supplies used.

	1946		1945	
	Amount	Cost	Amount	Cost
3/8" Wire Rope	2,825'	239.08	2,275'	193.98
1/2" Wire Rope	5,991'	631.55	5,525'	622.96
5/8" Wire Rope	72,638'	12778.28	84,145'	14449.76
No. 4 Electric Cable	4,280'	2143.53	5,920'	2524.90
No. 6 Electric Cable	-	-	315'	126.00
Scraper Blocks	87	2291.55	91	2408.47
Gen.Electrical Reprs.& Renew.		31488.23		41629.75
Loader Motors		928.80		-
Circuit Breaker		101.00		-
Total		50,602.02		61955.82

The tonnage and unit cost for the past five years for 5/8" Wire Rope are compared below:

Year	Product	Type of 5/8" Rope Used	Purchased	Cost	Unit Cost	Feet Per Ton Ore
1946	401,939	"Trulay"	72,638'	12,778.28	.0317	.180
1945	550,169	"	84,145'	14,449.76	.0263	.153
1944	587,051	"	103,746'	17,760.31	.0303	.177
1943	634,530	"	83,032'	14,693.88	.0231	.131
1942	713,530	"	102,819'	17,928.55	.0251	.144

CLIFFS SHAFT MINE
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9. EXPLORATIONS:

Diamond drill holes drilled during the year 1946 were as follows:

	FOOTAGE DRILLED	FEET OF ORE
D. D. Hole No. 561	81	No Ore
563	94	No Ore
564	466	66'
565	461	25'
566	358	No Ore
567	361	No Ore
568	380	No Ore
569	10	No Ore
570	451	46'
571	272	23'
572	63	No Ore
TOTAL	2997	160'
		5.3%

On the 2nd level "A" Shaft, Hole No. 570 was drilled horizontally north from coordinates 73 S - 413 E. The collar elevation of the hole was +1073. This hole was drilled to test the theory that the "B" Shaft synclinal structure extends east to the 400 E coordinate line. The hole proves this theory correct because slate was encountered in the hole from 59' to 114'. Associated with the horizon underlying the slate a total of 46' of ore was cut. The drill was moved about 400' west to drill Hole No. 571 horizontally north from coordinates 14 N - 83 E. The purpose of this hole was to better delineate the synclinal structure at a point further down the pitch and to look for ore that might be in the formation under the slate hanging wall. The hole cut 17' of ore in the rib of the old workings before encountering the hanging wall which here constitutes the south limb of the syncline. After penetrating the synclinal slate formation the hole cut another 11' of ore on the north limb of the syncline and then entered dike footwall material.

In the first part of the year, Hole 563 was completed by being extended 94' through a mixture of lean ore, slate, conglomerate hard ore jasper, chert and soft ore jasper in the order named. The hole was bottomed at 196'. This hole was started in 1945 on the 6th level "A" Shaft at coordinates 1262 S - 978 E. It was drilled at an angle of —29° on a course S 5° E. Although a small run of ore was encountered in the 1945 drilling, no first class ore was found in the formation cut by the 1946 drilling which was on the Section 10 Lease.

In the east part of the mine on the 8th level, a 3½" drainage hole, No. 572, was drilled N 30° E with a dip of —10° from coordinates 420 S - 3514 E. This hole was not completed at the end of the year having been advanced only 63' of a total expected footage of 125'. The hole is to serve as a means of draining the old No. 3 Mine workings.

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9. EXPLORATIONS: (Cont'd)

On the Section 10 Lease two holes, No's. 564 and 566, were drilled on the 8th level from coordinates 1675 S - 2320 E and 1632 S - 2140 E respectively. Both of these holes were drilled horizontally south to explore for additional ore on the Section 10 Lease in the area south of the main Section 10 ore body and west of the Moro Mine syncline. The first hole encountered 55' of first class ore in one single run from 130' to 185'. This ore occurs between footwall siderite on the north and hanging wall slate on the south. If the Moro Mine was an ore body developed, as seems apparent, on the north limb of a westward pitching syncline, then the relationship of formations exposed by Hole No. 564 is normal. The discovery of nothing but siderite and soft ore jasper in Hole No. 566 is, however, not to be expected unless the west portion of the Moro Mine syncline has a pitch to the east or unless there is a fault between Holes 564 and 566.

In the Section 9 Development one hole, No. 561, was completed in quartzite on the 1st level elevation and one new hole was drilled. The new hole, No. 565, was at coordinates 1324 S - 4143 W. It was drilled horizontally S 43° W to test the formation for ore occurrence and to gather structural information. Twenty-two feet of first class ore was cut by the hole after penetrating 101' of footwall material, mainly dike. From the end of the ore at 123' to the bottom of the hole at 461', the only material cut by the drill was hanging wall slate and quartzite. The drilling completed on the 1st level elevation discovered some first class ore but in general, the results were disappointing. Development by mining crews will be necessary to determine the extent of these ore bodies.

To explore for ore on the 3rd level elevation of the Section 9 Development two holes, No's. 567 and 568 were drilled; the first, horizontally north from coordinates 939 S - 4072 W and the second, horizontally south from coordinates 1317 S - 4132 W. Both of these holes started in hard ore formation and finished in quartzite, but no ore was encountered in either hole.

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10. **TAXES:**

Comparative data for 1946 and 1945 follows:

	1946		1945	
	Valuation	Taxes	Valuation	Taxes
Realty	2,600,000	93,373.80	2,545,000	91,460.17
Minerals under NW¼ of Sec. 9-47-27	175,000	6,284.78	175,000	6,289.01
Personal	406,100	14,584.26	746,100	26,812.74
Lot 2, Sec. 3-47-27 (Bancroft)	800,000	28,730.40	800,000	28,749.76
SE¼ of NE¼ of Sec. 9-47-27 (Barnum)	52,000	1,867.48	52,000	1,868.73
Lot 174, Nelson Addition	100	3.59	100	3.59
South 35.91 ft. of Lot 179	50	1.80	50	1.80
S½ of NW¼ of Sec. 10-47-27	850,000	30,526.05	650,000	23,359.18
Total	4,883,250	175,372.16	4,968,250	178,544.98
Taxes per ton produced		.4363		.3245
Taxes per ton shipped		.4348		.2946

Valuations and taxes for the past ten years are shown below:

Year	Taxes	Valuation	Tax Rate
1946	175,372.16	4,883,250	35.913
1945	178,544.98	4,968,250	35.9372
1944	159,909.45	4,443,250	35.9893
1943	146,539.81	4,268,250	33.9926
1942	143,225.85	4,093,250	34.6443
1941	144,195.60	4,042,150	35.3198
1940	137,284.25	3,982,150	34.4748
1939	141,248.04	4,007,150	34.8999
1938	140,789.79	3,852,150	36.1865
1937	127,643.22	3,712,150	34.0444

Valuations and taxes both dropped slightly from 1945 figures.

City of Ishpeming Tax Levy	1946		1945	
	Amount	Rate	Amount	Rate
Valuation	11,678,285.00		11,829,970.00	
Tax Levy by Funds				
County Tax	71,821.45	6.15	65,064.83	5.5
County Road Tax	8,758.72	.75	16,561.96	1.4
School Tax	94,594.11	8.1	95,822.76	8.1
School Debt Serv. Tax	10,662.50	.913	11,087.50	.9372
Gen'l Optg. Debt Ser.	175,174.28	15.00	177,449.55	15.00
Capital Improvement	58,391.42	5.00	59,149.85	5.00
Total Taxes	419,402.48	35.913	425,136.45	35.9372

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11. ACCIDENTS AND PERSONAL INJURY:

The accident record for the year is shown below:

	Cliffs Shaft Mine	C. C. I. CO. Undg. Mines	C. C. I. CO. All Operations
Tons of Ore Mined	401,939	2,642,344	4,416,253
Hours of Labor	748,152½	4,020,561¾	5,976,795½
No. of Fatalities	-	-	-
No. of Compensable Accidents	16	86	101
No. of Non- " "	18	113	125
Total Lost Time Accidents	34	199	226
No Lost Time Accidents	43	373	515
Days Lost-Compensable Injuries	1087	5078	7994
Days Lost-Non- " "	44	271	301
Total Days Lost	1131	5349	8295
Frequency Rate	44.445	49.49	37.812
Severity Rate	1.512	1.33	1.388

Frequency Rate - Number of accidents for every 1,000,000 man hours. Fatalities 6,000 days.
Severity Rate - Number of days lost per 1,000 man hours.

12. NEW CONSTRUCTION ORE EQUIPMENT:

The following E. & A.'s were continued from 1945 or authorized during 1946:

E. & A. No. CC-140

This E. & A. for $35,002.00 covers the purchase and installation of a 1,000 gallon per minute pump to handle water expected from the Section 10 Development. The authorization dates from December 1944 but the pump installation was not completed until September of 1946. Total cost was $37,408.93. Overrun was due to excessive expense of cutting pumphouse room where rock conditions made it necessary for us to support the back with steel sets.

E. & A. No. CC-148

In May of 1945, this E. & A. was approved for purchase and installation of auxiliary post brakes on the "A" and "B" Shaft hoists. Total authorized was $7,370.00. Installation was completed in May of 1946 at a cost of $5,550.50.

E. & A. No. CC-150

This E. & A. was for the purchase and installation of a fan to provide forced ventilation in the Cliffs Shaft Mine. The fan and motor has been received and charged but cannot be installed until early summer of 1947.

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12. NEW CONSTRUCTION ORE EQUIPMENT: (Cont'd)

E. & A. No. CC-153

The boiler and stoker of the main dry was replaced under this E. & A. at a total cost of $5,940.68.

E. & A. No. CC-163

The purchase of an Eimco Model 40 Loader to improve the development program in the Cliffs Shaft Mine was approved December 14, 1945. Total cost was $9,659.84.

E. & A. No. CC-169

On August 29, 1946 this E. & A. for a second Eimco Model 40 Loader was approved in the amount of $10,883.00. This loader is expected in April of 1947.

E. & A. No. CC-171

On October 11, 1946 this E. & A. of $3,097.00 was approved for the purchase and installation of an aftercooler to improve the condition of the compressed air and thereby improve drilling efficiency and reduce the danger of fires or explosions in the compressed air lines and receivers.

14. MAINTENANCE AND REPAIRS:

Dwellings

	Labor	Supplies	Total
Hard Ore Location	1,522.55	213.64	1,736.19
Barnum Location	227.29	46.80	274.09
Outhwaite Purchase	157.89	34.19	192.08
Hyde Purchase No. 1	136.57	51.10	187.67
Hyde Purchase No. 2	1,716.90	1,922.07	3,638.97
Smith Purchase	151.69	7.37	159.06
Nelson Purchase	55.85	12.17	68.02
Berg Purchase	46.21	35.40	81.61
Ramsdell Purchase	1,318.93	902.57	2,221.50
Grand Total	5,333.88	3,225.31	8,559.19

Comparative figures for the past six years follows:

Total for Year	1946	-	$ 8,559.19
"	1945	-	10,772.98
"	1944	-	12,771.58
"	1943	-	18,006.43
"	1942	-	7,708.55
"	1941	-	7,208.75

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15. POWER:

The following five year comparison shows power consumption, cost and rate per K.W.H.:

Year	K. W. H.	Cost	Rate Per K.W.H.
1946	5,824,429	83288.58	.014299
1945	7,097,196	102385.23	.014426
1944	7,800,360	111649.01	.014313
1943	7,431,998	107603.42	.0144783
1942	7,093,627	104081.28	.0146725

The detail of distribution of power at the mine follows:

	K. W. H.	Cost
Scraping Ore & Rock	446,378	6,211.45
Pumping	1,398,094	20,182.48
Hoisting	943,652	13,435.15
Stocking Ore	10,221	148.18
Crushing Ore	166,300	2,371.72
Dry House Expense	71,738	1,024.29
Surface	33,915	490.32
Telephone & Safety Devices	89,008	1,259.49
Mine Office	11,099	158.83
Machine & Carpenter Shops	4,048	57.61
Drill & Jackbit Shops	36,937	544.13
Heating Plants	9,878	136.73
Compressors	2,197,261	31,275.03
Electric Haulage	394,400	5,829.34
Ventilation	11,500	163.83
Total	5,824,429	83,288.58

Comparative data for 1946 and 1945 follows:

	1946	1945	Difference	Inc.%	Dec.%
Production - tons	401,939	550,169	148,230		36.8
	K.W.H.	K.W.H.			
Scraping Ore & Rock	446,378	529,843	83,465		5.34
Pumping	1,398,094	1,545,037	146,943		10.51
Hoisting	943,652	1,225,040	281,388		29.81
Stocking Ore	10,221	10,220	1		-
Crushing Ore	166,300	218,676	52,376		31.49
Dry House Expense	71,738	85,290	13,552		18.89
Surface	33,915	38,369	4,454		13.13
Telephone & Safety Devices	89,008	82,536	6,472	7.84	
Mine Office	11,099	11,752	653		5.88
Machine & Carpenter Shops	4,048	4,439	391		9.65
Drill Shops	36,937	49,401	12,464		33.74
Heating Plants	9,878	7,015	2,863	4.08	
Compressors	2,197,261	2,710,896	513,635		23.38
Electric Haulage	394,400	565,172	170,772		43.30
Ventilation	11,500	13,510	2,010		17.48
Total	5,824,429	7,097,196	1,272,667		21.85

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18. NATIONALITY OF EMPLOYEES

The following table shows the various nationality groups employed at the mine as of December 31, 1946:

	American Born	Foreign Born	Total
English	86	20	106
Finnish	98	55	153
Swedish	46	8	54
Italian	18	16	34
French	40	4	44
Norwegian	25	2	27
Irish	6	1	7
German	6	-	6
Czechoslovakian	1	-	1
Total	326	106	432

Comparison for 1946, 1945 and 1944 follows:

	1946		1945		1944	
	Number	% of Total	Number	% of Total	Number	% of Total
English	106	24.6	109	25.7	102	24.7
Finnish	153	35.4	143	33.8	139	34.0
Swedish	54	12.5	57	13.5	55	13.3
Italian	34	7.7	30	7.1	34	8.2
French	44	10.7	42	10.0	38	9.2
Norwegian	27	6.3	24	5.7	22	5.0
Irish	7	1.6	9	2.1	12	3.0
German	6	1.5	7	1.7	7	2.0
Austrian	0	-	1	0.2	1	0.2
Polish	0	-	0	-	1	0.2
Slovanian	0	-	0	-	1	0.2
Czechoslovakian	1	0.2	1	0.2	0	-
Total	432	100.0	423	100.0	412	100.0

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1. General

The production in 1946 was 247,853 tons compared with 326,633 tons in the previous year. The large decrease in production is due to the strike which lasted for a period of three and one-half months and also due to a continual decrease in the size of the orebody as mining has progressed to lower elevations resulting in reducing the number of mining contracts that can be employed. Due to the reduction in the size of the underground operation, the labor force was reduced by 25% but an operating schedule of two shifts hoisting and three shifts mining for six days per week has been maintained throughout the year.

Due to depletion of reserves, mining operations will be completed before the close of 1947. The exploration drilling program that has been conducted during the past several years has failed to disclose new ore of importance and very little additional drilling was done in 1946. One hole was completed from the 8th Level into the area south of the main orebody but no concentration was disclosed and late in the year a second hole was being drilled to explore the same area below the level. There has been no previous exploration in this area and there is only a remote possibility that new reserves may be disclosed that will extend the life of the property beyond 1947.

Increased costs resulting from higher wages and supply costs made it advisable to abandon development of the proposed 9th Level. A continual decrease in the size of the orebody in depth limits the number of mining contracts that can be employed to the extent that a profitable operation can not be conducted if depletion of the ore to its lower limits is attempted. Before development of the new level was undertaken, a study of the factors involved indicated a marginal operation and the subsequent increase in labor and supply costs made it definitely advisable to abandon the program. As a result the life of the mine has been shortened to the extent that operations will be completed when the reserves above the 8th Level are depleted.

Shipment from the mine totaled 200,375 tons which represents a large decrease compared to the tonnage shipped in 1945. Slightly more than 90% of the shipments were Lloyddale grade and the small shipment of Silica grade was due to including only a small proportion of this ore in the Cliffs Group cargoes. There was no Silica grade loaded from the stockpile, the small shipment of 17,711 tons was loaded from the pocket. At the close of the shipping season all the Lloyddale grade in stockpile was loaded out and a very favorable stockpile over-run was realized. The stockpile inventory at the close of the year showed 238,504 tons of Silica grade and 19,669 tons of Lloyddale grade.

Mining operations in the main orebody have been confined to areas between the 7th and 8th Levels in the east half of the deposit and on the 7th Level and above in the west half. Nearly all the top slicing areas are being converted to a sub level caving system of mining excepting where good results from this system are being obtained. Scram stopes were developed wherever possible and in the east half of the orebody several very productive ones were developed under an old slicing area.

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1. General (Cont.)

Two stopes were developed above the 8th Level in the small orebody south of the main deposit and mining was completed in both of them before the end of the year due to depletion of the ore. A small westerly extension of this deposit is being developed but the extent of ore outlined indicates that several months of mining in 1947 will complete the operations in this deposit.

It is planned to mine a block of ore in the east half of the main orebody between the 7th and 8th Levels by means of two sub level stopes. Work has been underway for several months driving the necessary development headings for the stopes and the work has progressed so mining can be started early in the coming year. When mining has depleted this block of ore operations in the west half of the deposit will also have reached the lower limit of mining from the 8th Level so that the reserves above this level will be thoroughly depleted when operations are suspended.

There was no production during the industry-wide strike that was called on February 7th and terminated on May 22nd. The only employees who regularly reported for work during this period were a small crew of maintenance men, supervisors and the office force. As the strike dragged on two factions developed within the union and feelings, on many occasions, reached a fever pitch. A large group that wanted to return to work on terms the Company had offered was bitterly opposed by another group that flagrantly violated provisions of a court injunction by employing mass picketing and threatening violence to men who attempted to report for work. These tactics were very effective in thoroughly frightening employees and discouraged those who wanted to work. As a result many necessary maintenance men failed to report for work during the latter months of the strike so the underground supervisory force was employed on this work during most of the strike period. Fortunately no heavy crushing conditions were prevalent in the mine so it was possible to resume normal operations immediately upon termination of the strike.

In accordance with the supplemental agreement that was the basis for settlement of the strike a wage increase of 18½¢ per hour was granted and became effective on May 22nd. An increase of 10¢ per hour, effective March 22nd was offered as a basis for settlement of the strike and this increase was paid to the maintenance men employed during the period from March 22nd to May 22nd. However, this increase was voided by the supplemental agreement and the 18½¢ increase was applied to rates in effect prior to February 8, 1946.

2. PRODUCTION, SHIPMENTS AND INVENTORIES

a. Production by Grades

Grade	Tons	Percent
Lloyddale	175,280	70.7
Lloyd Silica	72,573	29.3
	247,853	100.0

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2. PRODUCTION, SHIPMENTS AND INVENTORIES (Cont.)

a. Production by Grades (Cont.)

There was a decrease of 78,780 tons in production compared with the previous year and the percentage of Lloyddale grade produced decreased slightly from 74.8% to 70.7% in 1946. Operations during the year were based on a proportion of 70% Lloyddale and 30% Silica grade compared to a 75% - 25% ratio in 1945. The caving and stoping methods that will be employed during the remaining life of the mine will result in a higher Silica grade proportion, and during the last stages will approach 50% of the production.

b. Shipments

Total shipments were considerably less than in the previous year and slightly more than 90% of the tonnage was Lloyddale grade. The total of this grade shipped exceeded the Lloyddale production by a small amount but shipments of Silica grade were only 17% of the tonnage shipped in the previous year. The amount of the latter grade mixed in the Cliffs Group ore was only a fraction of the tonnage used in the previous year and this accounts for the small shipment of this grade. All the Lloyddale grade in stock was loaded out before the close of the shipping season and a stockpile over-run of 13,410 tons was realized.

The following table shows the shipments during the past six years:

Year	Lloyddale	Silica	Total
1941	406,526	51,397	457,923
1942	366,505	214,352	580,857
1943	289,257	283,254	572,511
1944	260,472	16,577	277,049
1945	238,045	101,423	339,468
1946	182,664	17,711	200,375

c. Stockpile Inventories

Grade	Tons
Lloyddale	19,669
Lloyd Silica	238,504
Total	258,173

The inventory of ore on hand at the end of the year showed 51,307 tons more than at the end of last year with a large increase in the Silica grade inventory and a slightly smaller Lloyddale grade balance.

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2. PRODUCTION, SHIPMENTS AND INVENTORIES (Cont.)

d. Division of Product by Levels

The ore produced above various Levels was as follows:

	Lloyddale Tons	Lloyd Silica Tons	Total Tons
Seventh Level	11,070	8,210	19,280
Eighth Level	161,287	67,286	228,573
Total	172,357	75,496	247,853

The bulk of the product was again mined between the 7th and 8th Levels with the production above the 7th Level showing a large decrease. Mining was nearly completed above the latter level late in the year and tramming operations on this level were abandoned during the third quarter of 1946.

e. Production by Months

Month	Days	Lloyddale Ore Tons	Lloyd Silica Tons	Total Ore Tons	Rock Tons	Tons Per Man Per Day
January	26	21,096	8,944	30,040	2,452	6.09
February	6	5,464	952	6,416	464	4.09
March	-	-	-	-	-	-
April	-	-	-	-	-	-
May	8	6,818	2,319	9,137	124	4.32
June	25	22,998	7,984	30,982	264	5.93
July	26	22,029	9,593	31,622	356	6.24
August	26	19,374	8,919	28,293	456	5.86
September	24	18,274	10,956	29,230	668	6.25
October	27	19,503	9,114	28,617	624	5.57
November	25	14,916	7,326	22,242	44	5.38
December	25	15,227	6,466	21,693	116	5.53
Total	218	165,699	72,573	238,272	5,568	5.96
Current Year Stockpile Over-run		9,581	-	9,581		
Grand Total		175,280	72,573	247,853	5,568	

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2. PRODUCTION, SHIPMENTS AND INVENTORIES (Cont.)

f. Ore Statement

	Lloyddale Tons	Lloyd Silica Tons	Total Tons	Total Last Year
On Hand January 1, 1946	23,224	183,642	206,866	219,701
Output for Year	165,699	72,573	238,272	321,691
Over-runs	13,410	-	13,410	4,942
Total	202,333	256,215	458,548	546,334
Shipments	182,664	17,711	200,375	339,468
Balance on Hand	19,669	238,504	258,173	206,866
Decrease in Output			78,780	
Decrease in Shipments			139,093	
Increase in Ore on Hand			51,307	

The operating schedule for the past five years follows:

1942 3-8 hr shifts 5-2/3 days per week Jan. 1 to Dec. 31, 3 crews.

1943 3-8 hr shifts 5-2/3 days per week Jan. 1, to Feb. 1, 1943. 3-8 hr shifts 5-1/3 days per week Feb. 1 to Dec. 31, 1943

1944 3-8 hr shifts 5-1/3 days per week January 1, to July 1, 1944. Effective July 1, 1944, three shifts per day, 5 days per week, and effective October 30th, hoisting on two shift schedule.

1945 2-8 hr shifts hoisting and 3-8 hr shifts mining, 5 days per week, January 1st to January 27th. Effective January 27th, 2-8 hr shifts hoisting and 3-8 hr. shifts mining, 6 days per week to December 31, 1945.

1946 2-8 hr shifts per day hoisting and 3-8 hr shifts per day mining, 6 days per week.

g. Delays

There were no delays to operations that resulted in a loss in product. During the idle period when the employees were on strike, the mining places required very little retimbering as did the main level drifts and other develop-openings, making it possible to resume operations at a normal rate upon termination of the strike.

During the day shift operation on June 27th, the main power cable shorted and blew out between the engine house and a main switch outside the building. Hoisting was delayed for about one hour while repairs were made but the loss in product was made up during the balance of the day shift and the following shifts.

3. ANALYSIS

a. Average Mine Analysis on Output

Grade	Tons	Iron	Phos.	Silica
Lloyddale	175,280	59.29	.167	7.83
Lloyd Silica	72,573	53.32	.147	16.58

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3. ANALYSIS (Cont.)

b. Analysis of Ore in Stock December 31, 1946

Grade	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Lloyddale Dried	19,669	58.84	.182	8.92	.250	2.52	.65	.43	.010	2.82	
Lloyddale Nat'l.		51.93	.161	7.87	.221	2.22	.57	.38	.009	2.49	11.75
Lloyd Sil. Dried	238,504	53.32	.126	16.89	.220	2.50	.65	.40	.011	3.10	
Lloyd Sil. Nat'l.		47.70	.113	15.11	.197	2.24	.58	.36	.010	2.77	10.54

c. Complete Analysis of Ores Shipped

Grade	Tons	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss
Lloyddale	182,664	59.20	.158	8.48	.25	2.52	.65	.43	.010	2.82
Lloyd Silica	17,711	52.90	.129	17.34	.22	2.50	.65	.40	.011	3.10

d. Complete Analysis of Straight Cargoes

There were no straight cargo shipments.

4. ESTIMATE OF ORE RESERVES

a. Developed Ore

The following is an estimate of ore reserves as of December 31, 1946 using a factor of 12 cubic feet per ton.

	No. 1 Deposit	No. 2 Deposit	Total Tons
Between 7th & 8th Levels	391,691	-	391,691
Above 210' Sub Level	-	18,734	18,734
Total Gross as of Nov. 30, 1946	391,691	18,734	410,425
Less December Production	14,059	1,168	15,227
Total Gross as of Dec. 31, 1946	377,632	17,566	395,198
Less 10% for Mining & Rock	39,169	1,873	41,042
Net Total Developed Reserves	338,463	15,693	354,156

The following table shows a comparison of developed ore during the past three years:

	1944	1945	1946
Reserves on January 1st	707,170	726,938	846,119
Production	248,064	244,273	175,280
Balance	459,106	482,665	670,839
Reserves on December 1st	726,938	846,119	354,156
New Ore Developed	267,832	363,454	316,683

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4. ESTIMATE OF ORE RESERVES

a. Developed Ore

The large decrease in the reserves is due to the ore below the 8th Level being excluded from the estimate. In the previous year, ore below the 8th Level in both the main deposit and the orebody south of the dike was included in the reserves but this ore is now considered economically unavailable and consequently is excluded from the mineable reserves. Mining and development in areas above the 8th Level has outlined the limits of the ore so completely that there is no possibility of disclosing new extensions in either of the orebodies that will add materially to the reserves and prolong the life of the mine.

The exploration drilling that was done during the past several years has failed to disclose any ore of importance in the area to the south and southwest of the main deposit. Favorable structure and formation was disclosed by some holes but the concentration when encountered was limited to very short runs of ore indicating an insufficient tonnage to warrant the cost of the development for mining. The area to the south of the main deposit was being explored by drilling at the close of the year but the results from the first hole were not very encouraging. A second hole encountered a short run of good quality ore below the 8th Level early in 1947 but additional drilling must be done to determine the extent of the concentration. The probability of new ore discovery is very remote because the most favorable areas for such a find have failed to show concentration in merchantable amounts.

b. Estimated Analysis of Ore Reserves

Grade	Iron	Phos.	Sil.	Mang.	Alum.	Lime	Mag.	Sul.	Loss	Moist.
Lloyddale Dried	58.80	.160	8.50	.22	2.32	.68	.34	.010	3.17	
Lloyddale Nat'l.	51.89	.141	7.50	.19	2.05	.60	.30	.009	2.80	11.75

The above analysis applies to Lloyddale grade only as the reserves of Silica grade are not estimated.

5. LABOR AND WAGES

a. General

Relations with employees particularly during the strike were not on a very amiable basis. It was obvious that the strained relations were fostered by a relatively small group who were constantly agitating to gain supporters for the union cause. Surprisingly there were many who were swayed by the union propaganda to the extent that incidents of mass hysteria and mob rule were evidenced a number of times on the picket line and again by largely the same group taking part in similar scenes at other properties. A majority of the employees, despite their union affiliation took only a passive interest in the dispute and several individuals in this group were singled out and ostracized by other union members. When operations were resumed, after the strike was settled, no trouble developed in maintaining proper job relations between the employees. Much credit is due the supervisory staff for very ably working to reestablish harmonious relations and maintaining discipline by holding strictly to a firm but fair attitude toward the men.

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5. LABOR AND WAGES (Cont.)

a. General (Cont.)

The grievance committee was quite active in submitting complaints and all excepting one were settled in "Step 2" of the procedure. One grievance in which the final decision is still pending has reached the last step in the procedure and is the first grievance from the mine to go before the arbitrator. This grievance followed a disciplinary action against an employee for insubordination and it is earnestly hoped that our action in this matter will be upheld by the arbitrator.

There was a relatively large labor turn-over despite the large decrease that has been made in the size of the labor force. The number of men on the payroll at the end of the year was 169 compared with 227 a year ago. There was a total of 23 men who quit, 15 were transferred to other mines, 29 were laid off, four were retired and two were drafted into the service. A total of 15 employees were hired, all of whom were former employees returning after being discharged from the armed services, making a net decrease of 58 men on the payroll. Employees were laid off because of the decrease in the size of the operation in June and again in December and a further reduction will be made early in 1947.

b. Comparative Statement of Wages & Product

	1946	1945	Incr.	Decr.
Product	247,853	326,633		78,780
No. of Shifts & Hours				
Jan. 1 to Dec. 31	3-8 Hr. Mining (6 Days Per Week)			
	2-8 Hr. Hoisting (6 Days Per Week)			
Jan. 1 to Jan. 27		2-8 Hr. Hoisting (5 Days Per Week)		
		3-8 Hr. Mining (5 Days Per Week)		
Jan. 27 to Dec. 31		2-8 Hr. Hoisting (6 Days Per Week)		
		3-8 Hr. Mining (6 Days Per Week)		
AVERAGE NO. OF MEN WORKING				
Surface	34	53		19
Underground	122	152		30
Total	156	205		49
AVERAGE WAGES PER DAY				
Surface	9.31	7.63	1.68	
Underground	10.46	8.86	1.60	
Total	10.16	8.54	1.62	

The following table shows a comparison of the average wages per day for surface and underground for the past five years:

YEAR	SURFACE	UNDERGROUND
1942	6.74	7.85
1943	7.15	8.10
1944	7.06	7.99
1945	7.63	8.86
1946	9.31	10.46

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5. WAGES AND LABOR (Cont.)

b. Comparative Statement of Wages & Product (Cont.)

WAGES PER MONTH OF 24 DAYS	1946	1945	Incr.	Decr.
Surface	223.44	183.12	40.32	
Underground	251.04	212.64	38.40	
Total	243.84	204.96	38.88	
WAGES PER MONTH OF 22 DAYS				
Surface	204.82	167.86	36.96	
Underground	230.12	194.92	35.20	
Total	223.52	187.88	35.64	
PRODUCT PER MAN PER DAY				
Surface	23.38	20.69	2.69	
Underground	8.01	7.30	.71	
Total	5.96	5.40	.56	
LABOR COST PER TON				
Surface	.398	.369	.029	
Underground	1.307	1.213	.094	
Total	1.705	1.582	.123	
AVERAGE PRODUCT STOPING	24.58	20.86	3.72	
AVERAGE WAGES CONTRACT MINERS	10.98	9.05	1.93	
TOTAL NUMBER OF DAYS				
Surface	10,601 3/4	15,786 1/4		5,184 1/2
Underground	30,957 3/4	44,725 1/2		13,767 3/4
Total	41,559 1/2	60,511 3/4		18,952 1/4
AMOUNT OF LABOR				
Surface	98,691.49	120,493.57		21,802.08
Underground	323,925.83	396,224.32		72,298.49
Total	422,617.32	516,717.89		94,100.57

PROPORTION OF SURFACE TO UNDERGROUND MEN

1942 - 1 to 3.90
1943 - 1 to 3.40
1944 - 1 to 3.24
1945 - 1 to 2.88
1946 - 1 to 3.59

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6. SURFACE

a. Buildings

There was no new construction or additions erected to existing buildings during the year. Only minor repairs were required to maintain the buildings in good condition and some interior painting was done.

In the shift bosses change quarters a larger shower booth was made and hangers provided for the underground clothes in a portion of an adjoining room.

The walls and ceiling in the office and the captain's quarters were given two coats of paint of two-tone color.

Due to the decrease in the size of the underground labor force the conditions in the dry house change rooms have been considerably improved. For several years, while the labor force was at a maximum, the change rooms were badly overcrowded.

A new smoke stack was installed for the heating plant boiler at the north end of the shop and office building. A new sheet metal stack 22" in diameter and 52' long was installed, replacing one of similar size which was badly rusted and developed a number of holes so that the efficiency of the heating plant was reduced.

b. Stocking Ground

All the Lloyddale grade in stockpile to the east of the shaft was loaded out before the close of the shipping season. Two temporary wood trestles have been regularly used for stocking Lloyddale grade in this area and when all the ore was loaded out, both trestles were reerected. A total of 24 bents of wood trestle were constructed for stocking during the winter months.

There was no shipment of Silica grade made from the stockpile and the inventory of this grade in stock is gradually increasing. There are three separate piles of Silica grade, one to the east, another to the north and a third in the area west of the shaft. The latter area is only partly filled and stocking is being continued on this pile. There were five bents of wood trestle erected to extend the west trestle and provide additional capacity for stocking during the winter months.

The practice of blasting the stockpiles before the start of the shipping season has been continued. Both Lloyddale grade piles were blasted by means of long holes put down from the crest of the pile and good results were again obtained in hastening the thawing of the frozen ore.

c. Roads

Only a small amount of grading was necessary and an occasional load of mine rock was hauled for filling to maintain the roads and the parking lot area in good condition. In the winter months the roads have been maintained clear of snow after each snow fall by the tractor-bulldozer.

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7. UNDERGROUND

a. Shaft Sinking

There was no shaft sinking in 1946.

b. Development

The development program was considerably smaller than in the previous year due to the continual decrease in the size of the underground operation as mining progressed in depth. Development of the 8th Level was completed in the previous year and there was no main level development done in 1946 excepting some preliminary development for the 9th Level which was abandoned and will be described later. The development program was confined almost entirely to developing sub level stopes and sub caving areas where this system of mining has replaced the top slicing method.

In the east half of the main orebody mining has been conducted at the highest elevations and reached the 7th Level elevation at the close of the year. Development above the 7th Level consisted of driving two separate transfer drifts to the east and west from No. 821 raise for stope operations. A number of mill raises were put up from each of the transfer drifts and intermediate sub level connections driven to connect the mills. Adjacent to the stopes on the west side, an area where top slicing was formerly employed was converted to a sub level caving method of mining. The development here consisted of driving standard size drifts radiating from the raise to the ore limits and then caving the pillar above. On the 390' sub level, which is the top elevation at which mining was conducted during the year, a short drift connection to a ventilation raise was driven in the footwall slate to the north.

The major portion of the development was conducted for sub level stopes between the 7th and 8th Levels in the main orebody and the small orebody south of the dike. During the latter half of the year development was conducted for two stopes in the east half of the main orebody. Transfer drifts for each of the stopes were driven at an elevation of 22' above the 8th Level along the strike of the orebody and a number of mill raises were cut out and intermediate sub level drifts were driven to connect the mills. Work was nearly completed at the close of the year so stope operations could be started early in 1947. The block of ore that is being developed for stoping in the east half of the deposit is narrow in width but a substantial vertical height of ore has made it possible to develop relatively large stopes.

In the central part of the main orebody a scram stope was developed to the east of No. 808 Raise along the north footwall side. A transfer drift was driven to the east of the raise and five mill raises put up and a sub drift was driven directly above to connect the mills. Near the west limits of the orebody three contracts have continued operations and these areas have been converted to a sub caving method. The development in each case consisted of driving standard size drifts radiating from the raise to the limits of the ore and then caving the pillar directly above.

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7. UNDERGROUND (Cont.)

b. Development (Cont.)

In the orebody south of the dike a substantial amount of stope development was done to extend this work to the ore limits as the stopes were being enlarged. The transfer drifts for the stopes were drivem in the previous year as was the major portion of the other development but as the ore limits were outlined by mining, additional development and exploration was required to keep abreast of the mining. During the latter months of the year a small pillar of ore lying between the stope and the dike at the east end of the orebody was recovered by a scram stope. A short transfer drift was driven branching to the northwest from the southeast crosscut on the 210' sub level and three mill raises were put up and a sub drift connection between the mills comprised the development for the scram stope. Before the close of the year mining was completed in the first two stopes and a westerly extension of the orebody was being explored and developed. A transfer drift 200' in length was driven to the northwest from the south crosscut on the 210' sub level. The width of ore disclosed along the slate footwall is very narrow and subsequent development above the transfer disclosed a maximum height of only 40' of ore. Development was completed so mining could be started in December and indications were that the ore in the deposit south of the dike would be depleted in two or three months.

Only a small amount of development was done on the 8th Level and it consisted of putting up three short raises from the main level ore drift and extending the south crosscut 40' farther to provide a diamond drill station. The three raises, Nos. 819, 820 and 822, were put up to a height of 22' above the level and enabled driving the transfer drifts for the two stopes in the east half of the main deposit.

During the five weeks of operations early in the year prior to the strike, some development was done on the 8th Level in connection with the proposed 9th Level development. The rock drift to the east and west of the winze site was stripped to double width and an engine house room was excavated in rock along the south side of the plat. Some additional excavating was done directly above the proposed winze site preliminary to starting the sinking operation. This development program was abandoned and no additional work was done on it after the strike was settled.

c. Stoping

Most of the product in 1946 was obtained from caving and stoping methods in contrast to slicing operations in the previous year. Top slicing has been employed only where the best results from this system are obtained and where there is not sufficient vertical height of ore to employ a caving or stoping system. The bulk of the production was obtained from areas in the main orebody and the balance from the stopes in the small orebody south of the dike.