

THE CLEVELAND - CLIFFS IRON COMPANY

Ore Mining Department

ANNUAL REPORT OF GENERAL MANAGER

For Year Ending December 31, 1946

MS 86-100
2019

#2019

1950
/ 151

RETURN TO
ARCHIVES
SEC. Ba-4
FILE No. 19547

THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1948

INDEX

	<u>PAGE NO.</u>
Mr. C. J. Stakel's report to the president	1 - 13
Comparative statement of Michigan assessed valuation & taxes paid for the Mining Department and Cliffs Power & Light Company	14
Comparative cost of all explosives used at hard ore mines	15
Comparative cost of all explosives used at soft ore mines	16
Comparative cost of all mine timber used at soft ore mines	17
Total cost of supplies charged to "Cost of Ore at Mine"	18
Labor summary - all companies	19
Comparison of total days worked and tons of ore mined for the years 1948 and 1947	20
Statement of overtime for year 1948 and effect the penalty cost had on the year's production cost	21
 <u>Ishpeming District</u>	
Cliffs Shaft Mine	22 - 69
Lloyd Mine	70 - 100
Mather Mine "A" Shaft	101 - 157
Morris Mine	158 - 172
Tilden Mine	173 - 187
 <u>Negaunee District</u>	
Athens Mine	188 - 225
Cambria-Jackson Mine	226 - 253
Maas Mine	254 - 288
Mather Mine "B" Shaft	289 - 306
Negaunee Mine	307 - 335
 <u>Iron River District</u>	
Spies Mine	336 - 364
 <u>Mesaba District</u>	
Agnew Mine	365 - 373
Atkins Mine	374 - 383
Canisteo Mine	384 - 401
Hawkins Mine	402 - 415
Hill-Trumbull Mine	416 - 434
Holman-Cliffs Mine	435 - 453
Sargent Mine	454 - 462
Wanless Mine	463 - 465

Continued

THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1948

INDEX
Page 2

	<u>PAGE NO.</u>
<u>Safety Department</u>	
a. Fatal accidents	466 - 473
b. Non-fatal accidents	474 - 493
c. Safety inspection	494 - 513
d. Ventilation	514 - 523
e. Mine safety & mine rescue courses	524 - 528
f. Miscellaneous	529
<u>Mining Engineering Department</u>	
a. List of annual report map books	530 - 531
b. Map reports	531 - 532
c. Report on miscellaneous documents & abstracts	532 - 533
d. Engineering force	534 - 550
e. Distribution of time	550
f. Costs	551
h. Automobiles	551
i. Mines	552 - 554
j. Miscellaneous	554 - 561
<u>Mechanical Department</u>	
Agnew Mine	562
Athens Mine	562
Atkins Mine	562 - 563
Cambria-Jackson Mine	563
Canisteco Mine	563 - 564
Cliffs Shaft Mine	564 - 565
Hawkins Mine	565 - 566
Hill-Trumbull Mine	566
Holman-Cliffs Mine	566 - 567
Lloyd Mine	567
Maas Mine	568
Mather Mine "A" Shaft	568 - 569
Mather Mine "B" Shaft	569
Negaunee Mine	570
Sargent Mine	570
Spies Virgil Mine	570 - 571
Tilden Mine	571
Comparative tables	572 - 573
<u>The Cliffs Power & Light Company</u>	
General operations	574 - 577
Statistical data	578 - 580
Substation transformers	581 - 582
Charts	583 - 586

Continued

THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1948

INDEX
Page 3

	<u>PAGE NO.</u>
<u>Welfare Department</u>	
General	587 - 588
11-a. Workmen's compensation	589 - 597
c. Group insurance	598 - 600
23-a. Pension system	601 - 605
b. Republic mine funds	606
c. Suspense funds	606
d. Visiting nurses	607 - 610
f. North Lake Club	611
g. Gwinn Association	611
h. Ishpeming Y. M. C. A. building	612
i. Safety work	613
j. Hospitals and medical service and Ishpeming Hospital	614 - 634
k. Community health	635
l. Red Cross	642
m. Relief work	636
n. Employment	636
o. Incapacitated employes	637 - 641
p. Cost of living	642
q. Improvement work	643
r. Gardens and well-kept premises	643
s. Community service work	643
t. Clubs	643
u. Outdoor activities	643
v. Mather Inn	644
w. Various departments and activities	644, 646-647
x. Police Department	644
y. "The Cleveland-Cliffs Orbit"	645
z. Appreciation	645
<u>Electrical Department</u>	
Athens Mine	648
Cambria-Jackson Mine	648 - 649
Cliffs Shaft Mine	649 - 650
Lloyd Mine	650
Maas Mine	650 - 651
Mather Mine "A" Shaft	652 - 653
Mather Mine "B" Shaft	653
Negaunee Mine	653
Spies Mine	654
<u>Report of Geologist</u>	
a. Staff	
b. General description of the work of the department	
c. Surface geological surveys	
d. Mine geological surveys and operations	
e. Options and leases	
f. Explorations and cost	
g. Description of explorations	
h. Examination of mineral land offers	
l. Metallurgical tests and experiments	
j. Expense statements	

THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1948

CROSS INDEX BY MINES

	Cambria- Cliffs-				Maas	Mather	
	Athens	Jackson	Shaft	Lloyd		"A"	"B"
<u>Ishpeming, Negaunee, and Iron River</u>							
<u>Districts:</u>							
General	188-189	226	22-23	70-71	254	101	289
Production, shipments & inventories	189-192	226-229	24-28	71-73	255-257	102-105	
Analysis	192	229	29	73-74	257	105	
Estimate of ore reserves	192-193	230	30-33	74-75	258-259	106-107	289
Labor & wages	193-195	230-231	34-36	75-77	259-262	108-110	290
Surface	195-197	232-233	36	77-78	262-264	111-114	
Underground	197-210	234-241	37-56	78-88	265-276	115-133	
Cost of operating and/or opening	210-218	241-246	57-65	88-92	277-283	134-141	290-305
Explorations	219	246-247	65-66	92-93		142-150	
Taxes	220	248	66-67	93-94	283	151	305
Accidents & personal injuries	221	248	67	94-95	284-285	152-153	305-306
New construction or equipment	221-222	249-251	67	95-96	285-288	153-155	
Maintenance & repairs	222-223	251-252	68	97-99		155-156	
Power	224	252-253	68-69	99-100	288	156	
Nationality of employes	225	253		100		157	306
Water supply				100		157	
Condition of premises	224	253		100	288		

Morris Negaunee Spies Tilden

<u>Ishpeming, Negaunee, and Iron River</u>							
<u>Districts:</u>							
General	158	307	336	173-174			
Production, shipments & inventories	158-160	308-309	336-339	174-175			
Analysis	161	310	339-340	175-176			
Estimate of ore reserves	161-162	310	340	176-177			
Labor & wages	162	311-312	341-342	177-178			
Surface	162-165	313-314	342-343				
Underground or open pit operations	166-172	314-323	344-354	178-182			
Cost of operating		324-329	354-358	183-186			
Explorations		329	358				
Taxes		330	359-360	187			
Accidents & personal injuries		331	360	187			
New construction or equipment		331-332	360-362	187			
Maintenance & repairs		332-333	362-363				
Power		334	364				
Condition of premises		334	364				
Nationality of employes		335	364				
Water supply			364				

Continued

THE CLEVELAND-CLIFFS IRON COMPANY
ORE MINING DEPARTMENT

Manager's Annual Report Year 1948

CROSS INDEX BY MINES
Page 2

	Agnew	Atkins	Canisteo	Hawkins
<u>Mesaba District:</u>				
General	365	374	384	402-403
Production, shipments and inventories	365-366	374-375	385-386	403-404
Analysis	366	375-376	386-387	404-405
Estimate of ore reserves	367	376-377	387-389	405-406
Labor and wages	367	377	389-390	406-407
Surface	368	378	390-391	407
Underground and open pit operations	368-369	378-380	391-395	407-409
Cost of operating	369-370	380-381	396-398	411-412
Explorations	371	382	398	412-413
Taxes	371	382	398-399	413-414
Accidents and personal injuries	371-372	383	400-401	414
New construction or equipment	372-373	383	401	415
Maintenance and repairs	371	381	395-396	410
Nationality of employes				
Water supply				
Sewer system				
Condition of premises				
Gwinn Association				
Beneficiation			394-395	409-410

	Hill-Trumbull	Holman-Cliffs	Sargent	Wanless
<u>Mesaba District:</u>				
General	416-417	435-436	454	463
Production, shipments and inventories	417-419	436-437	454-455	
Analysis	419-421	437-438	455	
Estimate of ore reserves	421-422	439-440	455-456	463
Labor and wages	423	440	456	
Surface	423	440-441	456	464
Open pit and underground	423-426	441-445	457-458	464
Cost of operating	429-431	448-450	458-459	
Explorations	431	450	460	465
Taxes	431-432	450-452	460	465
Accidents and personal injuries	433	452	461	
New construction or equipment	434	452-453	461-462	
Maintenance and repairs	429	447	460	
Pumping				
Beneficiation	426-428	445-447		

Ishpeming, Michigan
February 28, 1949



Mr. A. C. Brown, President
Cleveland, Ohio

MAR -3 1949

Dear Sir:-

The Ore Mining Department in 1948 made progress to improve costs and increase efficiency in operations in general by following new methods; using new equipment and developing and improving mining techniques.

The outstanding achievement was the development of the Hydro-mucker used in the Mather "B" Shaft sinking project. The use of Carset bits cut drilling time materially at Mather "B" and at the Cliffs Shaft Mine in particular, besides speeding up the development work at the other underground properties.

The installation of Humphrey spirals at the Hill treatment plant proved a fine investment. They materially decreased the silica in the output thereby prolonging the life of the Hill Trumbull by making it possible to get a merchantable product from crude ore heretofore considered not amenable for beneficiation.

For the first time in the history of the Cliffs Shaft Mine hard ore was successfully drilled with the light 55 lb. Ingersoll Rand J-50 stope hammer drills. By the end of the year 30 of these drills were in operation.

On the Mesaba Range an attempt was made to obtain a true sample of the wash ores and decomposed taconite without concentration in drilling through the use of a core barrel for the sample and the use of aquajell and mud to stabilize the sides of the drill hole and to prevent caving. Experience has shown that ordinary structure and churn drilling practice does not give us the correct grade of the open pit ores.

At the Canisteo Mine for the first time a large 8 yard capacity dragline with a 140 ft. boom was used for stripping. This was purchased to be used in conjunction with a belt conveyor system but, unfortunately, the dragline was received too late in the season for the operation of the belt conveyor and this work will be started early in the spring of 1949. However, to break in the dragline crews, stripping at the west end of the Canisteo was conducted with the dragline loading into a pocket and from there into trucks before heavy frost set in, and thereafter, the stripping was lifted from the lower bench with the dragline, cast and reloaded at the west end of the Snyder pit to avoid steep grades and expensive haul.

Bottom dump trucks were likewise used for the first time in stripping at the Holman Cliffs Mine, the Canisteo and the Wanless Mines in 1948. These trucks proved to be more economical than the rear dump truck of the same capacity; this is accomplished through a better distribution of weight, a better power factor and lower tire costs. Their use enabled us to secure lower stripping costs.

Self-loading scraper units, called "Terra Cobras" were used for the first time in 1948 in stripping and auxiliary work at the Mesaba range properties. These are extremely economical machines in ground which is adapted to their use, such as clay, loam, with a small percentage of rock, and sand. They were used effectively at the Canisteo, in some of the stripping layers at the Holman Cliffs where they showed a good saving over loading with a shovel and haulage by trucks. In addition to their use in stripping, it was found they were extremely adaptable to the grading of reservoirs, the building of dikes and other auxiliary use around the range properties.

In the Marquette Range mines the use of prefabricated steel sets in the main level drifts has become common practice. Although some treated timber is still used where pressures are excessive, by and large steel sets are replacing wooden supports. In this connection at Mather "A" reinforced concrete slabs were used for the first time to replace wood lagging. These concrete slabs are permanent, fire-proof, have ample strength and are particularly adaptable for main travel and ventilating drifts and haulage ways and shaft plats.

For the first time in any Cleveland-Cliffs property at the Athens Mine a belt conveyor was installed above the 4th Level on Lot 13, or the Corbit Lease (in the "No. 2 Block" area). An electrically controlled traveling feeder straddles the belt. This feeder is moved under the proper chute as determined by the draw sheet schedule. After a trial period, requiring numerous adjustments, the so-called "push button mining" device operated smoothly.

Experiments with block caving in the original or No. 1 "Block" at the Athens, suggested the mining of the Corbit or Lot 13 Athens ore reserve by the same method. By the end of 1948 it was demonstrated that the decision to block cave this area was proper and plans were being made to adopt this system of mining at other properties. At the end of the year the "Block" in the Mather "A" was just coming into production. An area in the Maas Mine is also being considered for block caving.

The sub-caving mining technique as developed best at the Cambria Jackson and Mather mines, was used for the first time in our operations on the Mesaba Range at the Sargent Mine. At that property milling through the use of a tractor, pushing the ore into raises, contributed much to the extra tonnage and lower costs realized at that property in 1948.

At the Tilden property on the Marquette Range experiments were conducted with two 9" churn drill bits specially built for use with tungsten carbide inserts. The experiment was only partially successful. Further work will be done to try to develop a bit that will compete with the jet piercing process.

At the Holman Cliffs Mine operations at the fine ore plant got underway on June 7th. After a slow start, this new venture operated successfully for the balance of the season.

Electric power for the first time was generated by the Cliffs Power & Light Company with diesel engines. Although this plant represented an investment of about three quarters of a million dollars, it insured the continued operation of all mines on the Marquette Range at full schedule.

The new idea of using heavily weighted rods in diamond drilling was first tried late in the year. For years the usual technique had been to apply pressure at the drilling machine, putting the entire string of rods in compression. The new idea should provide for the full effect of gravity in maintaining the bit in vertical alignment by the use of the heavy weighted guide rods above the core barrel.

Another important technique developed in 1948 was proof of the efficiency of mudding or aquajell method of drilling through surface formations in place of the old standpiping method.

In 1948 we also secured the aid of the Ground Water Control Division of the U. S. Geological Survey to determine the hydrology of the Marquette Range with such completeness and detail to plan the program of ground water control and drainage at our properties, in particular the area from the North Lake District over and across the Mather Mine to the easterly limits of the City of Negaunee

ADMINISTRATIVE STAFF

Several new men were added to the staff in 1948.

Louis J. Erck, formerly with Butler Brothers, joined us to head up the Research and Metallurgical Department on January 1st.

J. J. Sheppard, mechanical engineer especially trained in the layout and construction of beneficiating plants, joined the Mesaba Range staff in July.

Edwin B. Johnson, Michigan Tech graduate specializing in ore dressing, was hired on June 9th. He is to be one of Louis Erck's assistants in the new Research Laboratory.

Two new employees were hired for the Marquette Range Mechanical Department. Dwight W. Jamar, graduated from Michigan Tech with a degree in Mechanical Engineering. He joined our staff on June 15th. Aatos E. Lillstrom was hired as of January 1st, 1949 to look after the underground mechanical loaders, Carset bits, belt conveyors, etc. He had world-wide experience and should prove a valuable addition to the Mechanical Department.

The Electrical Department engaged Reino P. Norell on July 1st. He is a graduate electrical engineer who came to us highly recommended.

Two new geologists were added to Mr. Derby's staff, Layton C. Binon was hired on June 14th and John S. Sumner reported in July. The former graduated from Michigan Tech and the latter from the University of Minnesota. Mr. Sumner specialized in geophysics and is being trained to operate the ultra-sonics equipment.

PRODUCTION & SHIPMENTS

Production

Production from the Michigan and Minnesota mines for the past five years was as follows:

<u>Year</u>	<u>Michigan Mines</u>	<u>Minnesota Mines</u>	<u>TOTAL</u>
1944	3,496,534*	2,400,481	5,897,015
1945	3,542,802*	2,376,286	5,919,088
1946	2,730,496*	1,642,184	4,372,680
1947	4,162,545*	3,767,682*	7,930,227
1948	4,112,679	4,595,354	8,708,033

* These figures do not include previous year's stockpile overrun.

The 1948 production from the Michigan Mines is split by grades as shown, viz:

Non-Bessemer Standard	3,294,847 tons
" " Special	651,086 "
Silicious Ore	166,746 "
Total	<u>4,112,679 tons</u>

Shipments

Shipments from our operations in Michigan and Minnesota for 1948 follow:

Michigan Mines	4,166,534 tons
Minnesota Mines	4,604,118 "
Total	<u>8,770,652 tons</u>

Shipments for 1947 and 1948 compare as follows:

Total shipments 1947	8,221,763 tons
" " 1948	<u>8,770,652 "</u>
Increase for 1948	548,889 tons

Shipments from the Athens, Cambria Jackson, Cliffs Shaft, Lloyd, Maas and Mather, Negaunee, Spies, Tilden and Virgil mines up to December 31st, 1948 total 83,307,219 tons. The Negaunee (since we took over that property) has shipped over 20,000,000 tons. The Cliffs Shaft has shipped about 18,500,000 tons.

Analysis

The following data is compiled to show the average mine analyses for the various mixtures, the Lake Erie analyses on the same cargos and the expected analyses:

MICHIGAN ORES - 1948

GRADE		RAILROAD TONS	IRON DRIED	PHOS _‡	MOIST _‡	IRON NATL _‡
Belden	Mine	658,647	57.05	.090	11.13	50.703
	Lower Lake		57.15			
	Expected analysis		57.56				.100	11.16	51.14
Cliffs Group via Escanaba	Mine	514,681	57.59	.136	11.07	51.258
	Lower Lake		57.62			
	Expected analysis		57.96				.128	11.28	51.42
Cliffs Group Harvester, etc.	Mine	114,097	58.25	.100	11.59	51.495
	Lower Lake		57.80			
	Expected analysis		58.33				.108	11.79	51.453
Cliffs Group Bethlehem	Mine	432,500	57.95		11.59	51.246
	Lower Lake		57.75			
	Expected analysis		58.45				.108	11.72	51.600
Cliffs Group P.M. & Co.	Mine	230,667	57.96		11.83	51.091
	Lower Lake		-			
	Expected Analysis		58.33					11.79	51.453
Cliffs Group J. & L.	Mine	203,796	57.95	.110	11.74	51.147
	Lower Lake		57.86			
	Expected analysis		58.33				.108	11.79	51.453
Cliffs Group Hanna, Rep. Etc.	Mine	626,400	58.07	.103	12.05	51.073
	Lower Lake		58.14			
	Expected analysis		58.33				.108	11.79	51.453
Cliffs Shaft Lump	Mine	397,081	60.46	.097	.30	60.421
	Lower Lake		60.93			
	Expected Analysis		59.50				.105	.40	59.262
Maas Special #2	Mine	407,456	58.76	.097	12.71	51.290
	Lower Lake		58.34			
	Expected analysis		59.27				.105	12.31	51.974
Tilden Silica	Mine	78,397	39.41	.039	1.77	38.715
	Lower Lake		39.79					2.04	38.975
Tilden Low Phos.	Mine	43,942	36.53	.015	1.48	35.989
	Lower Lake		37.45				.015	1.37	36.937
Virgil	Mine	40,468	57.06	.278	9.88	51.419
	Lower Lake		57.68					10.00	51.905

With few exceptions the lower lakes determinations run higher in iron natural than the mine results.

MINNESOTA ORES - 1948

<u>GRADE</u>		<u>RAILROAD TONS</u>	<u>IRON DRIED</u>	<u>PHOS₂</u>	<u>MOIST.</u>	<u>IRON NATL₂</u>
Newberry Bess.	Mine	466,945.64	56.395	.036	7.431	52.204
	Lower Lake		56.591	.035	7.060	52.596
Newberry Bess.	Mine	165,717.86	56.598	.037	7.665	52.260
J. & L.	Lower Lake		56.612	.036	7.240	52.513
Williamson	Mine	879,283.02	55.975		8.667	51.123
	Lower Lake		56.250		8.400	51.525
Williamson	Mine	839,451.54	56.063		8.505	51.295
J. & L.	Lower Lake		56.214		8.262	51.567
St. Paul - GN	Mine	468,684.67	55.457		11.972	48.818
	Lower Lake		55.663		12.044	48.958
Ralph-GN	Mine	184,508.84	51.914		10.838	46.288
	Lower Lake		51.803		10.892	46.158
St. Paul Special	Mine	652,172.30	55.868		10.621	49.934
	Lower Lake		55.978		10.706	49.984
St. Paul DM&I RR	Mine	171,047.72	56.091		12.897	48.854
	Lower Lake		55.257		12.936	48.101

If one compares the lower lake with the mine analyses, as was true with the Michigan cargos, the bulk of the tonnage forwarded from the Minnesota Mines indicated that the lower lake chemists got higher iron naturals.

COSTS

Michigan Underground Mines

YEAR 1948

<u>Mine</u>	<u>Production</u>	<u>COST OF PRODUCTION</u>		<u>TOTAL COST</u>	
		<u>Per Ton</u>	<u>AMOUNT</u>	<u>Per Ton</u>	<u>AMOUNT</u>
Athens	506,600	\$ 3.456	\$1,750,725.02	\$ 3.979	\$ 2,015,892.26
Cambria Jackson	491,817	2.331	1,146,581.56	2.750	1,352,292.56
Cliffs Shaft	602,453	3.734	2,249,811.54	4.208	2,535,136.20
Maas	673,126	3.017	2,030,645.06	3.415	2,298,892.10
Mather "A"	1,001,001	3.024	3,027,193.66	3.483	3,486,753.82
Negaunee	382,076	2.804	1,071,402.60	3.070	1,173,050.71
Total	3,657,073	\$ 3.083	\$11,276,359.44	\$ 3.517	\$12,862,017.65

YEAR 1947

<u>MINE</u>	<u>Production</u>	<u>COST OF PRODUCTION</u>		<u>TOTAL COST</u>	
		<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>
Athens	508,100	\$ 3.122	\$1,586,302.83	\$ 3.559	\$ 1,808,040.46
Cambria Jackson	554,105	1.991	1,103,446.01	2.259	1,251,526.35
Cliffs Shaft	546,796	3.705	2,025,819.02	4.170	2,280,139.31
Maas	722,401	2.554	1,845,036.19	2.950	2,131,161.05
Mather "A"	729,669	2.569	1,874,786.44	3.087	2,252,429.91
Negaunee	531,670	2.257	1,169,950.68	2.565	1,329,948.81
Total	3,592,741	\$ 2.674	\$9,605,341.17	\$ 3.077	\$11,053,245.89

1948

Increase in product	64,332		
Increase in cost		\$.409	\$.440
Percent	1.8%	15.3%	14.3%

Production increased about 2% over 1947 but costs increased approximately 15%. Effective July 16, 1948 wages were increased on a sliding scale which averaged about 9% over the total payroll.

LABOR

The overall labor supply for all properties in the Lake Superior area was ample except for the shortage of skilled miners. All operators complained they were unable to hire miners. We could have used to good advantage more miners at both the Sargent and Agnew mines. On the Marquette Range we trained scores of young active alert prospects for mining with a good deal of success. The outlook for the future indicates that we will have to continue to make miners because of the inability to hire ready-made miners.

The following figures show the rising trend of employees both in Michigan and Minnesota:

AVERAGE NUMBER OF EMPLOYEES

MICHIGAN PROPERTIES

January 1947	2,776 employees
July 1947	2,934 "
December 1947	2,917 "
January 1948	3,001 "
July 1948	3,103 "
December 1948	3,109 "

MINNESOTA PROPERTIES

March 1947	830	employees
May 1947	946	"
September 1947	1,048	"
December 1947	1,045	"
March 1948	922	"
May 1948	1,045	"
September 1948	1,128	"
December 1948	1,080	"

Detailed figures for the individual mines and facilities for 1948 follow:

YEAR 1948

MICHIGAN PROPERTIES

	<u>January</u>	<u>July</u>	<u>December</u>	<u>Total for Year</u>
Athens	350	334	346	345
Cambria Jackson	220	225	226	225
Cliffs Shaft	452	448	454	451
Lloyd	110	111	130	124
Maas	373	375	375	377
Mather "A"	513	559	627	564
Mather "B"	85	104	94	94
Negaunee	235	209	187	209
Spies	113	115	114	115
Tilden	10	29	3	18
Miscellaneous *	63	76	74	69
General Storehouse & Shops	138	172	142	154
General payroll-Ishpeming **	228	251	233	238
Cleveland	27	27	27	27
C.P. & L.Co. - Plant	76	57	67	68
General	8	11	10	10
Total	3,001	3,103	3,109	3,088

* Miscellaneous roll includes 53 hospital employees - balance Laboratory.

** General payroll includes 70 hospital employees.

MINNESOTA PROPERTIES

	<u>March</u>	<u>May</u>	<u>September</u>	<u>December</u>	<u>Total for Year</u>
Agnew	96	88	93	104	93
Atkins	25	49	55	72	50
Canisteo	181	175	177	202	184
Hawkins	83	134	144	154	129
Hill Trumbull	118	201	179	91	167
Holman Cliffs	230	213	279	246	254
Miscellaneous	28	28	38	45	35
Sargent	106	103	110	114	108
General Roll-Hibbing	55	54	53	52	54
Total	922	1045	1128	1080	1074

ORE RESERVES

MICHIGAN MINES

	<u>Dec.31,1947</u>	<u>Dec.31, 1948</u>	<u>Increase or Decrease</u>
Standard Ores	19,304,735	18,338,212	966,523
High sulphur ores	6,091,500	6,971,648	880,148
TOTAL	25,396,235	25,309,860	86,375

It will be noted that the underground mines developed just about as much new tonnage as the total ore mined during the year. The gains and losses by mines are shown by the figures which follow:

Athens Mine	92,500	ton loss
Cambria Jackson	496,512	" "
Cliffs Shaft	17,866	" "
Lloyd	192,637	ton gain
Maas	325,495	" loss
Mather	925,252	" gain
Negaunee	215,090	" loss
Spies Virgil	56,801	" loss

With the exception of the Cambria Jackson and Negaunee mines, it is certain that the other properties will more than develop enough new tonnage in 1949 to wipe out the tonnage deficiency.

-10-

MESABA RANGE

	<u>Dec. 31, 1947</u>	<u>Dec. 31, 1948</u>	<u>Increase or Decrease</u>
Agnew	1,745,000	1,277,199	467,801
Atkins	1,379,000	924,919	454,081
Canisteo	8,980,000	7,974,827	1,005,173
Hawkins	3,999,000	3,298,171	700,829
Hill Trumbull	2,166,000	1,443,845	722,155
Holman Cliffs	7,579,000	6,619,293	959,707
Sargent	1,874,000	1,447,384	426,616
Wanless	1,251,000	1,681,714	430,714
Bovey No. 1	-	1,500,000	1,500,000
Total	28,973,000	26,167,352	2,805,648

Most of the decreases represent the loss in tonnage approximately equal to the ore produced in 1948. There is actually more recoverable ore in sight at some properties than the reserve figures shown for December 31, 1948. The Hawkins may well be bumped 1,000,000 tons after review by the Minnesota tax authorities. Likewise the Holman might be bumped 2,000,000 tons.

ELECTRIC POWER

Electric energy sold and the total generated and purchased during 1948 reached an all time high. The 1948 figure reached 117,189,620 KWH compared with 111,372,320 KWH generated and purchased in 1947.

There was an increase of 4.8% in gross revenues over 1947 and the gross earnings were in excess of any that had been previously received by the power company. The net profit in 1948 dropped to \$222,669 from \$391,745 in 1947. This large decrease in net profit was due to increased labor and material costs, together with the worst year for hydro-production since 1925.

The year 1948 was marked by the installation of the first Diesel engine units. The first five purchased in 1947 were installed and the first unit went into operation on March 15th. By May all five units were in continuous operation.

We were favored by an early spring break-up and a critical water situation was averted by increased stream flow by March 20th. However, in a short time it became apparent that due to subnormal winter precipitation and lack of the normal heavy spring rains, we were heading into a power crisis.

We never did get over 51.5% of the storage capacity filled by May and in June the water in storage started dropping. Then and there it was decided to install additional Diesel units. Accordingly in August authorization was obtained for the purchase of five more Diesels at an estimated installed cost of \$420,000.

By the first of December, all five generating sets were ready for operation.

In the meantime, realizing that the cost of Diesel power generated energy would be very high and because of the cancellation of the purchased power contract with the Wisconsin-Michigan Power Company, the Cliffs Power & Light Company was authorized to proceed with the installation of a 7500 KW steam plant at an approximate cost of \$1,900,000. During the fall and early winter 50% of the foundations for the building were completed.

Revised rate schedules for wholesale power rates for the mines, wholesale power rates for quarries and process plants, rates for small industries and off-peak power rates were being considered and studied late in the year with the idea of presenting the revision in the rate schedules to the Michigan Public Service Commission for approval.

Due to the extremely low water in the Hoist Dam, basin repairs were made on the upstream face of the dam by the Intrusion Prepaht Company.

SAFETY DEPARTMENT

The accident record for the Company's properties showed much improvement over the previous year. The fatality rate dropped, the frequency rate improved and the severity rate was halved. The figures speak for themselves. Detailed data follows:

FATAL ACCIDENT RECORD

<u>Year</u>	<u>Number of Men Employed</u>	<u>Number of Fatalities</u>	<u>Fatality Rate</u>
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
1941-1945	17,403	15	0.86
1946	2,791	0	0.00
1947	3,942	7	1.78
1948	4,305	3	0.70

-12-

follow: The number of man shifts worked and tons of ore produced per fatality

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

<u>Year</u>	<u>Number of Fatalities</u>	<u>Number of days worked per fatality</u>	<u>Number of tons of ore mined per fatality</u>
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	747,079	4,416,253
1947	7	153,031	1,130,679
1948	3	386,965	2,869,090

Although 1948 shows much improvement over 1947, there is still a lot of work to be done to equal the 1945-1946 record.

Another tabulation follows which is of interest in comparing our frequency and severity ratings with national averages:

COMPARISON OF FREQUENCY - SEVERITY RATINGS

	<u>Frequency</u>	<u>Severity</u>
1947 National Rating, All mining (except coal)	50.54	6.17
1947 " " Underground Metal Mining	67.66	7.90
1947 " " Open cut Metal Mining	10.81	1.23
1947 Lake Superior District, All Mines	22.10	4.39
1948 The Cleveland-Cliffs Iron Co., Compensable Accidents	15.94	3.502
1948 The Cleveland-Cliffs Iron Co., All accidents	45.01	3.571
1948 " " " " Open cut Mining	24.87	.549
1948 " " " " Concentrating Plants	80.22	.952
1948 " " " " Top slicing	62.47	2.662
1948 " " " " Stopping	31.66	2.787
1948 " " " " Sublevel caving	59.04	12.879
1948 " " " " Low head block caving	76.57	5.749
1948 " " " " General Shops	10.49	.847
1948 " " " " General Roll	0.00	0.000
1948 " " " " Miscellaneous	6.73	.013
1948 " " " " C.P. & L.Co.	0.00	0.000

-13-



DETAILED STATEMENTS

Comparisons of valuations and taxes; explosives; mine timber; supply breakdown, etc., will be forwarded to Cleveland shortly.

BAE1 G- RAM

Yours very truly

A handwritten signature in cursive script is written over a rectangular box. The signature is highly stylized and difficult to decipher, but it appears to be a name with a prominent initial.

General Manager

CJS:DP

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

	1945	1946	1947	1948
PRODUCT - Tons	550,169	401,939	546,796	602,453
<u>POWDER</u>				
Pounds - Gelamite 2X	523,450	360,550		
60% Gelatine	350			350
Gelamite #1		7,550	52,250	80,500
Hercomite 2X			449,650	520,600
Hercomite 2XA			47,600	
Total Pounds Powder	523,800	368,100	549,500	601,450
Total Cost	\$ 60,549.00	45,329.42	74,587.53	84,605.78
Fuse - Feet.....	791,194	561,500	814,864	838,775
Caps - Number	124,160	86,865	131,140	131,261
Duplex Shot Wire - Feet	7,760	11,115	--	--
Electric Caps	12,358	23,500	15,435	19,830
Fuse Lighters	35,000	11,900	42,500	56,320
Connecting Wire - Lbs.....	637	347	768	727
Tamping Bags	11,700	8,300	10,200	11,224
Powder Bags				12
No. 18 Shot Wire - Feet			13,081	13,628
Total Cost - Fuse, Caps, etc. \$	8,323.06	6,584.20	12,050.74	13,760.42
Total Cost - All Explosives \$	68,872.06	51,913.62	86,638.27	98,366.20
Average Price per Pound - Powder \$	.1150	.1231	.1357	.1406
Cost per ton - Powder	\$.1100	.1127	.1364	.1404
Cost per ton - Fuse, etc. ....	.0151	.0164	.0220	.0228
Cost per ton - All Explosives...	.1251	.1291	.1584	.1632
Pounds Powder per ton of ore....	.952	.916	1.005	.998

The production increased 55,657 tons or 10.2% in 1948, compared with 1947. The average price per pound for Powder increased \$.0049, or 3.6% over 1947, and \$.0175, or 14.2% over 1946. The cost per ton for all explosives increased \$.0048, or 3% over 1947, and \$.0341, or 26.4% over 1946.

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

	1945	1946	1947	1948
PRODUCT - Tons	2,562,695	2,143,676	3,286,638	3,152,904
POWDER				
Pounds - 40%	150	100	7,897	
50%	--	--	--	
60%	37,457	33,125	13,325	51,758
80%			3,206	568
LX and 2X Hercomite....	1,093,650	896,138	1,195,381	1,144,255
LX and 2X Gelamite....			137,100	199,990
Herculite				850
Total Pounds - Powder.....	1,094,659	929,363	1,356,909	1,397,421
Total Cost - Powder	\$ 125,861.91	113,896.57	184,282.70	199,294.38
Fuse - Feet	3,824,987	3,082,459	4,377,420	4,121,214
Caps - Number.....	541,726	421,489	550,703	528,234
Leading Wire - Feet	4,500	17,750	112,510	17,785
Connecting Wire - Pounds	72	62	96	128
Tamping Bags - Number	86,295	62,350	36,000	2,000
Tamptite Shells			38,950	34,420
Powder Bags	127	137	170	190
Fuse Lighters	105,700	96,900	124,300	112,350
Electric Exploders	4,074	9,381	15,291	18,306
Master Fuse Lighters	2,000	1,000		1,000
Primacord - Feet				277,286
Total Cost, Fuse, Caps, etc. \$	28,557.13	\$ 25,792.30	45,871.33	55,113.19
Total Cost, All Explosives. \$	154,419.04	139,688.87	230,154.03	254,407.57
Average Price per Pound - Powder \$	.1150	.1226	.1358	.1426
Cost per Ton - Powder	\$.0491	.0531	.0561	.0632
Cost per Ton - Fuse, Caps, etc.. \$	.0112	.0121	.0139	.0175
Cost per Ton - All Explosives .. \$	.0603	.0652	.0700	.0807
Pounds of Powder per ton of Ore	.4271	.4335	.4128	.4432

The mines included in 1948 figures are Athens, Cambria Jackson, Lloyd, Maas, Mather "A", and Negaunee.

1948 Production decreased 133,734 tons, or 4.1% as compared with 1947. Average price per pound for Powder increased \$.0068, or 5% over 1947, and \$.02, or 16.3% over 1946. The cost per ton for all explosives increased \$.0107, or 15.3% over 1947, and \$.0155, or 23.8% over 1946.

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

	1945	1946	1947	1948
PRODUCT - Tons	2,562,695	2,143,676	3,286,638	3,152,904
<u>TIMBER</u>				
Feet - 6-8"	345,704	339,912	418,939	555,404
8-10"	179,170	191,462	202,301	193,679
10-12"	390,086	345,818	361,575	343,987
12-14"	233,952	160,846	174,390	125,630
14-16"	16,714	5,237	12,835	22,036
Treated Timber	8,389	9,807	13,499	2,595
<u>Total Feet</u>	<u>1,174,015</u>	<u>1,052,081</u>	<u>1,183,539</u>	<u>1,243,331</u>
<u>Total Cost</u>	<u>\$ 136,629.67</u>	<u>126,217.36</u>	<u>163,655.34</u>	<u>177,526.83</u>
<u>LAGGING</u>				
Feet - 7	6,458,823	4,828,872	6,186,393	6,262,127
<u>Total Feet</u>	<u>6,458,823</u>	<u>4,828,872</u>	<u>6,186,393</u>	<u>6,262,127</u>
<u>Cost</u>	<u>\$ 90,743.61</u>	<u>68,795.03</u>	<u>94,068.34</u>	<u>100,798.92</u>
Poles - Feet	5,479,330	3,485,770	3,196,555	2,971,360
Poles - Cost	115,326.82	80,753.58	77,184.65	88,446.08
Wire Fencing - Rods	208	63	90	60
Wire Fencing - Cost	240.12	73.29	10.52	63.12
Steel Sets			14,491.68	44,013.04
Concrete Sets				11,185.08
<u>GRAND TOTAL COST</u>	<u>\$342,940.22</u>	<u>275,839.26</u>	<u>349,410.44</u>	<u>422,033.07</u>
Average Cost per foot - Timber.	.1164	.1199	.1383	.1128
" " " 100' - Lagging.	1.405	1.424	1.521	1.6096
" " " 100' - Poles...	2.104	2.316	2.414	2.9766
" " " Rod - Fencing..	1.150	1.16	1.18	1.0520
Feet of Timber per ton of ore..	.458	.491	.360	.3943
" " Lagging " " " " ..	2.520	2.252	1.882	1.9861
" " Poles " " " " ..	2.138	1.626	.972	.9424
" " Fencing " " " " ..	.0013			.0003
Cost per ton for Timber .....	.0533	.0589	.0498	.0563
" " " " Lagging .....	.0354	.0321	.0286	.0320
" " " " Poles .....	.0450	.0376	.0235	.0281
" " " " Fencing .....	.0001			
" " " " Structural Steel			.0044	.0140
" " " " Concrete Sets				.0035
<u>Total Cost per ton ...</u>	<u>\$.1338</u>	<u>.1286</u>	<u>.1063</u>	<u>.1339</u>

1948 Production decreased 133,734 tons, or 4.1% as compared with 1947. Total cost per ton for all timber increased \$.0273, or 25.6%.

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

SOFT ORE MINES

	1945	1946	1947	1948
PRODUCT - Tons	2,562,695	2,143,676	3,286,638	3,152,904

<u>CLASSIFICATION</u>	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>
General Supplies	\$118,680.10	\$.046	\$130,768.63	\$.061	\$263,751.82	\$.080	\$325,932.61	\$.103
Iron & Steel	38,150.87	.015	48,990.40	.023	93,845.90	.029	178,906.88	.057
Machinery	56,165.00	.022	111,045.43	.052	184,861.63	.056	290,254.37	.092
Explosives.....	155,417.06	.061	139,771.78	.065	237,793.22	.072	267,845.53	.085
Lumber and Timber	373,091.09	.145	300,772.30	.140	395,918.94	.120	457,298.10	.145
Fuel	30,192.55	.012	24,354.23	.011	36,880.91	.011	50,356.32	.016
Electric Power	452,656.12	.177	363,012.67	.169	570,798.56	.174	560,968.17	.178
Miscellaneous	163,071.12	.063	57,565.92	.028	72,979.68	.023	86,602.21	.027
Total	\$1,387,423.91	.541	1,176,281.36	.549	1,856,830.66	.565	2,218,164.19	.703

HARD ORE MINES

	550,169	401,939	546,796	602,453
PRODUCT - Tons				

<u>CLASSIFICATION</u>	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>	<u>AMOUNT</u>	<u>PER TON</u>
General Supplies	37,900.25	.068	36,551.28	.092	69,518.09	.127	79,821.82	.134
Iron & Steel	33,933.08	.062	25,785.43	.064	59,216.76	.108	71,372.95	.118
Machinery	17,083.10	.031	42,003.20	.104	74,426.64	.136	98,662.88	.164
Explosives	68,872.06	.125	51,913.62	.129	86,642.60	.158	98,366.20	.163
Lumber and Timber	15,546.68	.028	12,306.75	.031	29,023.34	.053	24,712.61	.041
Fuel	6,111.06	.012	3,205.94	.008	5,853.67	.012	7,524.44	.012
Electric Power	102,385.23	.186	74,927.89	.186	113,591.74	.208	117,605.65	.195
Miscellaneous	69,252.06	.126	5,154.82	.014	13,044.77	.024	18,009.45	.030
Total	\$ 351,083.52	.638	251,848.93	.628	451,317.61	.826	516,076.00	.857

NOTE: 1948 Soft Ore Mines included in statement, Athens, Maas, Negaunee, Lloyd, Mather, and Cambria-Jackson.

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

	<u>1945</u>		<u>1946</u>		<u>1947</u>		<u>1948</u>	
PRODUCTION - TONS	5,926,724		4,402,437		7,970,030		8,605,471	
	DAYS	AMOUNT	DAYS	AMOUNT	DAYS	AMOUNT	DAYS	AMOUNT
Surface	359,951	\$ 2,874,020.12	321,987	\$ 3,025,895.78	484,004	\$ 5,129,821.26	524,388	\$ 5,977,241.26
Cost per Ton .....		.485		.687		.644		.695
Underground	495,916	4,539,430.56	361,865½	3,749,800.17	530,893½	6,108,235.82	573,482½	7,198,264.61
Cost per Ton .....		.766		.852		.766		.836
Superintendence & General Roll	61,504½	585,781.08	55,709½	596,572.89	58,401½	795,466.17	63,604½	925,453.99
Cost per Ton .....		.099		.136		.100		.108
GRAND TOTAL	917,371½	\$ 7,999,231.76	739,562	\$ 7,372,268.84	1,073,299½	\$12,033,523.25	1,161,474½	\$14,100,959.86
COST PER TON		1.350		1.675		1.510		1.639
Average Rate per Day		\$ 8.72		\$ 9.97		\$ 11.21		\$ 12.14
Tons per Man per Day		6.46		6.41		7.43		7.19

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 in 1946 from February 8th to May 22nd, due to Union Strike.

WAGES:

Wages were increased 9%, effective July 16th, 1948, based on a sliding scale from 9½¢ to 16½¢ per hour.

1948 WORKING SCHEDULE:

MICHIGAN

All underground mines operated 2-8 hr. shifts 6 days per week, excepting Lloyd, which increased to 3-8 hr. shifts on November 29, 1948. Tilden Mine operated 1-8 hr. shift 6 days per week from May 16th to August 31st, 1948.

MINNESOTA

Agnew and Sargent, underground mines, worked 2-8 hr. shifts 6 days per week.
 Atkins Mine - Ore operations commenced May 1st and ceased October 25th, working 2-8 hr. shifts 6 days per week.
 Canisteo Mine - Ore operations commenced April 17th, and ceased October 16th, working 3-8 hr. shifts 6 days per week.
 Hill-Trumbull Mine - Ore operations commenced May 1st and ceased October 16th, " 3-8 " " 6 " " "
 Holman-Cliffs Mine - " " " April 30th " " October 16th, " 2-8 " " 6 " " "
 Hawkins Mine - " " " May 17th " " October 14th, " 2-8 " " 5 " " "

COMPARISON OF TOTAL DAYS WORKED AND TONS OF ORE MINED
FOR THE YEARS 1948 AND 1947

	1948 DAYS	1947 DAYS	1948 DAYS	1947 DAYS
NON-PRODUCTIVE UNITS:				
Miscellaneous Payroll	18,581 $\frac{3}{4}$	15,987		
Shops and Storehouse	3,526	3,587 $\frac{1}{4}$		
C. C. I. Co. Miscellaneous & General	96,912 $\frac{3}{4}$	70,776 $\frac{1}{4}$		
Mesaba-Cliffs Miscellaneous & General	80,105 $\frac{3}{4}$	91,250		
The Cliffs Power & Light Company	20,770	20,208		
General Roll - Undistributed	60,957 $\frac{1}{4}$	55,823 $\frac{1}{2}$		
Princeton	---	230		
Total Deductions	280,853$\frac{1}{2}$	257,862		
Grand Total - All Operations	1,161,474$\frac{3}{4}$	1,073,299$\frac{1}{2}$		
Net Operating Mines	880,621$\frac{1}{2}$	815,437$\frac{1}{2}$	880,621$\frac{1}{2}$	815,437$\frac{1}{2}$
Total Tons	8,605,471	7,970,030		
Tons per Man per Day	9.77	9.77		
OPEN PIT PRODUCTION				
	TONS			
Tilden Mine	140,692	168,669	4,614	4,347
Canistec Mine	908,833	854,638	27,361 $\frac{1}{2}$	23,689 $\frac{1}{2}$
Hill-Trumbull Mine	768,394	785,604	36,612 $\frac{1}{2}$	39,602 $\frac{1}{2}$
Holman-Cliffs Mine	993,805	768,192	34,452 $\frac{1}{2}$	25,773
Hawkins Mine	660,037	620,416	25,720 $\frac{1}{2}$	24,495 $\frac{1}{2}$
Atkins Mine	483,705	432,705	9,231 $\frac{1}{2}$	6,081
Total	3,955,466	3,630,224	138,022$\frac{1}{2}$	123,988$\frac{1}{2}$
Open Pit - Tons per Man per Day	28.66	29.28		
Net Days - Underground Mines			742,598$\frac{1}{2}$	691,149$\frac{1}{2}$
Net Tons - Underground Mines			4,650,005	4,339,806
Underground Mines - Tons per Man per Day			6.26	6.28
PERCENTAGE OF TOTAL PRODUCTION				
	1948		1947	
	TONS	PER CENT	TONS	PER CENT
Underground Mines	4,650,005	54.04	4,339,806	54.45
Open Pit Mines	3,955,466	45.96	3,630,224	45.55
Total	8,605,471		7,970,030	

THE CLEVELAND-CLIFFS IRON COMPANY
STATEMENT SHOWING PENALTY COST OF OVERTIME
WORKED BY EMPLOYEES DURING YEAR 1948
AND EFFECT THE PENALTY COST HAD ON THE YEAR'S PRODUCTION COST

	MICHIGAN PROPERTIES	MINNESOTA PROPERTIES	TOTAL
<u>YEAR 1948.</u>			
January	\$ 54,436.13	\$ 7,706.82	
February	51,271.61	6,778.95	
March	51,005.26	6,929.74	
April	49,664.08	11,506.80	
May	62,365.29	20,275.38	
June	51,445.04	19,406.05	
July	49,677.34	23,880.19	
August	48,655.81	20,996.93	
September	48,699.02	20,945.59	
October	69,915.60	22,175.04	
November	52,229.41	7,565.30	
December	49,916.92	6,668.92	
Total - Year 1948	\$ 639,279.53	\$ 174,334.15	\$ 813,613.68
Total - Year 1947	545,408.20	168,285.23	713,693.43
<u>PRODUCTION</u>			
Tons - Year 1948	4,093,305	4,512,166	8,605,471
- Year 1947	4,162,545	3,807,485	7,970,030
<u>EFFECT THE PENALTY COST HAD ON YEAR'S PRODUCTION COST</u>			
Increased 1948 by .....	.1562	.0386	.0945
Increased 1947 by .....	.1310	.0442	.0895

Note:-

All wages were increased $12\frac{1}{2}\%$ per hour on May 9th, 1947. On July 16, 1948, all wages were increased from $9\frac{1}{2}\%$ to $16\frac{1}{2}\%$ per hour, which amounted to a 9% increase on total payrolls.

CJB:MS

4-7-49

(3)

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

1. GENERAL:

The Cliffs Shaft Mine produced a total of 602,453 tons of ore during the year 1948. Both shafts were in operation throughout the year for a total of 307 days. This production exceeds the original estimate and revised estimate by 14,000 and 8,000 tons respectively. The extra tonnage is one of the principle factors responsible for holding the cost of production to within \$.03 of 1947 costs in spite of the wage increase which came on July 16th, 1948.

There was an average of 90.1 gangs working in the mine during the year as compared to 90.5 during 1947. Twenty-six to 33 of these crews or an average of 28.4 gangs were double contracts employing two miners but no miner's helper. The remainder of the gangs were staffed by a miner and a miner's helper. The two-miner contract has had a very salutary effect on production in some places whereas in other places there is little evidence of any increased efficiency. However, this system permits the shifting of inexperienced or inefficient miners to group them with the better class miners in such a way as to improve the production of the contract. This educational process will extend over a long period of time before its benefits can be realized. We feel that the system is an improvement and has given better morale to the working force. An average of 11.6 gangs or 12.8% of the total number of contracts in the mine were engaged in development drifting or raising throughout 1948. Including these raising and drifting contracts, 41.2 contracts did development work as contrasted to the depletion mining of floors, backs and pillars.

Shipments of Lump ore from stockpile were completed on November 15th. The Crushed ore was all shipped approximately two weeks prior to this date. Total shipments from the mine of ore from both pocket and stockpile equalled 597,888 tons. The current year stockpile overrun amounted to 10,997 tons and the pocket overrun amounted to 18,001 tons. Total overrun of 28,998 tons represents 5.05% of the production. The increase in the overrun compared to the last few preceding years is attributable to the new skips which were installed during 1947. As mentioned then, the back and sides of the skip were increased in height in order to prevent spillage. The elimination of this source of trouble permitted the skip tenders to dump fully loaded cars and thereby increase the percentage of overrun carried in each skip load. The skip weight factor was not changed from 5.10 tons during 1948.

From January 1st, 1948 to October 7th, 1948 the revolving trommel in the Crusher building, which screens our product, was equipped with two sections bearing 2" holes and one section bearing 1½" holes. From October 7th to the end of the year the trommel was equipped as follows; the bottom section with 2" holes, the center section with 2½" holes and the top section with 1½" holes. This change was occasioned by the difficulty in obtaining delivery of the proper cast manganese screen sections. On November 28th, we changed the ratio of separation of the product to 29% Crushed and 71% Lump. Actual tonnages during 1948 showed 427,903 tons of Lump ore and 174,550 tons of Crushed ore or about 71% and 29% respectively.

To improve the hoisting plant new counterweights were installed in "A" and "B" Shaft in the early part of 1948. The "A" Shaft hoisting motor was completely rewound; both stator and rotor coils being replaced. Improvements made on the hoists themselves consisted of two new brake couplings and pins which make the action much smoother.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

1. GENERAL:

Major improvements or additions to ore handling equipment during 1948 consisted of the installation of a new main shaft and mantle for the No. 8 Crusher, installation of a new picking belt and the purchase of a new electric hoist for removing chunks from the Crusher. Plans were drawn and some of the steel was purchased for re-building the railroad Lump Ore pocket. It is expected that this work will be completed sometime late in 1949.

The rock disposal trestle was partially torn down and a new system of rock disposal was started in the Fall of 1948. The discarded rock is now loaded via a new pocket on the northwest corner of the Crusher building into an Athey Caterpillar crawler wagon and hauled by tractor to fill the low ground west of the stocking area.

One of the large items of expense on the Surface during 1948 was occasioned by the paving of most of the road system. This was a decided improvement in conditions and has eliminated most of the dirt and dust that previously was blown in on the machines in the Shops and Engine House.

The old steamshovels were scrapped in 1948 and replaced with a second-hand 85-B Bucyrus-Erie electric shovel from the Mesaba Range. The other steamshovel had been replaced in the previous year by a second-hand 80-B Bucyrus-Erie electric shovel from the Tilden Pit. During 1949 we improved the latter shovel by cutting the boom length 5'. We also purchased, for general utility loading, the used 10-B Caterpillar Clam from the Mather "A" Mine.

Miscellaneous improvements were made to Shop buildings such as the installation of toilets and urinals in the Bit Shop and Blacksmith Shop; installation of new unit heaters in the Shop buildings; the connection of the Crusher building and Machine Shop heating system to the Main Dry boiler and the complete overhaul of our TD-14 tractor. We also laid a new 4" supply line and built a new pumphouse north of the Main Dry where there is now installed a centrifugal pump with flood suction from the lake for pumping cooling water to the compressors and aftercooler.

For the Underground operations we purchased, in 1948, 4 - DA35 Ingersoll-Rand hand-cranked drifters; 3 - DA30 Ingersoll-Rand automatic drifters; 1 - DA89 Gardner-Denver hand-cranked drifter; 2 - CF79 Gardner-Denver automatic drifters; 2 - TN300 Joy automatic drifters; 1 - HC-10-R Cleveland reverse feed stoper; 2 - Ingersoll-Rand IR-48 stopers; 14 - JB-4 IR jackhammers; 3 - J-10 IR jackhammers; 7 - J-50 IR jackhammers; 3 - H-111 sinkers; 1 - H-10 LeRoi sinker; 1 - LB-57 Joy sinker; 1 - S55-W Gardner-Denver sinker for a total of 45 drilling machines. We also purchased two 25 cell storage batteries for Underground locomotives. From the Negaunee Mine we purchased one new Joy hydro-jib Jumbo equipped with 8 foot feeds.

During 1948 we completed the installation of the Jeffrey Aerodyne fan on the 6th level in the east end of the mine. The use of the fan has materially improved the ventilation in the Cliffs Shaft Mine.

We continued to operate the microseismic listening station in the "B" Shaft area although, during 1948, we completed all mining activity in the original experimental site on the 12th level. The equipment was moved, there for, to the 13th level where a new station was set up for recording microseismic sounds in the roof arch of the area bounded by coordinates 0 to 200 S - 1400 to 1600 W.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

2. PRODUCTION,
SHIPMENTS, &
INVENTORIES:

a. Production by Grades:

<u>Grade</u>	<u>Tons</u>	<u>% of Total</u>
Cliffs Shaft Lump	361,238	
Cliffs Shaft Crushed	<u>145,376</u>	
Total	506,614	84.10
Bancroft Lump	37,558	
Bancroft Crushed	<u>16,361</u>	
Total	53,919	8.95
Section 10 Lump	29,107	
Section 10 Crushed	<u>12,813</u>	
Total	<u>41,920</u>	6.95
GRAND TOTAL FEE & LEASE ORE	<u>602,453</u>	<u>100.00</u>

Production by grades and percentages of Lumps and Fines for the past ten years follows:

<u>Year</u>	<u>Lump Ore</u>		<u>Crushed Ore</u>		<u>Run-of-Mine Ore - Tons</u>	<u>Total Tons</u>
	<u>Tons</u>	<u>%</u>	<u>Tons</u>	<u>%</u>		
1939	259,517	67.69	123,883	32.31	3,858	387,258
1940	371,745	67.68	177,469	32.32	3,384	552,598
1941	464,802	74.14	162,132	25.86	31,813	658,747
1942	225,759	79.98	56,510	20.02	431,261	713,530
1943	200,616	79.82	50,732	20.18	383,280	634,628
1944	443,123	76.29	137,701	23.71	6,227	587,051
1945	430,193	78.19	119,976	21.81		550,169
1946	294,264	73.21	107,675	26.79		401,939
1947	396,561	72.50	150,235	27.50		546,796
1948	427,903	71.00	174,550	29.00		602,453

The revolving trommel was equipped during 1948 as follows:

(Bottom section - 2" Screen
Jan. 1st to Oct. 7th - (Center " - 2" Screen
(Top " - 1½" Screen

(Bottom section - 2" Screen
Oct. 7th to Dec. 31 - (Center " - 2½" Screen
(Top " - 1½" Screen

On November 28th we changed ratio of separation of product to 29% Crushed and 71% Lump.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

2. PRODUCTION, ETC.:

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 1940	723,163	
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
1947	45,030	36,611
1948	53,919	41,920
Total	1,256,550	134,945

b. Shipments

<u>Grade</u>	<u>Pocket Tons</u>	<u>Stockpile Tons</u>	<u>Total Tons</u>	<u>Total Last Year</u>
Cliffs Shaft Lump	238,907	119,295	358,202	326,039
Cliffs Shaft Crushed	92,464	50,550	143,014	133,824
Bancroft Lump	30,684	7,484	38,168	32,137
Bancroft Crushed	11,228	5,165	16,393	13,121
Section 10 Lump	21,665	7,766	29,431	24,757
Section 10 Crushed	8,017	4,663	12,680	9,839
Total 1948	402,965	194,923	597,888	539,717
Total 1947	392,808	146,909	539,717	
Increase	10,157	48,014	58,171	

c. Stockpile Balances:

Ore in stock as of December 31, 1948:

Cliffs Shaft Lump	36,227
Cliffs Shaft Crushed	16,484
Bancroft Lump	1,454
Bancroft Crushed	1,170
Section 10 Lump	1,845
Section 10 Crushed	1,408
Total	58,588

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

2. PRODUCTION, ETC: (Cont'd)

d. Division of Product by Levels:

<u>Level</u>	<u>"A" Shaft Tons</u>	<u>"B" Shaft Tons</u>	<u>Total Tons</u>
1st	4,368	34,550	38,918
2nd	18,324	123	18,447
3rd	23,561	11,530	35,091
4th	20,375	28,604	48,979
5th	32,499	25,374	57,873
6th	24,537	32,211	56,748
7th	52,213	2,075	54,288
8th	45,619	-	45,619
9th	31,219	8,346	39,565
10th	71,865	10,490	82,355
11th	60,498	5,994	66,492
12th	9,072	22,724	31,796
13th	-	-	-
14th	-	20,996	20,996
15th	-	5,285	5,285
Total	394,151	208,302	602,453
Rock			12,298
Total Ore & Rock			614,751

e. Division of Product between Shafts:

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

<u>Year</u>	<u>"A" Shaft</u>		<u>"B" Shaft</u>		<u>Total</u>
	<u>Tons</u>	<u>%</u>	<u>Tons</u>	<u>%</u>	
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
1947	337,019	61.6	209,777	38.4	546,796
1948	394,151	65.4	208,302	34.6	602,453

The rate of production between the two shafts maintained much the same tenor as in the past 10 years with "B" Shaft production dropping slightly in relation to that of "A" Shaft. The downward trend of "B" Shaft production was predicted and will continue in the future.

The hoist is ordinarily divided almost evenly between "A" and "B" Shafts. In 1948, "B" Shaft consistently hoisted a little more ore than "A" Shaft and in August, "B" Shaft was operated during the week that the "A" Shaft hoisting motor was rewound. As a consequence, "B" Shaft hoisting exceeded that from "A" Shaft by 39,107 tons during the year 1948. The table below shows how the product was hoisted through the 12 months of the year.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

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

Month	1948 Product as Hoisted		
	"A" Shaft Tons	"B" Shaft Tons	Total Tons
January	21,155	23,383	44,538
February	21,144	23,886	45,030
March	25,474	28,084	53,558
April	23,899	23,626	47,525
May	21,790	24,728	46,518
June	22,315	26,751	49,066
July	21,598	27,394	48,992
August	16,522	26,699	43,221
September	20,461	23,449	43,910
October	23,392	26,254	49,646
November	22,375	24,021	46,396
December	27,976	27,079	55,055
Total without Overrun	268,101	305,354	573,455
Pocket Overrun	8,425	9,576	18,001
Stockpile "	5,147	5,850	10,997
Grand Total Tons	281,673	320,780	602,453
% of Total	46.7	53.3	100.0

f. Production by Months:

Month	Optg. Days	CLIFFS SHAFT		BANCROFT		SECTION 10		Total
		Lump	Crushed	Lump	Crushed	Lump	Crushed	
Jan.	26	27,665	10,256	2,850	979	2,199	767	44,716
Feb.	24	27,450	10,088	3,119	1,114	2,499	869	45,139
March	27	33,123	12,208	3,432	1,200	2,842	1,001	53,806
April	26	30,867	13,039	3,866	1,543	1,697	668	51,680
May	25	29,810	11,433	3,636	1,439	2,614	1,011	49,943
June	26	31,930	11,859	3,193	1,355	2,738	1,096	52,171
July	26	30,774	12,079	2,806	1,229	1,996	849	49,733
Aug.	26	28,618	10,029	3,016	1,219	2,233	875	45,990
Sept.	24	27,192	10,095	3,184	1,325	1,746	716	44,258
Oct.	26	29,347	12,809	3,493	1,438	3,339	1,513	51,939
Nov.	25	27,460	11,273	2,826	1,607	2,613	1,462	47,241
Dec.	25	33,872	13,527	2,496	976	2,840	1,129	54,840
Current Years								
Stkpl. Overrun		3,130	6,681	359	937	249	857	10,997
Total 306		361,238	145,376	37,558	16,361	29,107	12,813	602,453

g. Ore Statement:

Grade	On Hand	Output	Total	Shipments	Balance	Inc. or Dec.
	Jan. 1, 1948	for Year					On Hand	in Output
C. S. Lump	33,191	361,238	394,429	358,202	36,227	
C. S. Crushed	14,122	145,376	159,498	143,014	16,484	
Banc. Lump	2,064	37,558	39,622	38,168	1,454	
Banc. Crushed	1,202	16,361	17,563	16,393	1,170	
Sec. 10 Lump	2,169	29,107	31,276	29,431	1,845	
Sec. 10 Crushed	1,275	12,813	14,088	12,680	1,408	
Total 1948	54,023	602,453	656,476	597,888	58,588	49,188
Total 1947	46,944	546,796	593,740	539,717	54,023	144,857

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

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

h. Delays:

Date	Time Lost	Tons Lost	Remarks
Jan. 2	2½ hrs.	250	Motor on picking belt burned out
9	6½ "	700	Motor on "A" Shaft hoist burned out
10	8 "	600	Same trouble as on the 9th.
14	2½ "	300	Repairing "A" Shaft hoist motor
24	½ "	100	Repairing in "A" Shaft
26	1½ "	200	Repairing Crusher
Feb. 10	1½ "	200	Large chunks
11	1½ "	100	Large chunks
12	1½ "	150	Large chunks
13	1 "	100	Large chunks
16	1½ "	150	No power & Repairing "B" Shaft
24	½ "	75	Large chunks
Mar. 8	1½ "	75	Large chunks
12	3 "	375	Picking belt broken down
13	1 "	150	Picking belt broken down
15	3 "	350	Car off track on main level
16	½ "	75	Top tram car door opened
19	1 "	150	Large chunks
22	1 "	100	Large chunks
24	2 "	200	Repairing Crusher
25	2½ "	250	Skip wheel fell of "A" Shaft skip; Air lift broken at "B" Shaft pocket.
30	4 "	200	Repairs on "A" Shaft skip
Apr. 5	1 "	100	Elect. Haulage Cable shorted
10	2 "	200	Large chunks
29	3 "	250	Skip runner broken "B" Shaft
May 5	¾ "	75	Large chunks
10	3 "	300	Repairing "B" Shaft skip
20	4 "	600	Cars off track on 5th level
June 1	3 "	350	Skip wheel fell off "A" Shaft skip
2	2½ "	250	Timber broken on 8th level "A" Shaft
5	2 "	150	Large chunks in Crusher
14	¾ "	75	Repairing pocket "A" Shaft
July 6	1 "	150	Large chunks & spill in surface pocket
19	1¼ "	150	Large chunks
20	1 "	50	Large chunks
Aug. 5	1½ "	100	Air lift out of order
19	1¼ "	100	Large chunks
23	2½ "	150	Switchboard "A" Shaft hoist out of order
27	1½ "	100	Large chunks
30	1½ "	100	Large chunks
Sept. 7	3 "	150	Repairing "B" Shaft skip
24	1½ "	150	Broken gate 5th level "B"; & repairs to locomotive
27	¾ "	75	Repairing doors "A" Shaft cage
30	2 "	150	Repairing Crusher
Oct. 7	2 "	150	Repairing "A" Shaft sheave wheel
13	1 "	75	Wire broken on panel board, Engine House
19	1½ "	200	Large chunks
26	2 "	150	"B" Shaft hoist switchboard repairs & Repairing crusher
Nov. 5	3½ "	100	Broken gate 5th level "A" Shaft
Dec. 1	1 "	100	Repairing "B" Shaft skip
Total 1948		9400	
Total 1947		26020	

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

3. ANALYSIS:

a. Average Analysis of 1948 Output:

	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>
Cliffs Shaft Lump	60.45	.098	8.98
Cliffs Shaft Crushed	51.58	.099	19.44
Bancroft Lump	60.98	.103	7.84
Bancroft Crushed	52.09	.108	19.00
Section 10 Lump	59.57	.106	9.08
Section 10 Crushed	52.33	.117	17.90

The year 1948 showed a continuation in the upward trend of silica. Iron content in the analysis did not change appreciably from the year before with the exception of a drop of 1% in the case of Section 10 Lump.

The diamond drill exploration of old workings gives good promise of establishing many stoping sites where high grade reserves exist. With more developed places available for mining it will be possible to more closely control the quality of the product.

b. Complete Analysis of 1948 Ores as Shipped From Mine:

<u>Grade</u>		<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>
Lump Ore	(x)	60.50	.098	8.66	.21	1.90	.75	.73	.011	.83
Crushed Ore	(x)	51.85	.096	19.25	.33	2.46	.89	.83	.012	1.32

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

c. Analysis of Ore in stock Dec. 31, 1948:

		<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>	<u>Moist.</u>
Cliffs Shaft Lump	Dried	60.59	.096	9.15	.21	1.90	.65	.63	.011	.83	-
	Natural	60.41	.096	9.12	.21	1.89	.65	.63	.011	.83	.30
Cliffs S. Crushed	Dried	51.49	.093	19.81	.33	2.46	.89	.83	.012	1.32	-
	Natural	50.68	.092	19.50	.32	2.42	.88	.82	.012	1.30	1.60
Ban.&Sec. 10 Lump	Dried	59.76	.099	9.45	.21	1.96	.85	.82	.011	.83	-
	Natural	59.58	.099	9.42	.21	1.94	.85	.82	.011	.83	.30
Ban.&Sec. 10 Cr.	Dried	51.36	.114	20.07	.33	2.46	.89	.84	.012	1.32	-
	Natural	50.55	.112	19.75	.32	2.42	.88	.83	.012	1.30	1.60

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

		<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum.</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>	<u>Moist.</u>
Cliffs Shaft Ore	Dried	57.11	.107	10.70	.47	2.36	1.21	1.00	.019	1.89	-
	Natural	56.62	.106	10.60	.47	2.34	1.20	.99	.019	1.87	.85
Banc. & Sec. 10 Ore	Dried	58.01	.131	9.70	.45	2.35	1.15	.95	.019	1.75	-
	Natural	57.56	.130	9.63	.45	2.33	1.14	.94	.019	1.74	.75

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

4. ESTIMATE
OF ORE
RESERVES:

Assumption: 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, 1948:

<u>Level</u>	<u>Available Ore in Bancroft Area "A" Shaft</u>			
	<u>Developed</u>		<u>Prospective</u>	<u>Total</u> <u>Tons</u>
	<u>Floors</u> <u>Tons</u>	<u>Pillars</u> <u>Tons</u>	<u>Breasts</u> <u>Tons</u>	
2nd			2,000	2,000
3rd	2,200	800		3,000
4th	6,900			6,900
8th		9,300		9,300
9th	11,600	1,800		13,400
10th	45,000	90,900	2,000	137,900
11th	101,200	10,600	4,000	115,800
12th	12,100	2,900	2,000	17,000
Total	179,000	116,300	10,000	305,300

Summary:

Bancroft Ore Available	305,300
Less December Production	<u>3,472</u>
Gross Tonnage as of Dec. 31, 1948	301,828
Less 10% for Mining & Rock	<u>30,530</u>
Net Total Bancroft Ore Available	271,298

<u>Level</u>	<u>Section 10 Lease</u>			
	<u>Developed</u>		<u>Prospective</u>	<u>Total</u> <u>Tons</u>
	<u>Floors</u> <u>Tons</u>	<u>Pillars</u> <u>Tons</u>	<u>Breasts</u> <u>Tons</u>	
1st	3,500	5,500		9,000
2nd	4,200			4,200
3rd			2,000	2,000
4th			4,000	4,000
5th	23,100	68,200		91,300
6th	68,200		2,000	70,200
7th		12,800	2,000	14,800
8th	12,800	97,900		110,700
9th	<u>103,700</u>			<u>103,700</u>
Total	215,500	184,400	10,000	409,900

Summary:

Section 10 Ore Available	409,900
Less December Production	<u>3,968</u>
Gross Tonnage as of Dec. 31, 1948	405,931
Less 10% for Mining & Rock	<u>40,990</u>
Net Total Section 10 Ore Available	364,941
Net Total Bancroft & Section 10 Lease	636,239

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

4. ESTIMATE
OF ORE
RESERVES:

(Cont'd)

Available Cliffs Shaft Ore "A" Shaft

<u>Level</u>	<u>Developed</u>		<u>Prospective</u>	<u>Total</u> <u>Tons</u>
	<u>Floors</u>	<u>Pillars</u>	<u>Breasts</u>	
	<u>Tons</u>	<u>Tons</u>	<u>Tons</u>	
1st		2,500	2,000	4,500
2nd	2,000	1,200		3,200
3rd	4,700		4,000	8,700
4th	9,000		8,000	17,000
5th	23,900	3,700	8,000	35,600
6th	39,700	42,000	6,000	87,700
7th	105,000	9,900	6,000	120,900
8th	75,100	14,500	4,000	93,600
9th	154,700	1,800	10,000	166,500
10th	44,200	108,500	6,000	158,700
11th	69,400	82,100	2,000	153,500
12th	34,500	44,700	2,000	81,200
15th	22,800			22,800
<u>Total</u>	<u>585,000</u>	<u>310,900</u>	<u>58,000</u>	<u>953,900</u>

Available Cliffs Shaft Ore "B" Shaft

<u>Level</u>	<u>Developed</u>		<u>Prospective</u>	<u>Total</u> <u>Tons</u>
	<u>Floors</u>	<u>Pillars</u>	<u>Breasts</u>	
	<u>Tons</u>	<u>Tons</u>	<u>Tons</u>	
1st	22,100	5,400	6,000	33,500
2nd	30,000		2,000	32,000
3rd	2,200	17,900		20,100
4th			6,000	6,000
5th	34,600		2,000	36,600
6th	14,700	11,200	4,000	29,900
7th	36,000			36,000
8th	25,800	5,700	4,000	35,500
9th	11,000		2,000	13,000
10th	18,800			18,800
11th	43,900	3,000	2,000	48,900
12th	4,600			4,600
13th	3,200		2,000	5,200
14th	5,900		2,000	7,900
15th	13,700	15,200	4,000	32,900
<u>Total</u>	<u>266,500</u>	<u>58,400</u>	<u>36,000</u>	<u>360,900</u>

Section 9 Development

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

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

4. ESTIMATE
OF ORE
RESERVES:

(Cont'd)

Summary:

Cliffs Shaft Ore Available "A" Shaft	953,900
Cliffs Shaft Ore Available "B" Shaft	360,900
Cliffs Shaft Ore Available Section 9	29,700
Total	<u>1,344,500</u>
Less December Production	47,399
Gross Tonnage as of Dec. 31, 1948	<u>1,297,101</u>
Less 10% for Mining & Rock	134,450
Net Total Free Ore Available	<u>1,162,651</u>

Recapitulation:

Net Cliffs Shaft Ore Available	1,162,651
Net Bancroft Ore Available	271,298
Net Section 10 Ore Available	<u>364,941</u>
Grand Total	<u>1,798,890</u>

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

	<u>Dec. 31, 1948</u>	<u>Dec. 31, 1947</u>
Cliffs Shaft Ore Available	1,162,651 tons	1,161,202 tons
Banc. & Sec. 10 Ore Available	<u>636,239 "</u>	<u>655,554 "</u>
Total	1,798,890 "	1,816,756 "
Decrease in 1948	17,866 "	

New Ore Developed in 1948 - 602,453 minus 17,866 equals 584,587 tons

The following table shows the variations in ore reserves in "A" and "B" Shafts since 1932:

<u>Year</u>	<u>Net Available Ore in Sight</u>			
	<u>Sec. 10 Ore</u> <u>Tons</u>	<u>Bancroft Ore</u> <u>Tons</u>	<u>Cliffs Shaft Ore</u>	
			<u>"A" Shaft</u> <u>Tons</u>	<u>"B" Shaft</u> <u>Tons</u>
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
1947	401,249	254,305	834,584	299,888
1948	364,941	271,298	827,519	335,132

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

4. ESTIMATE
OF ORE
RESERVES:

(Cont'd)

Reserves decreased by 17,866 tons as compared to the 1947 estimate. The fee reserves remained practically static but Bancroft Lease reserves increased approximately 17,000 tons while Section 10 Lease reserves decreased about 36,000 tons. Additional exploratory information was responsible for the decrease in reserves of the Section 10 Lease. In the case of the Section 10 Lease the estimate has been necessarily conservative because development is still in an early stage.

The table below shows the sharp increase in reserves between 1946 and 1947 when the Section 10 Lease began to enter the picture. As development of the Lease proves additional reserves it is expected that the fee and Bancroft Lease reserves will decrease to offset these gains.

The 1945 increase is due primarily to the change in method of figuring the estimate whereby only one deduction of 10% is made as compared to two 10% deductions in previous years.

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

1948	1,798,890 Tons
1947	1,816,756 "
1946	1,704,552 "
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 "

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

5. LABOR AND
WAGES:

a. General:

Nine more men were employed underground in 1948 compared to 1947. The surface crew was kept the same size as in the preceding year.

We continued to gradually increase the number of contracts employing two miners rather than one miner and a scraper operator. By the end of 1948, thirty-three of the ninety-three contracts were under this system. We have now reached the point where we are promoting men to miners who started work at the Cliffs Shaft Mine in 1947. The use of the two-miner contract system is therefore serving as a means of accelerating the training of new miners as well as promoting a better morale by having both men in the contract under an incentive pay scale.

b. Comparative Statement of Wages and Product:

	<u>1948</u>	<u>1947</u>
PRODUCT:	602,453	546,796
No. of Shifts & Hours	2-8 hr.	2-8 hr.
No. of Days Operated	307	305
 <u>Average Number of Men Employed</u>		
Surface	95	95
Underground	<u>332</u>	<u>323</u>
Total	427	418
 <u>Average Wages Per Day</u>		
Surface	10.78	9.90
Underground	<u>11.82</u>	<u>10.81</u>
Total	11.59	10.60
 <u>Product Per Man Per Day</u>		
Surface	18.76	16.54
Underground	<u>5.88</u>	<u>5.53</u>
Total	4.48	4.14
 <u>Labor Cost Per Ton</u>		
Surface	.585	.615
Underground	<u>2.010</u>	<u>1.958</u>
Total	2.595	2.573

Labor cost per ton of ore increased only .022 per ton in 1948 over 1947 costs. This in spite of the fact that there was a scaled wage increase of from 9½¢ per hour to 11½¢ per hour. This increase raised average wages from \$10.60 per day to \$11.59 or \$.99 per day which is a 9.35% increase. Based on 1947 production this would have resulted in a per ton cost increase of \$.24. However, the increase in efficiency that stepped up production from 4.14 tons per man to 4.48 tons per man reduced labor costs to keep them almost static with 1947 costs.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

5. LABOR AND
WAGES:

(Cont'd)

Three factors are responsible, we believe, for the increase in efficiency. First, the introduction of a better incentive pay scale for contract miners which went into effect on May 15, 1948. Second, the introduction of tungsten carbide-tipped bits which are used in conjunction with jackleg-mounted jackhammers for stope drilling. These bits were started in February of 1948. By January 1, 1949, we had 33 contracts using them. The third factor improving the efficiency is the increase in productivity engendered by the two-miner contract.

Penalty earnings increased somewhat in 1948 as shown below. This was to be expected from the percentage of wage increase.

1948	\$110,552.09
1947	<u>101,291.02</u>
Increase	\$ 9,261.07

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

<u>Year</u>	<u>Surface Labor</u>	<u>Underground Labor</u>	<u>Total Labor</u>
1948	.585	2.010	2.595
1947	.615	1.958	2.573
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

(°) Costs for 8½ operating months.

	<u>Shifts</u>	<u>Earnings</u>	<u>Avg. Wages 1948</u>	<u>Avg. Wages 1947</u>
Contract Miners				
Dev. in Rock	2,015	26,009.04	12.91	12.97
Dev. in Ore	2,750	34,482.98	12.54	11.79
Stopping	<u>30,502</u>	<u>369,235.15</u>	<u>12.11</u>	<u>10.95</u>
Total Contract Miners	35,267	429,727.17	12.18	11.17
Contract Trammers	<u>549</u>	<u>9,220.96</u>	<u>16.80</u>	<u>15.80</u>
Total Contract Labor	<u>35,816</u>	<u>438,948.13</u>	<u>12.26</u>	<u>11.26</u>

Total Number of Days

	<u>1948</u>	<u>1947</u>
Surface	32,348	33,064
Underground	<u>102,254</u>	<u>98,932</u>
Total	<u>134,602</u>	<u>131,996</u>

Amount for Labor

	<u>1948</u>	<u>1947</u>
Surface	352,729.69	336,146.49
Underground	<u>1,210,995.20</u>	<u>1,070,573.74</u>
Total	<u>1,563,724.89</u>	<u>1,406,710.23</u>

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

5. LABOR AND
WAGES:

(Cont'd)

Proportion of Surface to Underground Men

1948	1 to 3.33
1947	1 to 3.40
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

6. SURFACE:

a. Buildings and Repairs:

The following figures show cost of repairs to mine buildings for the years 1944 - 1948:

	<u>1948</u>	<u>1947</u>	<u>1946</u>	<u>1945</u>	<u>1944</u>
Office & Warehouse	1037.22	394.80	67.57	537.42	1200.83
Shops	7702.74	1224.02	1726.31	1679.64	719.73
Shaft House	1115.74	1463.91	1380.98	567.28	822.60
Engine House	1476.00	5624.90	1717.91	1052.36	553.86
Dry House	2876.71	1353.76	1352.63	1569.07	2597.53
Coal Dock & Trestle	765.97	1754.31	279.96	419.37	258.24
Crusher Building	899.74	200.84	145.77	878.57	628.19
Miscellaneous	<u>1548.47</u>	<u>1416.61</u>	<u>342.65</u>	<u>967.27</u>	<u>3997.94</u>
Total	17422.59	13434.15	7013.78	7670.98	10778.92

Total cost increased \$3,988.44 in 1948 as compared to 1947.

The increase in cost of supplies accounts for some of the total rise in building repairs. In the individual categories, improvements and repairs are explained below. The office and warehouse expense increased because of rewiring of this building and the installation of fluorescent lights. Shop buildings expense jumped as a result of the revamping of the heating system which included the installation of unit heaters; the replacement of outside doors and the installation of toilets and urinals. Additional showers were installed in the Surface dry and a separate room was provided for the toilet facilities in this building. New outside doors were installed in the Main dry. These items account for the increase of dry house expense. The principal expense under miscellaneous buildings was the installation of a shower room for the sample crushing room and new unit heaters for the steel warehouse.

37

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND:

a. Development

1. Section 10 Lease:

Production from the Section 10 Lease increased 5,309 tons in 1948 compared to 1947. The number of gangs increased from 8 to 9 plus which is probably the main factor responsible for the slight increase in productivity.

The known ore occurrences of the Section 10 Lease may be divided into three categories for the purpose of discussion. They are No. 1: the syncline between the 1st and 3rd levels in the area immediately south of the north boundary of the Section 10 Lease between coordinates 0 and 600 E. No. 2: the anticline between 1600 E and 3000 E lying adjacent to the Cliffs Shaft fee property along its south boundary. No. 3: the main syncline which is the westward extension of the Moro Mine structure. In the No. 1 area, two gangs performed development work during 1948. Contract No. 1, on the 1145' sub-level, spent the major portion of the year mining floor but they did drift east a distance of approximately 20' to coordinates 1280 S - 300 E. This development is parallel to the strike of the ore vein which dips south beneath slate hanging wall. The ore vein is about 20 to 25' wide and is underlain by dike footwall. Diamond drill exploration has established the fact that this ore extends downward to the south at least to the 3rd level elevation. In order to be able to mine the downward extension of this Southwest ore vein, part of which lies in the Section 10 Lease, it was necessary to drive a drift on the 5th level in order to get beneath this territory. During 1948, Contract 63 drifted 620' in siderite and ore to reach the Section 10 boundary. On the Section 10 Lease itself the drift was extended east a distance of 30' to coordinates 1280 S - 60 E. Raises have been located which are to be put up to the 1st level elevation from this 5th level drift.

In the No. 2 area on the 4th level elevation, Contract No. 2 advanced their main stope west 70' to coordinates 1370 S - 2170 E. This stope is parallel to the strike of the ore vein which dips south beneath slate hanging wall. The ore vein is approximately 125' wide in this particular location. Contract No. 2 also developed a cross cut stope 20' wide, which was advanced north a distance of 35' where it holed to former workings thereby establishing a pillar. A definite system has been outlined for the development of stopes and pillars in the Section 10 ore deposits. It is our intention to follow this prescribed pillar-stope pattern in our mining operations so that pillars may be kept in line from level to level. This will make it possible to secure the maximum of recovery and at the same time insure adequate support for the hanging wall rock.

Ten double gangs worked in the No. 3 area during 1948. Four of these operated on the 5th level. Contract No. 21, located at coordinates 1350 S - 2200 E, is the farthest east of the 4 crews. This gang stripped ore for a distance of 100' along the south side of the 5th level drift which is parallel to, and near, the hanging wall contact of the ore vein. Having widened the drift to stope width, the crew advanced a 30' wide stope north for a distance of 75' to the coordinate location shown above.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

1. Section 10 Lease: (Cont'd)

This crew will in the future develop cross cuts following the outlined pillar pattern. A new raise is being put up by No. 4 Contract which will hole to the floor of 21 stope in the first half of 1949. Approximately 200' west of 21 Contract in the same ore vein, Contract 25 advanced two breast stopes to the north. One of these is located at 1330 S - 1965 E and the other at 1380 S - 2010 E. Here, too, the ore vein is at least 60' wide, bounded by the slate hanging wall on the south and the dike or siderite on the north. Still farther to the west, Contract 74 explored the footwall contact by drifting 40' north to coordinates 1320 S - 1790 E. This drift proved that at this location the footwall is not a simple dike but consists of two members with an ore vein in between. This crew also stoped north at 1360 S - 1700 E. In the most westerly location on the 5th level, Contract No. 96 advanced the 5th level drift west for a distance of 190' in ore to reach coordinates 1360 S - 1310 E. The drift was stopped in ore although we believe the ore vein has narrowed to little more than drift width at this location. Further exploration will be carried on to the west at this elevation when new raises which will facilitate the removal of ore have been put up from the 8th level.

On the 7th level, Contract No. 4 completed a raise from the 7th level to the 5th level by holing to the 5th level drift at 1515 S - 2360 E. The completion of this raise permits extension to the east of the 5th level drift in order to intercept the top of two raises put up in ore from the 8th level to the 5th level elevation. This is the ore that is cut by old diamond drill hole No. 392 just east of the Section 10 Lease boundary. Contract No. 80 stoped north to coordinates 1430 S - 2170 E where they encountered siderite footwall that dips to the south. From the end of this stope, Contract 80 raised toward 21 stope on the 5th level and reached the elevation of the 6th level by the end of 1948. The breast of this raise is located at 1410 S - 2190 E.

Five different crews worked on the 8th level at various times during 1948. In the early part of the year Contract No. 4 put up a raise to No. 80 stope on the 7th level at coordinates 1430 S - 2180 E. This raise was developed in order to make it easier to get the ore out of 80 stope on the 7th level. In the eastern part of the 8th level, Contract 41 extended the north cross cut 350' southeast crossing the Section 10 Lease Moro Mine boundary at 1740 S - 2660 E and stopping the drift at 1760 S - 2790 E which location is on the Moro Mine property. From this drift, two raises were put up to the 5th level elevation. Contract No. 26 started their raise on the Moro Mine property at the coordinates 1750 S - 2735 E and stopped the raise in ore at the 5th level elevation. Contract 41 started their raise in the Section 10 Lease at 1715 S - 2650 E. This raise was put up mainly in ore and stopped at the 5th level elevation. Stoping will be started at the top of these two raises as soon as a drift connection can be established on the 5th level. In the most southerly known ore occurrence on the Section 10 Lease, Contract No. 40 stripped both sides of the north-south drift which crosses this ore to produce a north-south stope located at coordinates 1965 S - 2400 E. Cross cuts extending both to the east and to the west will be developed in the future in this ore vein which we believe strikes nearly east and west. This ore occurrence seems to be an up-faulted portion of the north limb of the main Section 10 syncline, although the structure has not been explored

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

1. Section 10 Lease: (Cont'd)

sufficiently to verify this theory. In the western part of the Section 10 Lease on the 8th level, Contract No. 96 drifted 575'; first, northwest then west and then back southwest to reach the coordinates 1410 S - 1255 E. The old drift which was headed west in the ore vein encountered such badly broken ground that it was impossible to continue its extension to the west. Because of this situation, Contract 96 came back into solid ground at coordinates 1420 S - 1710 E and drifted northwest into the footwall and then turned back southwest to intercept the ore vein along its westward extension. Raises will be put up from this drift to the 5th level elevation thereby permitting further exploration to the west on the 5th level.

Only one crew worked on the 10th level of the Section 10 Lease during the year 1948. It had been our intention to drill a 4" diamond drill hole 450' southeast into the 12th level of the Moro Mine in order to drain that property. After further consideration it seemed inadvisable to attempt such a long drill hole when we knew that we needed additional drift development on the 10th level in order to facilitate future mining. Therefore, the hole was not drilled and instead of this, Contract No. 28 drifted 290' south and southeast toward the Moro Mine to reach coordinates 1965 S - 2400 E. From this location we will drill the drainage hole into the Moro Mine. The hole will now be approximately 270' long instead of 470'.

2. "B" Shaft Pillar Area:

As mentioned in the previous annual report, the Cliffs Shaft Mine has been conducting an experiment using microseismic recording instruments to test for evidence of strain induced in roof arches as a result of pillar removal. The original area involved in this experiment located about 1200' west of "B" Shaft between the 11th and 12th levels is circumscribed by coordinates 0 to 200 S and 1000 to 1300 W. Stopping operations in this area ceased at the end of February 1948 with the removal of an additional 730 tons which makes a total recovery of 20,905 tons of ore from an area which had been considered to be worked out. No additional evidence was forthcoming that roof stress had increased in spite of the fact that we removed 5 pillars.

Shortly after the discontinuance of mining in the original area the microseismic recording equipment was moved to the 14th level where we have selected a new territory in which to continue this experimental work. It is our intention to trim pillars in this new area which is bounded by coordinates 0 to 200 S - 1400 to 1600 W. This change in technique is the result of the experience gained in the original area on the 11th level where we found that complete removal of pillars, while it did not develop large scale roof stresses, did produce local spalling or slabbing of the hanging wall rock. This spalling contaminates the ore and therefore it is better to leave just enough pillar to support the slabs of rock which have a tendency to fall from the back with complete removal of support.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

3. Cliffs Shaft and Bancroft Lease:

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

<u>Month</u>	<u>Total No. of Gangs</u>	<u>No. of Double Gangs</u>	<u>Gangs Developing</u>	<u>% of Total</u>	<u>Gangs Drifting or Raising</u>	<u>% of Total</u>
January	91	26	45	50.0	15	16.0
February	91	28	37	40.6	13	14.2
March	91	28	42	46.1	9½	10.4
April	90	26	51	56.6	12½	13.8
May	91	26	33	36.2	13½	14.8
June	91	29	37	40.6	15½	17.0
July	83	27	39	47.0	13½	16.2
August	87	27	40	46.0	11	12.6
September	88	28	41	46.6	10½	11.9
October	93	32	36	38.7	8	8.6
November	93	31	47	50.5	8	8.6
December	93	33	47	50.5	9½	10.2
Monthly Average	90.1	28.4	41.2	45.7	11.6	12.8
Year 1947				46.0		
Year 1946				42.7		
Year 1945				45.7		
Year 1944				49.8		
Year 1943				54.9		
Year 1942				53.5		

The only significant change in 1948 as compared to 1947 was the increase in the number of double gangs working in the mine during 1948. This is a consequence of our belief that the two-miner contract produces better morale, increases the efficiency through the extension to more men of the incentive pay system and promotes the training of new men who can be grouped with good miners.

No new ore areas were discovered in the Cliffs Shaft Mine during 1948. In the latter part of the year we embarked on a system of exploration by diamond drilling which is different from any program previously developed. With the exception of the Section 10 Lease, the northeast corner of the Cliffs Shaft fee property near the Harlow Clark New York property and the westward extension of the "B" Shaft syncline into Section 9, there are no remaining areas where the delimiting Goodrich formation contact has not been ascertained. From all practical consideration, therefore, there is only the Section 10 Lease and the Section 9 area where virgin hard ore deposits might be developed. However, there are many places throughout the old workings in the mine where all the ore has not been extracted and small veins of ore may and do occur adjacent to these old workings. We believe that these occurrences cumulatively amount to considerable tonnages of reserves. In order to explore for such deposits and establish their grade, the mine has purchased a diamond drill capable of drilling short holes that is to be used testing the floors and ribs of the old workings in favorable spots. This work started in the latter part of 1948 and a definite program has been laid out which it is expected we will continue indefinitely. The establishment of such reserves in and adjacent to the old workings makes it possible to plan development, in advance of mining, on a more efficient basis. It will

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

also make it possible to control product analysis along with high production because we will have several localities into which mining gangs can be quickly moved when old stopes become depleted.

No work was done in the Section 9 territory of "B" Shaft during 1948 primarily because mining in this territory is inefficient due to our lack of knowledge of structure and the narrowness of the known ore veins. Additional exploration of the Section 9 area should be promoted in the near future.

"A" SHAFT
1st Level

During 1948, there was only one contract that did development work in "A" Shaft on the 1st level. This contract, No. 18, stripped ore from the east rib of an old stope and then raise stoped from the west side of this old stope to the 1145' sub-level at coordinates 930 S - 490 E. The ore vein strikes northwest-southeast and dips northeast beneath slate hanging wall. There is some possibility that ore may extend southeast along the strike. This possibility will be explored before we leave the area.

2nd Level

In the Bancroft Lease, Contract No. 29 breast stoped north in the ore vein which they discovered in 1947. The ore vein is bounded on both the east and west sides by dike which dips east. It is a typical footwall ore vein occurring in the nose of an eastward pitching syncline. Additional ore reserves may be found extending northeast if the synclinal structure has not been truncated in that direction by faulting. Any further exploration in that area is to be carried on from the 5th level where the ore vein is crossed by the drift near Contract 29 raise. The breast of the stope on the 2nd level is located at 500 N - 1150 E. The only other development on the 2nd level in "A" Shaft during 1948 was at 290 S - 1520 E where Contract No. 12 put up a raise stope from the 2nd level to old workings on the 1st level. This development practically exhausted the merchantable ore that occurred in this area.

3rd Level

Approximately 100' southwest of "A" Shaft, Contract No. 38 raise stoped from the 4th level to the 3rd level in a flat-lying vein of conglomerate ore that is overlain by the Goodrich slate which here pitches to the east at the end of the "A" Shaft syncline. Most of the future development in this ore vein will be below the 3rd level as it extends down the pitch to the east and along the strike to the north and south.

4th Level

Four crews were engaged in development work on the 4th level, "A" Shaft, during 1948. At the west end of the "A" Shaft syncline, Contract 38 as mentioned in the discussion of the 3rd level development raise stoped to the 3rd level elevation. They also breast stoped east to coordinates 600 S - 775 E and advanced one narrow cross cut to the north which was extended approximately 30'. The upper portion of this ore is

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

conglomeritic but the lower part is in specular hematite. East of this location in the Main Vein at coordinates 520 S - 1415 E, Contract No. 66 put up a raise stope from the 5th level to the 4th level elevation where they encountered jasper and slate hanging wall. Almost due north of this location, Contract No. 92 extended a stope east to 180 S - 1510 E. It was extended 50'. This ore vein occurs between two dikes that strike east-west and dip north. In the northeast corner of the recent development the stope encountered the slate hanging wall which dips to the northeast. Any additional work in this area will be largely confined to the mining of the floor of the existing stope area.

In the extreme east end of the mine, Contract No. 8 breast stoped west and then south through a large pillar, splitting it into two pillars by holing to old workings at coordinates 330 S - 3230 E. Still farther to the east at 200 S - 3600 E, Contract No. 26 breast stoped south to encounter a vertical dike that strikes east and west. Additional ore reserves may exist east of this territory toward the sub-levels of the old No. 3 mine above the 4th level.

5th Level

As mentioned in the discussion of the 4th level development, Contract No. 66 put up a raise stope from the 5th to the 4th level at coordinates 520 S - 1415 E.

6th Level

Of the 4 crews that performed development work on the 6th level, "A" Shaft, one was located in the ore vein along the south side of the "A" Shaft syncline and the other three in the vein along the north limb of the syncline. In the South Vein at an elevation slightly below the 6th level, Contract No. 6 breast stoped east 30' to coordinates 1200 S - 2100 E. This development exhausted the ore in this particular area and Contract No. 6 was then moved to the 7th level elevation. Along the north rim of the syncline, Contract 59 holed a raise from the 7th level at 385 S - 1770 E and then advanced the breast of this old stope east to connect with other old workings at coordinates 380 S - 1800 E. In the future, we expect this crew to mine ore in the floor of these old workings. Farther to the east, Contract No. 51 formed a new pillar by stoping east to coordinates 150 S - 2770 E. Most of the activity of this crew consisted of depletion mining of ore floors. Southeast of this location at 340 S - 2790 E, Contract No. 67 breast stoped 60' northwest and then developed 50' of cross cut northeast to connect to old workings. The ore vein here strikes northwest-southeast and dips southwest beneath slate hanging wall. Additional ore reserves are expected to the northwest of this development.

7th Level

As mentioned above, Contract No. 6 was moved to the 7th level where they sliced ore from the south rib of an old stope at 1120 S - 2170 E. This work may lead to the development of a new footwall ore vein immediately south of the coordinate location cited. This ore vein will strike east and west and dip north. The development work of 59 Contract was also mentioned in the discussion of the 6th level. The only other development on the 7th level was a raise which was put up to that elevation from the

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

8th level by Contract 95. This raise was more in the nature of an exploration than development and no new ore was discovered at its location of 400 S - 2760 E.

8th Level

In the Bancroft Vein, Contract No. 10 breast stoped 60' south to coordinates 30 S - 2200 E. This stope was developed as a result of the discovery that ore occurred behind the dike which bounded the old workings along the south rib. In order to make it easier to get into No. 10 Contract a drift was developed from the Cliffs Shaft haulageway at coordinates 50 S - 2150 E. This drift was advanced northeast by 28 crew a distance of 40' where it holed to the southwest corner of No. 10 stope. All of this drift was driven in ore which we expect to mine in the future. In the east part of the mine, Contract No. 78 put up two new raise stopes at 110 N - 3120 E. Both of these started on the 8th level elevation and holed to the top of old raise stopes that had previously been developed by 78 gang, east of this location. During most of the year, Contract 78 mined floor from the 8th level stopes. Still farther to the east, Contract 81 drifted 130' southwest to hole to their stope at coordinates 140 N - 3320 E. This drift provided easy and direct access to their stope from the 8th level. Inasmuch as most of the drift was advanced through first class ore this crew was able to develop a sizeable stope by stripping ore from both sides of the drift.

9th Level

Three crews performed development work in the Bancroft Lease on the 9th level, "A" Shaft, during 1948. Contract No. 10 put up a raise from coordinates 20 N - 2190 E. This was the raise that discovered the ore lying south of the dike which limited the 8th level Bancroft stope along its south rib. Contract No. 16 increased the outline of their stope just below the 9th level elevation by stripping ore from the east rib and breasting south 50' to coordinates 180 N - 1580 E. They also put up a small raise stope to the west, holing to their 8th level workings at coordinates 250 N - 1560 E. The ore vein in this area is located in the west end of a syncline that pitches east at a very shallow angle. Ore will extend downward to the east past the 10th level elevation. Southeast of the above location, Contract No. 69 drifted 70' west in ore and then developed a stope 90' long by 25' wide which was extended south from near the end of the drift. This activity is located at 100 N - 1850 E. The ore in this location lies on top of slate as a result of its having been faulted over the Goodrich formation.

There were 4 crews that did development work on the 9th level "A" Shaft fee property. Contract No. 46 breast stoped north and east a total distance of approximately 50' in a vein of ore about 30' wide, to reach coordinates 580 S - 1525 E. This ore vein is along the footwall contact at the east end of the "A" Shaft syncline. It strikes east and west and will undoubtedly lead 46 Contract east until it holes to old 15 workings at coordinates 575 S - 1630 E. Southeast of this area at 850 S - 1700 E, Contract No. 90 started a raise stope to the west. This activity is along the south limb of the "A" Shaft syncline and it too is near the footwall of the ore horizon. Still farther east at 915 S - 2350 E, Contract 65, in a hanging wall ore vein, breast stoped 50' to

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

the east and mined floor below the 9th level elevation in this same stope. In the east end of the mine, Contract No. 101 advanced their breast stope east 60' to coordinates 290 N - 3620 E. We have plans for a new raise from the 10th level near the breast of this recent development in order to facilitate the removal of ore. This latter ore vein strikes east and west and dips nearly vertical between dike footwall on the south and either slate or dike hanging wall on the north.

10th Level

The only crew that did development in the Bancroft Vein during 1948 was Contract 44 which put up a short raise from the 10th to the 9th level at coordinates 100 N - 1850 E. This raise holed to the new stope developed by 69 Contract on the 9th level.

On the fee property there were 7 contracts engaged in development work during 1948. In the Southeast ore vein, Contract No. 3 breast and raise stoped 90' southwest to 1040 S - 2420 E. This crew also drove a cross cut southeast for a distance of 25'. The ore vein in general is bounded by lean or jaspery material although rock was encountered in the breast of the main heading at the coordinate location cited. Two-hundred feet east of this location, Contract No. 55 put a short raise up from a sub-level below the 10th level which holed to the end of the 10th level stope at coordinates 1020 S - 2680 E. They also drifted 50' east in the lower part of the bench of this 10th level stope. This drift will serve to remove ore which will be mined from the floor at the inside end of the stope leaving a floor brace to support the hanging wall rock. Along the north flank of the "A" Shaft syncline, Contract No. 44 drove 350' of drift northeast from coordinates 500 S - 1975 E to connect with the old Bancroft drift at 250 S - 2200 E. This drift was driven in order to eliminate some dangerous trackage passing through an open stope where we expect to mine floor in the near future. The crew also stripped the drift leading north to the Bancroft deposit, eliminating many of the bad curves in the drift. Farther to the east in the Main Vein, Contract 7 raise stoped from the 10th level elevation to the floor of old workings on the 9th level at coordinates 390 S - 2300 E. They also developed a breast stope east to coordinates 460 S - 2350 E where we expect to put up a second raise stope to the 9th level floor. At the east end of the main "A" Shaft syncline, Contract No. 35 breast stoped south 30' to coordinates 590 S - 3030 E. This material became too lean to warrant additional mining and the place was abandoned in the early part of 1948. The remaining two development crews worked in the northeast part of the mine. Contract No. 23 put up a raise from the 10th level to the 9th level and drifted 75' west from the top of this raise to connect with old 23 stope at 35 N - 2720 E. There is good ore on the 9th level elevation along the course of this drift which 23 Contract will mine in the future. Still farther to the northeast, Contract 64 started a small breast stope headed northeast along the course of old diamond drill hole 582. At the end of 1948, the breast of this stope was located at 340 N - 3260 E. This vein is at the east end of the Bancroft deposit syncline. The ore should extend down to the west and up to the east but may be cut off to the north by up-faulted dike footwall.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

11th Level

In the Bancroft Vein, Contract No. 62 breast stope 70' southwest in the hanging wall ore vein which dips north beneath slate hanging wall. On the south side the ore is bounded by dike. This ore vein will eventually connect to 84 stope 175' west of this location. Coordinates of the breast at the end of the year were 185 N - 2450 E. In the same ore vein, Contract 84 breast stope east to coordinates 235 N - 2300 E.

In the Main Vein, at the east end, Contract No. 68 breast stope 60' south to coordinates 700 S - 2825 E. This stope should hole to the traveling road drift and some reserves may be found along the west rib of the present development. At about the middle of the Main Vein, Contract No. 91 started to breast stope south through the center of a pillar that is 150' long by 100' wide.

12th Level

A small amount of development work was performed by two contracts during the past year. Contract No. 24 advanced a short raise stope west to coordinates 620 S - 2340 E where they holed to old workings from which they subsequently mined rib and floor. At the west end of the 12th level deposit, Contract No. 39 stripped ore from both sides of the traveling road drift and breast stope south at an elevation slightly above the 12th level to reach the coordinates 680 S - 2000 E. This last development encountered rock on all sides and was, therefore, discontinued.

"B" SHAFT

1st Level & Sub-Levels:

On the sub-levels above the 1st level in "B" Shaft, there were 4 contracts that performed development work during the past year. On the 1205' sub-level, Contract No. 58 near the west end of the workings, sliced ore from the east rib of an old stope at coordinates 850 S - 265 W. This gang also did some development work on the 1165' sub-level at coordinates 685 S - 30 W, where they breast stope north under the slate hanging wall which dips to the north. Contract No. 17 did a small amount of development work at the east end of the 1205' sub-level by breast stoping east at coordinates 780 S - 310 E. On the 1145' sub-level, Contract No. 1 breast stope west 60' to connect with the stope produced by 85 Contract in the Southwest Vein at coordinates 1215 S - 75 E. Contract No. 1 advanced the opposite end of their stope east for a distance of 30' to 1270 S - 305 E. This latter work was described under the discussion of the Section 10 Lease. At the west end of the Southwest Vein workings, Contract 75 breast stope 70' west to 1170 S - 315 W and developed one cross cut raise stope to the north which was 15' deep. The ore vein in this area strikes east and west and dips south between slate hanging wall and dike footwall. Most of the ore is conglomeritic. In about the center of the Southwest Vein, Contract 85 breast stope both west and east to connect with No. 75 workings and No. 1 workings at coordinates 1200 S - 310 W and 1210 S - 40 E.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

2nd Level

In a vein of ore that lies just beneath the hanging wall slate along the south limb of the "B" Shaft syncline, Contract No. 72 renewed development by breast stoping southwest to coordinates 120 S - 190 W. This may lead to the development of some additional reserves in the hanging wall ore vein. Southwest of this location at coordinates 400 S - 500 W, Contract 86 breast stoped 40' west from the top of a new raise which they put up to the 2nd level from the 5th level haulageway. This breast stope is headed toward the hanging wall contact and better ore should be encountered parallel with this hanging wall.

3rd Level

At coordinates 110 S - 150 W, Contract 72 did a small amount of development work on the 3rd level by stripping ore from the south side of the old drift at a point almost directly below their development work on the 2nd level. This did not prove to be very promising.

4th Level

There were 3 gangs that did development work on the 4th level during 1948. Contract No. 11 breast stoped 70' north to connect to old workings made by 13 Contract. The connection was established at 245 S - 140 W. Some additional ore can be mined by cross cuts from this north-south stope and from the floor of the old stope. Immediately south of this location at 525 S - 115 W, Contract No. 33 breast stoped north and east through steel ore of good quality that is bounded by jasper on all sides except the breast. This ore vein is a footwall deposit which will probably connect to the old workings southeast of "B" Shaft. In the North Vein, Contract 57 raise stoped 25' west to coordinates 110 S - 260 E. This work, however, practically depleted all the ore on this elevation in that territory and the gang was moved to the 5th level.

5th Level

As mentioned in the discussion of the Section 10 Lease development, Contract 63 completed 650' of drift which ended just inside the Section 10 Lease boundary. Raises will be put up from this drift into the Southwest Vein at the 1st level elevation. Four additional crews did development work during the year on the 5th level. Contract No. 32 breast stoped 50' east to coordinates 60 S - 160 W, intercepting old diamond drill hole No. 84 at which point they encountered rock converging from both the foot and hanging. This crew also drove two exploratory drifts at coordinates 520 S - 160 W and 610 S - 110 W, underneath 33 stope which is on the 4th level. No mineable ore was discovered in these drifts. Contract No. 37 resumed work in an old area just above the 5th level by breast stoping west from the old workings to connect with an old raise at coordinates 500 S - 550 W. Still farther to the west, Contract 71 developed two breast stopes, one headed to the southwest and the other southeast to coordinates 510 S - 740 W and 520 S - 630 W. Both of these are headed toward the footwall of the south limb of the "B" Shaft syncline.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

In old workings on the 1165' and 1220' sub-levels, at coordinates 875 S - 600 W, we have found large areas of unmined floor which is high grade ore. In the latter part of 1948 we started development to make available this ore which will be hoisted from the 5th level elevation. Contract 63 started a drift at coordinates 370 S - 425 W on the 5th level which will extend about 250' southwest to a point from which it will be possible to put up a raise to the 2nd level elevation. The ore mined on the subs will be scraped to this raise through a transfer drift extending up from the 2nd level. Additional development work on the sub-levels may prove the existence of ore extending both to the east and to the west underneath the slate hanging wall. It is our intention to explore these possibilities.

6th Level

At the extreme west end of the South limb of the "B" Shaft syncline, Contract No. 49 connected the hanging wall and footwall ore veins with a stope about 50' wide and 60' long. The best ore occurs near the hanging wall ore vein and some cross cuts can be developed in this area. The coordinate location of this work is 850 S - 1500 W. The only other development contract on the 6th level was No. 56 which produced two breast stopes, one headed southwest the other southeast toward the foot-wall contact of the ore vein. These stopes are located at 580 S - 820 W and 540 S - 740 W.

7th Level

A small amount of development work was done by 87 Contract at 115 S - 460 W. This crew raise stoped toward the hanging wall contact from their old workings. This development encountered rock as was expected.

9th Level

On the 9th level, Contract No. 14 breast stoped 45' south and 25' west to coordinates 750 S - 1310 W where they holed to their old workings from which the ore had been depleted. Some ore remains to be mined from the floor of the recent development.

10th Level

Three crews did some development work on the 10th level in 1948. Contract No. 11 put up a raise from coordinates 730 S - 1220 W which holed to 14 stope on the 9th level. Northwest of this location at 600 S - 1400 W, Contract No. 19 in the early part of the year, advanced a breast stope 25' southwest on a sub-level between the 10th and 9th levels. Most of the work performed by Contract 93 was depleting in character during 1948 but this crew did drive two breast stopes totalling nearly 75' in length at coordinates 350 S - 850 W. Two new pillars were formed by this development work.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

11th Level

On the 11th level, Contract No. 19 drifted southeast 80' to coordinates 540 S - 1110 W. This drift was driven in jasper and was discontinued temporarily because we were not as yet ready to mine the floor of the 10th level stopes where No. 100 Contract has been mining back during the past two years. Eventually, this drift will be completed to get under the ore on the 10th level. Contract 19, however, did discover a new vein of ore extending south from the mouth of their drift in which they breast stoped southeast 70' to coordinates 590 S - 1175 W. There is a good possibility that some of this ore may extend southwest along the footwall contact. We also know that good ore exists above this location on the 10th level elevation in the floor of old workings and in the diamond drill hole 583.

12th Level

On the 12th level, Contract No. 40 breast stoped both east and west from an old drift at coordinates 180 S - 1000 W and breast stoped south to coordinates 250 S - 970 W. All of this development encountered low grade jasper or dike footwall and the operation was discontinued early in the year.

15th Level

There were 3 gangs doing development work on the 15th level during the past year. Contract No. 36 raise stoped from the 15th level to the 14th level elevation and holed at coordinates 40 S - 1600 W. This development apparently mined the ore shown in diamond drill hole 451 on the 14th level. We expect to develop for the ore shown in diamond drill hole 454 but probably this work will be done by a different crew because 36 Contract will be engaged in trimming pillars in conjunction with the microseismic recording experiment. Contract 43 breast stoped southwest in the footwall ore vein lying on top of dike which dips northwest. They attained coordinates 480 S - 1490 W by the end of the year. In an attempt to find a mineable width of ore extending west underneath the slate hanging wall contact, Contract 47 drove three short drifts to develop for the ore that was cut by diamond drill hole 574 at coordinates 25 S - 1950 W. Apparently the drill hole paralleled the ore vein which proved to be about 4' thick dipping northwest at an angle of about 40°. Immediately northeast of this territory, Contract 47 did develop a small stope in this same ore vein by raise stoping northeast to coordinates 60 N - 1820 W. Here, too, the ore pinched out between dike footwall and slate hanging material.

3. Cliffs Shaft, Bancroft and Section 10 Lease:

The following table shows the gangs that did development work during 1948. The tonnage after each is the amount broken by these crews in development and allocated to the proper level.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

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

<u>"A" SHAFT</u>	<u>Contract Number</u>	<u>Mine Tally Ore</u>	<u>Rock</u>	<u>Shifts Mining</u>	<u>Shifts Barring While Developing</u>
2nd Level	5	383		46 $\frac{1}{2}$	1
	12	1,999		201	
	29	2,596	20	324 $\frac{3}{4}$	18
3rd "	27	643		51	
	38	852	479	63	
4th "	2	6,990		607 $\frac{3}{4}$	1
	66	1,255		57	6
	92	3,055	26	192 $\frac{1}{2}$	5
5th "	21	5,661		265 $\frac{3}{4}$	1
	25	4,376		364 $\frac{1}{2}$	6
	45	2,295		115 $\frac{1}{2}$	
	74	1,658		133 $\frac{3}{4}$	10
	96	1,785	4,111	508	14
6th "	31	209		130 $\frac{3}{4}$	
7th "	6	5,452		264 $\frac{3}{4}$	15
	61	485		27	
	67	576	15	37	
	80	4,975	153	439 $\frac{1}{4}$	
	95	1,311		103	9
8th "	4	546	576	235 $\frac{3}{4}$	
	26	2,351		258	8 $\frac{1}{2}$
	41	3,032	362	464 $\frac{3}{4}$	
	44	2,917	2,537	587	
	59	2,035		195 $\frac{3}{4}$	42
	78	3,203		126	14
	81	2,810		271	6
9th "	10	2,657		190 $\frac{1}{2}$	47 $\frac{1}{2}$
	16	6,610		502 $\frac{1}{2}$	8
	46	2,535	71	311 $\frac{3}{4}$	
	65	3,509		190 $\frac{3}{4}$	
	69	2,550	10	315 $\frac{1}{2}$	29
	90			106	
	101	5,197		254 $\frac{1}{2}$	25
10th "	3	7,451		242 $\frac{3}{4}$	
	7	12,314		289	24
	23	1,632		249 $\frac{1}{4}$	
	28	836	121	360 $\frac{1}{2}$	
	55	3,264		195	16
	64	908		94 $\frac{1}{2}$	
11th "	91	362		56	
	39	1,915		84 $\frac{3}{4}$	18
	62	4,167		357	17
	68	2,139		172 $\frac{1}{2}$	13
	79	184		25	1
	84	3,616		288 $\frac{1}{4}$	6
12th "	24	464		51	
Total "A" Shaft		<u>125,756</u>	<u>9,183</u>	<u>10,407$\frac{1}{4}$</u>	<u>361</u>

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

<u>"B" SHAFT</u>	<u>Contract Number</u>	<u>Mine Tally Ore</u>	<u>Rock</u>	<u>Shifts Mining</u>	<u>Shifts Barring While Developing</u>
1st Level	1	6,380		497 $\frac{3}{4}$	8
	17	719		75	
	18	2,060		144	
	58	1,561		135	10
	75	3,524	102	282 $\frac{1}{4}$	1
	85	3,346		217	
2nd "	76	117		47	
3rd "	38	1,969		39	
	72	770	158	51	
4th "	11	923		66	
	33	13,173		596 $\frac{1}{4}$	
	73	1,668		106 $\frac{1}{2}$	9
5th "	32	6,803	362	288	
	57	479		49	
	63	2,055	250	767 $\frac{1}{2}$	
	71	6,242		537 $\frac{3}{4}$	20
	86	3,499	122	191 $\frac{3}{4}$	
6th "	56	7,461	31	506	
9th "	14	4,029		184 $\frac{3}{4}$	
10th "	11	214	385	77	1
11th "	19	4,325	10	252	
12th "	40	3,239		144	5
14th "	37	648	20	110	
	43	2,509		303	
15th "	36	2,953	66	234 $\frac{1}{2}$	
	47	2,055	403	267 $\frac{3}{4}$	
Total "B" Shaft		82,722	1,910	6,169 $\frac{1}{2}$	54
Grand Total Dev.		208,478	11,093	16,576 $\frac{3}{4}$	415

The contract sheet tonnage exclusive of overrun equals 574,201 tons. The 208,478 tons mined by development crews is 36% of the total.

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

1943	629,555 Tons
1944	569,871 "
1945	535,454 "
1946	386,160 "
1947	531,971 "
1948	573,455 "
Total	3,226,466 "

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

1943	252,869 Tons
1944	206,926 "
1945	184,510 "
1946	119,649 "
1947	185,339 "
1948	208,478 "
Total	1,157,771 "

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

a. Development: (Cont'd)

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

From 1943 to 1949, developing gangs mined 1,157,771 tons (35.9%) per the contract sheet tally and depleting gangs mined 2,068,558 tons (64.1%) making a total of 3,226,329 tons. Total mine tally by skip count for the same period is 3,226,466 tons without overrun.

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

<u>Year</u>	<u>Avg. No. of Gangs on Ore Development</u>	<u>Tonnage Mine Tally</u>	<u>Shifts Worked</u>	<u>Tons Per Gang Per Shift</u>
1948	41.2	208,478	16,991 $\frac{3}{4}$	12.27
1947	41.7	185,339	14,690 $\frac{3}{4}$	12.62
1946	36.8	119,649	8,727 $\frac{1}{4}$	13.71
1945	38.5	184,510	11,395	16.19
1944	48.1	206,926	14,786 $\frac{1}{2}$	13.99
1943	56.2	252,869	16,836 $\frac{1}{2}$	15.02

b. Stoping:

<u>"A" SHAFT</u>	<u>Contract Number</u>	<u>Location by Coordinates at Approx. Center of Operations</u>	<u>Character of Work</u>
1st Level	30	275 S - 740 E	Mining Floor
	34	160 S - 415 E	" Pillar
3rd "	27	290 S - 700 E	" Floor
	104	775 S - 630 E	" "
4th "	27	280 S - 660 E	" "
	45	1220 S - 2780 E	" "
	57	200 S - 520 E	" "
	91	1210 S - 2300 E	" Back
5th "	8	380 S - 3330 E	" Floor
	31	260 N - 3630 E	" Floor & Back
6th "	31	250 N - 3580 E	" Back
	51	230 S - 2600 E	" Floor
	67	440 S - 2960 E	" "
	98	490 S - 1670 E	" Pillar & Floor
7th "	20	150 S - 2160 E	" Floor
	20	200 S - 2300 E	" "
	59	420 S - 1880 E	" "
	61	150 N - 3500 E	" "
	82	200 S - 1740 E	" "
	95	325 S - 2730 E	" "
8th "	26	1900 S - 2400 E	" Back
	40	1900 S - 2400 E	" Back & Rib
	54	225 S - 1840 E	" Floor
	78	40 N - 3120 E	" "
	81	150 N - 3320 E	" "
	95	325 S - 2730 E	" "

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)b. Stoping: (Cont'd)

	<u>Contract Number</u>	<u>Location by Coordinates at Approx. Center of Operations</u>	<u>Character of Work</u>
<u>"A" SHAFT</u>			
9th Level	64	220 N - 3000 E	Mining Floor
	65	920 S - 2280 E	" "
	69	140 N - 1975 E	" "
10th "	3	980 S - 2490 E	" "
	7	450 S - 2310 E	" "
	15	575 S - 1750 E	" "
	23	25 N - 2860 E	" Back
	35	575 S - 2720 E	" "
	55	970 S - 2630 E	" "
	70	300 N - 2840 E	" "
	89	375 N - 1830 E	" Back & Floor
11th "	39	600 S - 1930 E	" Floor
	53	50 N - 2475 E	" "
	60	600 S - 2700 E	" "
	62	200 N - 2500 E	" Back
	68	640 S - 2875 E	" Floor
	79	675 S - 2130 E	" "
	83	600 S - 2600 E	" "
12th "	24	650 S - 2250 E	" "
<u>"B" SHAFT</u>			
1st Level	1	1240 S - 125 E	Mining Floor-1145' sub.
	17	870 S - 60 E	" Pillar-1205' "
	18	830 S - 430 E	" Back
	58	790 S - 240 W	" Floor-1165' sub.
	73	630 S - 500 W	" Pillar
	85	1190 S - 65 E	" Pillar-1145' "
3rd "	38	910 S - 1400 W	" "
	72	275 S - 500 W	" Floor
4th "	11	230 S - 130 W	" "
	13	300 S - 300 W	" "
5th "	57	140 N - 100 E	" Back
6th "	49	825 S - 1500 W	" Floor
	77	160 N - 400 W	" Back
	87	100 S - 390 W	" Floor
7th "	42	50 S - 70 W	" "
9th "	14	720 S - 1250 W	" "
10th "	93	300 S - 850 W	" "
	100	570 S - 1030 W	" Back
11th "	19	550 S - 1200 W	" Floor
12th "	86	200 S - 1225 W	" "
14th "	37	170 S - 1450 W	" "
	43	420 S - 1475 W	" "
	48	275 S - 1575 W	" Back
15th "	36	70 S - 1500 W	" Pillar

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

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

b. Stoping: (Cont'd)

<u>"A" SHAFT</u>	<u>Contract Number</u>	<u>Mine Tally Ore Rock</u>	<u>Shifts Mining</u>	<u>Shifts Barring While Depleting</u>	
1st Level	30	4,177	199	266 $\frac{3}{4}$	12
2nd "	5	6,197		197	4
	12	3,539		85	9
	34	2,810		112	140
3rd "	27	6,482		504 $\frac{1}{2}$	5
	38	4,763		164 $\frac{1}{2}$	
	91			68	115
	104	9,792	56	596 $\frac{3}{4}$	10
4th "	22		71	10	41
	66	6,365	107	238 $\frac{3}{4}$	4
	92	1,821		96 $\frac{3}{4}$	3
5th "	8	5,880		299 $\frac{3}{4}$	2
	21	933		40	
	25	1,673		87	
	45	4,531		271 $\frac{3}{4}$	
	74	2,287	232	161 $\frac{1}{2}$	3
6th "	31	2,637		97	51
	51	11,399		306 $\frac{3}{4}$	
	98	9,221	5	234	111
7th "	6	775		26	
	20	14,229		276	25 $\frac{3}{4}$
	61	10,618	87	536 $\frac{1}{2}$	5
	67	5,477		246 $\frac{3}{4}$	20
	80	1,535		113	
	95	4,498		177 $\frac{3}{4}$	8
8th "	26	508		98	
	40	974		73	
	54	7,043		292 $\frac{1}{2}$	
	59	1,219		61	2
	78	6,441	87	316	10
	81	3,902		306 $\frac{1}{2}$	18
	82	6,645	61	298 $\frac{1}{4}$	12
9th "	10	1,683		71	
	16	1,352		96	4
	65	2,198		116	
	69	1,566		97	6
10th "	3	1,887		52 $\frac{1}{2}$	
	7	4,340		68 $\frac{3}{4}$	7
	15	6,418		299 $\frac{1}{4}$	6
	23	367		26	
	35	4,667	71	457	10
	55	5,852		178 $\frac{3}{4}$	1
	64	4,177		121	17
	70	5,462		263 $\frac{3}{4}$	17
	89	9,149		301 $\frac{3}{4}$	3
11th "	39	4,067		175	15
	53	13,158	71	297 $\frac{1}{4}$	11
	60	8,930		592 $\frac{1}{2}$	
	62	2,950	71	226	
	68	1,053		85 $\frac{3}{4}$	37
	79	6,796		272	7
	83	8,517		585 $\frac{1}{2}$	15
12th "	24	8,211		594 $\frac{1}{2}$	1
Total "A" Shaft		251,172	1,120	11,636 $\frac{1}{4}$	767 $\frac{3}{4}$

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)b. Stoping: (Cont'd)

<u>"B" SHAFT</u>	<u>Contract Number</u>	<u>Mine Tally</u>		<u>Shifts Mining</u>	<u>Shifts Barring While Depleting</u>
		<u>Ore</u>	<u>Rock</u>		
1st Level	1	395		50	
	17	4,414	102	285 $\frac{1}{4}$	38 $\frac{1}{2}$
	18	2,040	202	134 $\frac{3}{4}$	16
	58	7,660		417 $\frac{1}{2}$	26
	73	6,865	148	213	8
	85	941		73	
3rd "	38	1,423		38	
	72	110		105 $\frac{1}{2}$	182 $\frac{1}{2}$
4th "	11	2,392		104 $\frac{1}{2}$	21
	13	9,088		564	27
5th "	57	5,187	5	231 $\frac{3}{4}$	
6th "	49	11,949	5	594	
	77	5,393	51	288	
	87	6,000		255 $\frac{1}{2}$	17
7th "	42	1,984		78	10
9th "	14	3,953		115	
10th "	93	17,763	20	627 $\frac{3}{4}$	4
	100	7,890		207 $\frac{1}{4}$	67
11th "	19	1,408		45 $\frac{3}{4}$	
12th "	86	729		47	3
14th "	37	4,121		184 $\frac{3}{4}$	
	43	2,264		251 $\frac{1}{2}$	
	48	10,536		228 $\frac{3}{4}$	64
15th "	36	46		33	5
Total "B" Shaft		114,551	533	5,173 $\frac{1}{2}$	489
Grand Total Dep.		365,723	1,653	16,809 $\frac{3}{4}$	1,256 $\frac{3}{4}$

The mine tally from the contract sheets was 574,201 tons of which the depleting gangs broke 365,723 tons or 64%.

The following table gives a six year comparison:

<u>Year</u>	<u>Avg. No. of Gangs Stopping</u>	<u>Tonnage Mine Tally</u>	<u>Shifts Worked</u>	<u>Tons Per Gang Per Shift</u>
1948	49	365,723	18,066 $\frac{1}{2}$	20.24
1947	49	344,333	14,917	23.08
1946	49	266,278	10,505 $\frac{1}{2}$	25.35
1945	46	350,312	13,619 $\frac{1}{4}$	25.72
1944	48	364,650	13,984	26.07
1943	46	377,262	13,569 $\frac{1}{2}$	27.80

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

c. Drifting and Raising:

<u>Year</u>	<u>Rock Drifts and Raises</u>	<u>Ore Drifts and Raises</u>	<u>Total</u>
1948	3,068'	4,213'	7,281'
1947	3,221'	2,952'	6,173'
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'

d. Explosives, Drilling and Blasting:

Powder consumption per ton of ore increased .0141 lbs. per ton over 1947 usage. The average price increased from \$13.50 per cwt. to 13.957 per cwt. which resulted in an overall increase of \$.0054 per ton for powder.

The powder consumption per foot of rock development decreased 1.3 lbs. per foot of development compared to 1947 practice as shown in the table below:

<u>Year</u>	<u>Pounds of Powder Per Foot of Rock Development</u>
1944	18.7 Gelamite
1945	21.6 "
1946	17.0 Hercomite 2X
1947	17.8 " 2X
1948	16.5 " 2X

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND: (Cont'd)

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

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

	<u>Quantity</u>	<u>Average Price</u>	<u>Amount 1948</u>	<u>Amount 1947</u>
Gelamite No. 1 - CWT.	80,500	14.816	11927.28	7465.41
Hercomite 2 X - CWT.	469,750	13.957	65564.83	53698.87
Hercomite 2 XA - CWT.				5733.00
H. P. Gelamite - 60%	350	20.00	70.00	-
Total Powder	550,600	14.086	77562.11	66897.28
Fuse - Ft.	821,540	8.247 M	6775.71	6574.44
No. 6 Caps	128,229	1.342 M	1720.48	1699.05
E. B. Caps No. 6	11,665	16.95 C	1977.39	1254.20
Fuse Lighters	45,000	7.736 M	348.15	286.88
No. 18 Shot Wire - Ft.	8,018	15.367 M	123.22	135.53
Tamping Bags	10,850	7.74 M	83.99	62.69
Powder Bags	12	4.80	54.00	-
Connecting Wire - Lbs.	415	.843	350.08	347.78
Miscellaneous			268.83	71.54
Total Fuse, Etc.			11701.85	10432.11
Total Stopping & Dev. in Ore			89263.96	77329.39
Product - Tons			602,453	546,796
Lbs. Powder Per Ton Ore			.9141	.9000
Cost Per Ton For Powder			.1287	.1223
Cost Per Ton For Fuse, Etc.			.0194	.0191
Cost Per Ton For All Explosives			.1481	.1414

(Development in Rock)

Gelamite No. 1 - CWT.				40.40
Hercomite 2 X - CWT.	50,850	13.851	7043.67	7188.25
Hercomite 2 XA - CWT.				461.50
Total Powder	50,850	13.851	7043.67	7690.25
Fuse - Ft.	17,325	8.25 M	142.94	259.50
No. 6 Caps	3,032	1.383 M	41.96	54.80
E. B. Caps No. 6	8,165	16.537 C	1350.26	926.41
Fuse Lighters	11,320	7.743 M	87.60	25.31
No. 18 Shot Wire - Ft.	5,610	15.300 M	85.82	90.62
Tamping Bags	374	7.74 M	2.89	4.62
Connecting Wire - Lbs.	312	.80	250.24	257.37
Miscellaneous			96.86	-
Total Fuse, Etc.			2058.57	1618.63
Total Rock Development			9102.24	9308.88
Feet Rock Development			3,068	3,221
Cost Per Foot Rock Development			2.966	2.890
GRAND TOTAL ALL EXPLOSIVES			98366.20	86638.27
AVERAGE COST PER LB. FOR POWDER			.1406	.136

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

a. Comparative Mining Costs:

	<u>1948</u>	<u>1947</u>
Product - Tons	602,453	546,796
Underground Costs	2.807	2.694
Surface Costs	.432	.479
General Mine Expense	<u>.495</u>	<u>.531</u>
Cost of Production	3.734	3.704
Taxes	.326	.331
Depreciation	.069	.041
Loading & Shipping	<u>.085</u>	<u>.093</u>
Total Cost at Mine	4.214	4.170
Budget Estimate at Mine	4.210	3.811
No. of Days Operating	307	305
No. of Shifts and Hours	2-8 hr.	2-8 hr.
Average Daily Product	1962	1793

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Detailed Cost Comparison
Details of Accounts

	<u>Total 1948</u>		<u>Total 1947</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
<u>Underground Costs</u>				
Exploring in Mine	1279.07	.002	19487.79	.036
Development in Rock	75849.62	.126	82185.74	.150
Development in Ore	92875.57	.154	74540.36	.137
Stopping	911038.66	1.512	759081.65	1.389
Timbering	48842.32	.081	46199.83	.084
Tramming	179174.13	.297	163033.98	.298
Ventilation	807.69	.001	1016.88	.002
Pumping	38394.91	.064	37594.61	.069
Comp. & Air Pipes	72832.12	.121	65322.12	.119
Back Filling	2130.03	.003	1513.99	.002
Underground Suptce.	59937.06	.100	49361.15	.090
Comp. & Power Drills	26034.91	.083	23397.57	.043
Scrapers & Mech. Loaders	115011.73	.192	88742.09	.162
Tramming Equipment	57273.08	.095	53608.02	.098
Pumping Machinery	<u>9757.51</u>	<u>.016</u>	<u>7781.51</u>	<u>.014</u>
Total Undg. Costs	1691238.41	2.807	1472867.29	2.694
<u>Surface Costs</u>				
Hoisting	48980.73	.081	48344.91	.088
Stocking Ore	32554.55	.054	25616.28	.047
Screening, Crushing-Mine	63738.84	.106	54779.65	.100
Dry House	19039.69	.032	16076.48	.029
General Surface Exp.	34923.79	.058	21985.26	.040
Maint. Hoisting Equip't.	20453.06	.034	18808.23	.034
Shaft	6738.47	.011	25236.06	.046
Top Tram Equipment	7769.48	.013	6917.70	.013
Docks, Trestles & Pockets	8597.96	.014	30948.79	.057
Mine Buildings	<u>17422.59</u>	<u>.029</u>	<u>13433.15</u>	<u>.025</u>
Total Surface Costs	260219.16	.432	262146.51	.479
<u>General Mine Expense</u>				
Use & Occupancy - Ins. Rec'd.	-	-	4670.54	.009
Geological	4141.68	.007	3083.99	.005
Mining Engineering	7697.50	.013	7273.91	.014
Mech. & Elec. Engr.	4116.52	.007	4175.32	.008
Analysis & Grading	29648.32	.049	29546.65	.054
Safety Department	3994.92	.007	4091.93	.007
Tel. & Safety Devices	10593.34	.018	8410.01	.015
Local & Gen. Welfare	6138.62	.010	6092.63	.011
Spec. Exp. Pens. & All.	11422.99	.019	9861.92	.018
Ishpening Office	40528.28	.067	33962.28	.062
Mine Office	34676.48	.058	32492.24	.060
Insurance	21561.99	.036	14515.73	.027
Personal Injury	35423.17	.059	54220.23	.099
Social Security Taxes	30532.92	.051	33274.13	.061
Employees Vacation Pay	<u>57877.24</u>	<u>.096</u>	<u>54474.79</u>	<u>.100</u>
Total Gen. Mine Expense	298353.97	.495	290805.22	.531
Cost of Production	2249811.54	3.734	2025819.02	3.704

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Detailed Cost Comparison:
Details of Accounts:

	<u>L. A B O R</u>				<u>S U P P L I E S</u>			
	<u>1948</u>		<u>1947</u>		<u>1948</u>		<u>1947</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
<u>Underground Costs</u>								
Exploring in Mine	895.88	.001	13723.91	.025	383.19	-	5763.88	.011
Development in Rock	57440.20	.095	65283.16	.119	18409.42	.031	16902.58	.031
Development in Ore	73743.64	.122	60498.16	.111	19131.93	.032	14042.20	.026
Stopping	748433.86	1.240	641252.90	1.173	162604.80	.270	117828.75	.216
Timbering	30365.84	.050	24571.40	.044	18476.48	.031	21628.43	.040
Tramming	169142.97	.281	154100.16	.282	10031.16	.017	8933.82	.016
Ventilation	179.21	-	490.63	.001	628.48	-	526.25	.001
Pumping	18271.67	.031	14551.84	.027	20123.24	.033	23042.77	.042
Comp. & Air Pipes	15295.71	.025	10892.42	.019	57536.41	.096	54429.70	.100
Back Filling	2128.55	.004	1357.58	.002	1.48	-	156.41	-
Underground Suptce.	59573.04	.099	48986.73	.090	364.02	-	374.42	-
Comp. & Power Drills	2295.19	.038	4041.89	.007	23739.72	.039	19355.68	.036
Scrapers-Mech. Loaders	55097.01	.092	34762.07	.064	59914.72	.099	53980.02	.098
Tramming Equipment	35539.19	.059	34246.75	.063	21733.89	.036	19361.27	.035
Rumping Machinery	4340.29	.007	4125.32	.007	5417.22	.010	3656.19	.007
Total Undg. Costs	1272742.25	2.112	1112884.92	2.035	418496.16	.695	359982.37	.658
<u>Surface Costs</u>								
Hoisting	28099.04	.046	28144.87	.051	20881.69	.035	20200.04	.037
Stocking Ore	25791.10	.042	22575.99	.041	6763.45	.011	3040.29	.006
Screening, Crushing-Mine	48201.10	.080	39659.69	.072	15537.74	.026	15119.96	.028
Dry House	13007.83	.021	11459.39	.019	6031.86	.010	4617.09	.008
General Surface Expense	22262.69	.037	20001.28	.036	12661.10	.021	1983.98	.004
Hoisting Equipment	11968.55	.019	10668.78	.019	8484.51	.014	8139.45	.015
Shaft	5504.37	.010	19033.31	.035	1234.10	.002	6202.75	.011
Top Tram Equipment	4106.76	.006	3923.94	.008	3662.72	.006	2993.76	.005
Docks, Trestles & Pckts.	4470.50	.008	17064.93	.032	4127.46	.007	13883.86	.025
Mine Buildings	10024.19	.017	9109.74	.017	7398.40	.012	4323.41	.008
Total Surface Costs	173436.13	.288	181641.92	.332	86783.03	.144	80504.59	.147
<u>General Mine Expenses</u>								
Use & Occupancy-Ins. Rec'd.	-	-	-	-	-	-	4670.54	.009
Geological	3076.99	.051	1349.75	.002	1064.69	.002	1734.24	.003
Mining Engineering	6322.77	.011	5764.82	.011	1374.73	.002	1509.09	.003
Mech. & Elec. Engr.	3102.30	.005	2761.42	.005	1014.22	.002	1413.90	.003
Analysis & Grading	26612.17	.004	26181.38	.048	3036.15	.005	3365.27	.006
Safety Department	3002.92	.005	2914.85	.005	992.00	.001	1177.08	.002
Tel. & Safety Devices	2534.72	.004	2115.41	.004	8058.62	.013	6294.60	.011
Local & Gen. Welfare	2807.07	.005	2737.58	.005	3331.55	.006	3355.05	.006
Spec. Exp. Pens. & All.	1781.06	.003	1751.93	.003	9641.93	.016	8109.99	.015
Ishpeming Office	21699.76	.036	20207.07	.037	18828.52	.031	13755.21	.025
Mine Office	28980.41	.048	27804.87	.051	569.07	-	4687.37	.009
Insurance	-	-	-	-	21561.99	.036	14515.73	.027
Personal Injury	1595.41	.002	1361.28	.002	33827.76	.056	52858.95	.097
Social Security Taxes	-	-	-	-	30532.92	.051	33274.13	.061
Employees Vacation Pay	57877.24	.096	54474.79	.100	-	-	-	-
Total Gen. Mine Exp.	159392.82	.265	149425.15	.273	138961.15	.231	141380.07	.259
Cost of Production	1605571.20	2.665	1443951.99	2.640	644240.34	1.069	581867.03	1.064
Taxes	-	-	-	-	196814.41	.327	181298.27	.332
Total Cost	1605571.20	2.665	1443951.99	2.640	841054.75	1.396	763165.30	1.396

65.7%

65.4%

34.3%

34.6%

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

The cost of production increased .03 over the 1947 cost. The wage increase of 9% which became effective July 16, 1948 added approximately \$136,000 of labor expense in 1948 compared to the year 1947. On the basis of 1947 conditions this might have been expected to increase the cost of the ore by .25 per ton. Supply costs were higher in 1948 because the price of supplies continued to rise. In spite of these factors the cost of production was kept practically the same in 1948 as in 1947. The increase in efficiency is the explanation of this situation.

In the following cost analysis only those categories will be discussed that show appreciable divergences in costs which are not attributable to either the general wage and supply price increases or the general efficiency increase.

Exploring In Mine

	<u>1948</u>	<u>1947</u>
Labor for Undg. Drilling	\$ 472.28	\$10,714.24
Prop. of D.D. Supt.'s Time	151.15	721.87
Bortz Loss	692.33	6,355.82
Pipe and Fittings	156.09	17.14
Drill Equipment & Repairs	33.38	560.14
Rental of Drill Equipment	-	987.50
Miscellaneous Supplies	40.26	216.72
Compressor Expense	125.00	800.00
Credit on Bortz Bits	508.70	2,287.18
Blank Bits, Shells & Corebarrels	-	320.01
Diamond Setters	-	63.10
Total	<u>1,161.79</u>	<u>18,469.36</u>
Geological Expense for Drill	84.41	883.50
Analysis Expense	25.12	93.38
Auto Mileage Expense	7.75	41.55
Total Underground Drilling Cost	<u>1,279.07</u>	<u>19,487.79</u>
Geological Dept. Exp. for Mine Mapping	<u>4,141.68</u>	<u>3,083.99</u>
Total as Per Cost Sheet	<u>\$5,420.75</u>	<u>\$22,571.78</u>
Feet drilled underground with bortz	266	4,865
Cost Per Foot	4.809	4.005

The drilling done in 1948 was the start of our campaign to explore old workings for ore reserves. This will be short hole drilling almost exclusively. The cost per foot shown in 1948 is not significant because much of this represents test work to determine the best drill to use.

The table below gives the footage and percentage of each type of material drilled during 1947 and 1948.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Exploring in Mine: (Cont'd)

	<u>1948</u>		<u>1947</u>	
Soft Ore Jasper			195'	4.0%
Ore	12'	4.5%	144'	3.0%
Dike	153'	57.5%	2,769'	56.9%
Slate			601'	12.4%
Cong. & Lean Ore	93'	35.0%	151'	3.1%
Quartzite			775'	15.9%
Siderite			101'	2.1%
Jasper	8'	3.0%	129'	2.6%
Total	266'	100.0%	4,865'	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 1948. This project should be carried on in order to determine ore possibilities in this area well in advance of the depletion of our known ore reserves.

Development in Rock

Comparative costs for the past five years are shown below:

Year	Footage	Labor Cost		Supply Cost		Total Cost	
		Total	Per Ft.	Total	Per Ft.	Total	Per Ft.
1948	3,068	57,440.20	18.72	18,409.42	6.00	75,849.62	24.72
1947	3,221	65,283.16	20.27	16,902.58	5.25	82,185.74	25.51
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

The cost per foot decreased nearly a dollar in spite of an increase in the supply cost. Labor cost dropped over \$1.50 per foot mainly due to the increased use of jumbo equipped crews for drifting and the introduction of Carset bits.

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

	<u>1948</u>	<u>1947</u>	<u>1946</u>	<u>1945</u>	<u>1944</u>
Rock Raises	618'	665'	550'	493'	1678'
10' x 10' Main Haulage Drifts	2450'	2556'	1176'	1304'	1533'
8' x 8' Main Haulage Drifts	-	-	147'	172'	603'
Total	3068'	3221'	1873'	1969'	3814'

The next table helps to explain unit cost per foot, because the type of material has a marked effect on costs. In spite of the fact that a higher proportion of the development was in the harder materials such as jasper and siderite, the unit cost decreased. As mentioned above, the use of Carset bits has helped reduce the cost.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Development in Rock: (Cont'd)

	<u>Jasper or Lean Ore</u>	<u>Siderite</u>	<u>Dike or Slate</u>	<u>Total</u>
Rock Raises	86'	389'	143'	618'
10' x 10' Rock Drifts	819'	602'	1029'	2450'
8' x 8' Rock Drifts	-	-	-	-
Total	<u>905'</u>	<u>991'</u>	<u>1172'</u>	<u>3068'</u>

Development in Ore and Stopping

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:

<u>Year</u>	<u>Labor Cost</u>	<u>Supply Cost</u>	<u>Total Cost</u>
1948	822,177.50	181,736.73	1,003,914.23
1947	701,751.06	131,870.95	833,622.01

The detailed cost for the two years are shown below:

	<u>1948</u>		<u>1947</u>	
	<u>Total</u>	<u>Cost Per Ton</u>	<u>Total</u>	<u>Cost Per Ton</u>
<u>Labor</u>				
Miner's Labor	403,718.13	.670	303,819.19	.556
Other Labor	418,459.37	.694	397,931.87	.728
Total	<u>822,177.50</u>	<u>1.364</u>	<u>701,751.06</u>	<u>1.284</u>
<u>Supplies</u>				
General	7,009.87	.012	5,926.03	.010
Iron and Steel	42,021.34	.070	20,454.55	.037
Oils	1,427.47	.002	1,025.51	.002
Machinery	19,123.75	.032	10,825.83	.020
Explosives	89,263.96	.148	77,301.65	.141
Lumber	2,192.67	.004	1,151.64	.002
Electric Power	10,562.03	.018	7,929.63	.015
Sundries & Clearing Acct.	1,407.84	.002	1,501.88	.003
Shop Expense Accounts	8,727.80	.015	5,754.23	.011
Total	<u>181,736.73</u>	<u>.302</u>	<u>131,870.95</u>	<u>.241</u>
Total Labor & Supplies	1,003,914.23	1.666	833,622.01	1.525
Tons Hoisted	602,453		546,796	

Effective May 15, 1948 we instituted a new system of incentive pay rates at the Cliffs Shaft Mine. Concomitant with this, was the steady increase in use of Carset bits and the increase in the number of miners by setting up double crews. On the average, we had 108.3 miners in 1948 compared to 91.2 in 1947. On the other hand, miner's helpers dropped from an average of 118 in 1947 to 107 in 1948. From a cost standpoint, this reduced the per ton cost of Other Labor and increased the per ton cost of Miner's Labor. The improvement in productivity however, offset

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Development in Ore and Stopping: (Cont'd)

this increased cost by reductions of the per ton cost in other categories where charges are more or less fixed. In effect, what we did was make it possible for the miners to earn more money for which we got enough more product to lower the unit cost for almost all other charges. The full effect of this trend should show up even better in 1949.

Pumping

Costs in this category dropped .005 per ton in 1948.

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

<u>Month</u>	<u>1948</u>	<u>1947</u>	<u>1946</u>	<u>1945</u>	<u>1944</u>
January	717	723	785	826	663
February	701	762	750	804	694
March	696	739	744	808	750
April	724	679	786	913	751
May	720	830	766	835	815
June	692	874	783	907	829
July	758	888	787	909	840
August	797	865	735	848	882
September	766	905	769	861	995
October	730	843	714	834	998
November	730	808	732	828	962
December	699	798	664	799	1033
Avg. For Year	726	808	758	846	831

Compressors, Air Pipes & Power Drills

Costs remained practically the same in 1948 compared to 1947. This is explainable, even though we bought more machines, by the preponderance of less expensive types of machines. The use of Carset bits permits the use of less expensive drilling equipment which effects a saving.

The variety of machines purchased as shown in the table below is premeditated and constitutes a part of our program to test for the most effective drilling combination.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

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

	<u>1948</u>	<u>1947</u>	<u>1946</u>	<u>1945</u>	<u>1944</u>
DA-35 Ingersoll-Rand Drifters	4	11	6	6	6
DA-35 Automatic Ingersoll-Rand Drifters	0	0	3	1	0
DA-30 " " " "	3	0	0	0	0
D-12 Cleveland Drifters	0	0	0	1	3
D-12 Automatic Cleveland Drifters	0	0	0	2	0
D-25 Cleveland Drifters	0	3	4	0	0
D-89 Gardner-Denver Drifters	1	3	1	1	1
D-89 Automatic Gardner-Denver Drifters	0	3	2	0	0
CF-79 " " " "	2	0	0	0	0
TM-300 Automatic Joy Drifters	2	0	0	0	0
Cleveland Stoper	0	1	0	0	0
IR-58 Ingersoll-Rand Stoper	0	3	5	0	1
IR-48 " " " "	2	0	0	0	0
HC-10-R LeRoi Reverse feed Stoper	1	0	0	0	0
JB-4 Ingersoll-Rand Jackhammers	14	15	0	0	2
J-10 " " " "	3	0	0	0	0
J-50 " " " "	7	0	0	0	0
H-111 LeRoi Sinkers	3	0	0	0	0
H-10 " " " "	1	0	0	0	0
LB-57 Joy Sinkers	1	0	0	0	0
S-55-W Gardner-Denver Sinkers	1	0	0	0	0
Total	<u>45</u>	<u>39</u>	<u>21</u>	<u>11</u>	<u>13</u>

Scrapers & Mechanical Loaders

The cost increased .03 in this category all because of the increase in labor. We increased the size of this crew to 7 men in order to get the work done on our hoists.

	<u>1948</u>		<u>1947</u>	
	<u>Amount</u>	<u>Cost</u>	<u>Amount</u>	<u>Cost</u>
3/8" Wire Rope	1,065 ¹	90.95	1,750 ¹	153.13
1/2" Wire Rope	4,115 ¹	539.55	3,340 ¹	347.61
5/8" Wire Rope	99,297 ¹	21563.67	81,212 ¹	14969.85
No. 2 & 4 Electric Cable	6,141 ¹	3912.43	7,808 ¹	4997.52
Scraper Blocks	230	8760.00	156	5526.87
Gen. Electrical Reprs. & Renew.	-	79515.11	-	58685.50
Loader Motors	-	-	2	1075.40
3-Drum Sullivan Scraper Hoist	-	-	1	2986.18
Balance on " " "	-	630.00	-	-
Total	<u>-</u>	<u>115011.71</u>	<u>-</u>	<u>88742.06</u>

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING: (Cont'd)

b. Comparative Mining Costs: (Cont'd)

Scrapers & Mechanical Loaders: (Cont'd)

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	Cost Per Ton	Feet Per Ton Ore
1948	602,453	"Trulay"	99,297'	21,563.67	.0358	.165
1947	546,796	"	81,212'	14,969.85	.0274	.149
1946	401,939	"	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

c. Comparative Mining Costs - Surface

Surface mining costs decreased .047 in the aggregate. For most categories in the surface costs there was a slight increase but the decreases in shaft maintenance and maintenance of docks, trestles and pockets more than offset the small increases in the other categories. Shaft costs compare as follows:

1948		1947	
Labor	Supplies	Labor	Supplies
5,504.37	1,234.10	19,033.31	6,202.75

The retrimbering of two levels in "B" Shaft and one level in "A" Shaft in 1947 accounts for the high cost in 1947.

Two new steel pockets erected in the shafthouses in 1947 was responsible for the high cost in that year. The year 1948 can be considered more nearly typical.

1948		1947	
Labor	Supplies	Labor	Supplies
4,470.50	4,127.46	17,064.93	13,883.86

9. EXPLORATIONS:

In May of 1948, tests were started on two makes of light diamond drills to determine the most effective machine for drilling short holes in the Cliffs Shaft Mine. A plan has been laid out for the systematic testing of floors and ribs of old workings starting in the upper levels and working down. Through this procedure we will know definitely what reserves there are adjacent to and in the old workings. We will also know the grade of these reserves.

By the end of the year this program was underway and we had drilled ten short holes in "A" Shaft on the 2nd and 3rd levels in the area between 700 S - 900 S and 700 E - 1000 E. The record of these holes is shown below in the table.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

9. EXPLORATIONS: (Cont'd)

D. D. Hole No.	<u>Footage Drilled</u>	<u>Feet Of Ore</u>
584	8	None
585	20	"
586	34	"
587	21	"
588	31	"
589	33	"
590	12	"
591	39	"
592	22	"
593	<u>46</u>	<u>12'</u>
Total	<u>266</u>	<u>12'</u> 4.5%

10. TAXES:

Comparative data for 1948 and 1947 follows:

	<u>1 9 4 8</u>		<u>1 9 4 7</u>	
	<u>Valuation</u>	<u>Taxes</u>	<u>Valuation</u>	<u>Taxes</u>
Realty	2,000,000	79,468.80	2,575,000	92,202.25
Minerals under NW $\frac{1}{4}$ of Sec. 9-47-27	80,000	3,178.75	160,000	5,729.07
Personal	846,100	33,619.28	621,100	22,239.54
Lot 2, Sec. 3-47-27 (Bancroft)	785,000	31,191.50	750,000	26,855.03
SE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Sec. 9-47-27 (Barnum)	57,000	2,264.86	57,000	2,040.98
Lot 174, Nelson's Addition	100	3.97	100	3.58
South 35.91 ft. of Lot 179	50	1.99	50	1.79
S $\frac{1}{2}$ of NW $\frac{1}{4}$ of Sec. 10-47-27	<u>1,185,000</u>	<u>47,085.26</u>	<u>900,000</u>	<u>32,226.03</u>
Total	<u>4,953,250</u>	<u>196,814.41</u>	<u>5,063,250</u>	<u>181,298.27</u>
Taxes per ton produced		.3267		.3315
Taxes per ton shipped		.3292		.3360

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

<u>Year</u>	<u>Taxes</u>	<u>Valuation</u>	<u>Tax Rate</u>
1948	196,814.41	4,953,250	39.7344
1947	181,298.27	5,063,250	35.8067
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

Valuations decreased \$110,000.00 but taxes increased \$15,516.14 compared to 1947 figures.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

10. TAXES: (Cont'd)

City of Ishpeming Tax Levy

Valuation	1948		1947	
	Amount	Rate	Amount	Rate
	13,361,175.00		12,691,075.00	
<u>Tax Levy by Funds</u>				
County Tax	110,229.69	8.25	92,010.29	7.250
County Road Tax	22,045.94	1.65	20,940.27	1.650
School Tax	121,586.69	9.1	77,415.56	6.100
School Debt Serv. Tax	9,812.50	.7344	10,237.50	.8067
Gen'l Optg. Debt Serv.	200,417.63	15.00	190,366.13	15.000
Capital Improvement	66,805.87	5.00	63,455.37	5.000
Total Taxes	530,898.32	39.7344	454,425.12	35.8067

The school tax rate raised 3 mills and the county tax one mill which accounts for the increase of 4 mills in the rate.

11. ACCIDENTS AND PERSONAL INJURY:

The accident record for the year is shown below:

	<u>Cliffs Shaft Mine</u>	<u>C. C. I. Co. Undg. Mines</u>	<u>C. C. I. Co. All Operations</u>
Tons of Ore Mined	602,453	4,651,805	8,607,271
Hours of Labor	1,061,617½	6,328,698	9,287,170¾
No. of Fatalities	-	3	3
No. of Compensable Accidents	15	125	145
No. of Non- " " "	18	232	270
Total Lost Time Accidents	33	360	418
No Lost Time Accidents	74	869	1208
Days Lost, Compensable Injuries	1072	4953	6126
Days Lost, Non- " " "	26	540	634
Total Days Lost	1098	31818	32526
Frequency Rate	31.09	56.88	45.01
Severity Rate	1.034	5.027	3.571

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 1947 or authorized during 1948:

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. Some work remains to be done under this E. & A. on the directing of the air flow but the fan is in and working. There is \$3,142.07 unexpended balance in the E. & A.

E. & A. No. CC-283

This covers the cost of a Chicago Pneumatic CP-55A - Diamond Drill, a JA-3016 Rod Puller and two VA-647 Water Swivels. This equipment is being used to explore our old workings for ore reserves.

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

14. MAINTENANCE
AND REPAIRS:

Dwellings

	<u>Labor</u>	<u>Supplies</u>	<u>Total</u>
Hard Ore Location	\$2,513.50	\$1,953.78	\$ 4,467.28
Barnum Location	195.55	13.33	208.88
Outhwaite Purchase	1,072.53	284.80	1,357.33
Hyde Purchase No. 1	446.28	160.19	606.47
Hyde Purchase No. 2	1,585.85	1,532.09	3,117.94
Smith Purchase	295.14	68.33	363.47
Nelson Purchase	94.18	11.33	105.51
Berg Purchase	538.78	536.90	1,075.68
Ramsdell Purchase	79.74	9.88	89.62
Grand Total	<u>\$6,821.55</u>	<u>\$4,570.63</u>	<u>\$11,392.18</u>

Comparative figures for the past six years follows:

Total for Year 1948	-	\$11,392.18
1947	-	18,505.26
1946	-	8,559.19
1945	-	10,772.98
1944	-	12,771.58
1943	-	18,006.43

15. POWER:

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

<u>Year</u>	<u>K. W. H.</u>	<u>Cost</u>	<u>Rate Per K.W.H.</u>
1948	8,422,715	117605.65	.01396446
1947	8,119,492	113591.74	.0139889
1946	5,824,429	83288.58	.014299
1945	7,097,196	102385.23	.014426
1944	7,800,360	111649.01	.014313

The detail of distribution of power at the mine follows:

	<u>K. W. H.</u>	<u>Cost</u>
Scraping Ore & Rock	809,830	11,308.84
Pumping	1,303,352	18,200.61
Hoisting	1,313,209	18,338.26
Stocking Ore	12,931	167.64
Crushing Ore	236,964	3,309.08
Dry House Expense	74,280	1,037.28
Surface	48,019	670.46
Telephone & Safety Devices	103,111	1,439.89
Mine Office	12,529	174.96
Machine & Carpenter Shops	3,788	52.90
Drill & Jackbit Shops	56,962	795.44
Heating Plants	14,419	201.36
Compressors	3,732,487	52,122.16
Electric Haulage	677,362	9,458.99
Ventilation	23,472	327.78
Total	<u>8,422,715</u>	<u>117,605.65</u>

CLIFFS SHAFT MINE
ANNUAL REPORT
YEAR 1948

15. POWER: (Cont'd)

Comparative data for 1948 and 1947 follows:

	<u>1948</u>	<u>1947</u>	<u>Difference</u>	<u>Inc.%</u>	<u>Dec.%</u>
Production - Tons	602,453	546,796	55,657	10.2	
	<u>K.W.H.</u>	<u>K.W.H.</u>			
Scraping Ore & Rock	809,830	619,136	190,694	30.8	
Pumping	1,303,352	1,572,876	269,524		17.1
Hoisting	1,313,209	1,280,410	32,799	2.5	
Stocking Ore	12,931	11,036	1,895	17.0	
Crushing Ore	236,964	216,581	20,383	9.4	
Dry House Expense	74,280	81,842	7,562		9.2
Surface	48,019	27,267	20,752	76.1	
Telephone & Safety Devices	103,111	79,570	23,541	29.6	
Mine Office	12,529	10,575	1,954	18.5	
Machine & Carpenter Shops	3,788	4,042	254		6.3
Drill Shop	56,962	52,204	4,758	9.1	
Heating Plants	14,419	11,565	2,854	24.6	
Compressors	3,732,487	3,527,888	204,599	5.8	
Electric Haulage	677,362	609,571	67,791	11.1	
Ventilation	23,472	14,929	8,543	57.2	
Total	<u>8,422,715</u>	<u>8,119,492</u>	<u>303,223</u>	<u>3.7</u>	

HVA - 5 1948

LLOYD MINE
ANNUAL REPORT
YEAR 1948

1. GENERAL

The production was 98,284 tons compared with 253,976 tons in the previous year. The large decrease in production is due to operations being confined mostly on development of the 9th Level during the year. The small reserves above the 8th Level were depleted in the first half of the year and the new level did not reach a production basis until late in the year. As new ore areas were developed from the 9th Level and the underground operation expanded, the labor force was increased 15% compared with the size of the force at the beginning of the year. A working schedule of two shifts hoisting and three shifts mining for six days per week was in effect until the last week in November when hoisting was also placed on a three shift schedule.

Shipments from the mine exceeded production and totalled 164,155 tons. The bulk of the shipments again was Silica grade and amounted to approximately 70% of the total tonnage. The large shipments of Silica grade in the last two years has reduced the stockpile inventory of this grade to the smallest in many years. All the Lloydale grade in stockpile was loaded out before the close of the shipping season and only a very small overrun was realized. The stockpile inventory at the close of the year showed 22,006 tons of Lloydale grade and 6,160 tons of Silica grade on hand.

Late in the year some diamond drilling was done from the 9th Level into the area southwest of the main deposit. One hole was drilled but no ore was encountered and the program was temporarily abandoned. It is planned to drill at least one additional hole to the south of the main orebody from the 8th Level to explore a structure developed by mining and drilling on upper levels. There is no large exploration program planned at the present time and the drilling that is being done is with the hope that sufficient new ore can be discovered in one of the structures south of the main orebody to warrant development for mining.

Development of the 9th Level under E & A cc-159 has been underway throughout the year. The winze from the 8th to the 9th Levels was completed to a depth of 164' early in January. A major part of this development was in rock and it comprised a plat excavation to the east and west of the winze and a footwall drift along the north side of the orebody from which two crosscuts were driven branching to the south. Each of the crosscuts was driven into the sulphurous orebody south of the dike proving a larger area of this grade on the 9th Level than anticipated. The sulphur appears to be very spotty in this orebody but in general the sulphur content increases in depth from a standard ore on the 8th Level to an ore with about .405% sulphur on the 9th Level. By mixing the product from this deposit with the main deposit ore a grade with a sulphur content approximating .150% can be produced and operations in the coming year will be conducted on this basis.

At the close of the year development of the 9th Level had progressed so that production was being realized from two caving operations in the main orebody and two stopes in the sulphurous deposit. A small production was realized from several areas above the 8th Level during the first half of the year and upon depleting the mineable ore, operations were concentrated on the 9th Level.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

1. GENERAL (Cont.)

Effective July 16 a wage increase was granted hourly paid labor ranging from a minimum of 9½¢ to a maximum of 17¢ per hour. In addition to the six regular holidays that were observed during the year a one week vacation was allowed eligible employees during the week of August 9 and there was no production during this period.

2. PRODUCTION, SHIPMENTS AND INVENTORIES

a. Production by Grades

<u>Grade</u>	<u>Tons</u>	<u>Percent</u>
Lloyddale	72,071	73.3
Lloyd Silica	26,213	26.7
	<u>98,284</u>	<u>100.0</u>

Most of the Lloyddale grade was produced in the ore development on the 9th Level and nearly all the Silica grade was obtained from the last scam operations on the 8th Level.

b. Shipments

Shipments exceeded production by a large margin due to the substantial tonnage of Silica grade shipped from the stockpile. The small production and heavy stockpile shipments has reduced the inventory of this grade considerably but there is an estimated 26,712 tons of overrun that will be realized when the stockpile has been cleaned up. The small tonnage of Lloyddale grade in stockpile was all shipped and a disappointingly small overrun was realized.

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

<u>Year</u>	<u>Lloyddale</u>	<u>Silica</u>	<u>Total</u>
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
1947	145,480	272,632	418,112
1948	55,767	108,388	164,155

c. Stockpile Inventories

<u>Grade</u>	<u>Tons</u>
Lloyddale	22,006
Lloyd Silica	6,160
<u>Total</u>	<u>28,166</u>

The ore on hand at the end of the year is the smallest inventory in many years although this figure does not include the tonnage of estimated overrun of Silica grade.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

2. PRODUCTION, SHIPMENTS AND INVENTORIES (Cont.)

d. Division of Product by Levels

	<u>Lloydale</u> <u>Tons</u>	<u>Lloyd Silica</u> <u>Tons</u>	<u>Total</u> <u>Tons</u>
Eighth Level	20,378	20,709	41,087
Ninth Level	51,852	5,345	57,197
Total	72,230	26,054	98,284

Mining was completed above the 8th Level in 1948 and the product in 1949 will be obtained entirely from the 9th Level.

e. Production by Months

<u>Month</u>	<u>Days</u>	<u>Lloydale</u>	<u>Lloyd Silica</u>	<u>Total</u>	<u>Rock</u> <u>Tons</u>	<u>Tons Per</u>
		<u>Ore</u> <u>Tons</u>	<u>Ore</u> <u>Tons</u>	<u>Ore</u> <u>Tons</u>		<u>Man Per</u> <u>Day</u>
January	26	4,321	1,237	5,558	3,758	3.16
February	24	3,482	5,597	9,079	3,501	5.41
March	27	3,093	4,001	7,094	5,807	4.32
April	26	3,938	1,324	5,262	3,879	3.35
May	25	2,997	3,562	6,559	4,628	4.39
June	26	3,734	301	4,035	4,771	3.10
July	26	3,490	4,352	7,842	1,804	3.32
August	20	2,553	981	3,534	1,413	1.84
September	24	7,105	176	7,281	495	3.93
October	26	9,069	447	9,516	163	3.01
November	25	13,085	808	13,893	28	4.57
December	26	15,186	3,427	18,613	159	6.93
Total	301	72,053	26,213	98,266	30,406	3.92
Transfers		159	159			
		72,212	26,054	98,266	30,406	3.92
Current Year Stockpile						
Overrun		18		18		
Grand Total		72,230	26,054	98,284	30,406	

f. Ore Statement

	<u>Lloydale</u> <u>Tons</u>	<u>Lloyd Silica</u> <u>Tons</u>	<u>Total</u> <u>Tons</u>	<u>Total</u> <u>Last</u> <u>Year</u>
On Hand January 1, 1948	5,543	88,494	94,037	258,173
Output for Year	72,053	26,213	98,266	253,569
Transfers	159	159		
Overruns	18		18	407
Total	77,773	114,548	192,321	512,149
Shipments	55,767	108,388	164,155	418,112
Balance on Hand	22,006	6,160	28,166	94,037
Decrease in Output			155,692	
Decrease in Shipments			253,957	
Decrease in Ore on Hand			65,871	

LLOYD MINE
ANNUAL REPORT
YEAR 1948

2. PRODUCTION, SHIPMENTS AND INVENTORIES (Cont.)

f. Ore Statement (Cont.)

The operating schedule for the past five years follows:

- 1944 - 3-8 hr. shifts 5-1/3 days per week January 1 to July 1, 1944. Effective July 1, three shifts per day, 5 days per week, and effective October 30, hoisting on two shift schedule.
- 1945 - 2-8 hr. shifts hoisting and 3-8 hr. shifts mining, 5 days per week, January 1 to January 27. Effective January 27, 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.
- 1947 - Hoisting operations 2-8 hr. shifts per day, 6 days per week and mining 3-8 hr. shifts per day 6 days per week, January 1 to March. Effective March 1, hoisting and mining operations 2-8 hr. shifts per day, 6 days per week.
- 1948 - Hoisting operations 2-8 hr. shifts and mining 3-8 hr. shifts, 6 days per week, January 1 to November 29. Effective November 29, hoisting and mining 3-8 hr. shifts, 6 days per week.

g. Delays

There was one delay to operations that interrupted development work on the 9th Level. On the afternoon shift, June 7th, the hoisting engineer at the winze raised the counterweight bucket against the head sheave damaging the sheave and causing the rope to break. The bucket dropped about 180' to the bottom of the winze breaking the bottom set of shaft timber. In addition to repairs to the shaft timber it became necessary to install a new head sheave and make a new counterweight bucket before operations could be resumed. Development on the new level was delayed 48 hours by this breakdown.

3. ANALYSIS

a. Average Mine Analysis on Output

	<u>Grade</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Silica</u>
	Lloyddale	72,071	60.75	.149	5.71
	Lloyd Silica	26,213	51.31	.132	17.30
		98,284			

b. Analysis of Ore in Stock December 31, 1948

	<u>Grade</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>	<u>Moist.</u>
	Lloyddale Dried	22,006	60.95	.140	6.12	.250	2.21	.86	.57	.052	3.17	
	Lloyddale Nat'l.		54.40	.125	5.46	.220	1.97	.77	.51	.046	2.83	10.74
	Lloyd Sil. Dried	6,160	53.42	.132	16.75	.179	2.24	.47	.37	.019	3.22	
	Lloyd Sil. Nat'l.		47.67	.118	14.95	.160	2.00	.42	.33	.017	2.87	10.77

LLOYD MINE
ANNUAL REPORT
YEAR 1948

3. ANALYSIS (Cont.)

c. Complete Analysis of Ores Shipped

<u>Grade</u>	<u>Tons</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>
Lloyddale	55,767	60.50	.168	5.70	.25	2.21	.86	.57	.095	3.57
Lloyd Silica	108,388	52.20	.122	18.55	.18	2.24	.47	.37	.011	3.22

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, 1948 using a factor of 12 cubic feet per ton.

	<u>Standard Ore</u>		<u>Sulphurous Ore</u>	<u>Total Tons</u>
	<u>No. 1 Deposit</u>	<u>No. 2 Deposit</u>	<u>No. 2 Deposit</u>	
Above 8th Level	29,342	-	-	29,342
Between 8th and 9th Levels	317,199	86,029	177,468	580,696
Total Gross as of Nov. 30, 1948	346,541	86,029	177,468	610,038
Less December, 1948 Production	6,228	8,958	-	15,186
Total Gross as of Dec. 31, 1948	340,313	77,071	177,468	594,852
Less 10% for Mining and Rock	34,654	8,603	17,747	61,004
Net Total as of Dec. 31, 1948	305,659	68,468	159,721	533,848

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

	<u>1946</u>	<u>1947</u>	<u>1948</u>
Reserves on January 1	846,119	354,156	341,211
Production	175,280	131,354	72,071
Balance	670,839	222,802	269,140
Reserves on December 31	354,156	341,211	533,848
New Ore Developed	316,683	118,409	264,708

The increase in reserves is due to the 9th Level proving a larger area of sulphurous ore than anticipated and also because the reserves in this deposit have been estimated to the 9th Level. In the previous year the reserves in the latter deposit were estimated to an arbitrary lower limit 90' above the 9th Level because the ore below this elevation was assumed to be too high in sulphur content to be merchantable. On the basis of drill holes the reserves in this deposit have been divided in the estimate into standard and sulphurous grades. However, the spotty nature of the sulphur as proven by subsequent development makes it impractical to attempt a separation of these grades in the mining without seriously affecting production. In the coming year the product will consist of two grades similarly as in the past although the output will carry a higher sulphur content.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

4. ESTIMATE OF ORE RESERVES (Cont.)

a. Developed Ore (Cont.)

The No. 1 Deposit or main orebody, as outlined by the 9th Level development, is approximately the same size as assumed last year for estimating purposes. At the west end a more favorable width was found than expected but the length along the strike was considerably less than assumed. The proven ore between the 8th and 9th Levels shows a favorable increase over the previous estimate although the reserves are higher in sulphur than in former years.

b. Estimated Analysis of Ore Reserves

<u>Grade</u>	<u>Iron</u>	<u>Phos.</u>	<u>Sil.</u>	<u>Mang.</u>	<u>Alum</u>	<u>Lime</u>	<u>Mag.</u>	<u>Sul.</u>	<u>Loss</u>	<u>Moist.</u>
Lloyddale Dried	59.00	.180	7.50	.247	2.55	.87	.57	.149	3.57	
Lloyddale Nat'l.	52.51	.160	6.68	.220	2.27	.77	.51	.133	3.18	11.00

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

5. LABOR AND WAGES

a. General

Employee membership in the union has remained at practically 100% but, despite this union strength, relations have been on a satisfactory basis. Evidence of a generally good attitude among the employees is reflected in the small number of complaints that have been submitted. These, in each case, were minor in nature and were settled in Step 1 or 2 of the grievance procedure.

After the middle of the year as development on the 9th Level expanded the labor force was increased. The number of men on the payroll at the end of the year was 137 compared with 119 a year ago. There were 17 men transferred to other mines, 3 were laid off, 5 were retired, 6 quit and 2 died. A total of 34 men were hired and 17 were transfers from other mines making a net increase of 18 men on the payroll.

The wage increase that was granted effective July 16 ranged from 9½¢ to 11½¢ per hour for most classifications and increases to a maximum of 17¢ per hour were granted in several more specialized classifications.

b. Comparative Statement of Wages & Product

	<u>1 9 4 8</u>	<u>1 9 4 7</u>	<u>Incr.</u>	<u>Decr.</u>
Product	98,284	253,976		155,692
No. of Shifts & Hours				
Jan. 1 to Nov. 29		2-8 Hr. Hoisting (6 Days Per Week)		
		3-8 Hr. Mining (6 Days Per Week)		
Nov. 29 to Dec. 31		3-8 Hr. Hoisting (6 Days Per Week)		
		3-8 Hr. Mining (6 Days Per Week)		

LLOYD MINE
ANNUAL REPORT
YEAR 1948

5. LABOR AND WAGES (Cont.)

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

<u>Average Number of Men Working</u>	<u>1 9 4 8</u>	<u>1 9 4 7</u>	<u>Incr.</u>	<u>Decr.</u>
Surface	30 $\frac{1}{4}$	34 $\frac{1}{2}$		4 $\frac{1}{4}$
Underground	78 $\frac{1}{2}$	96 $\frac{1}{2}$		18
Total	108 $\frac{3}{4}$	131		22 $\frac{1}{4}$
<u>Average Wages Per Day</u>				
Surface	11.09	10.32	.77	
Underground	13.02	11.86	1.16	
Total	12.30	11.40	.90	

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

<u>Year</u>	<u>Surface</u>	<u>Underground</u>
1944	7.06	7.99
1945	7.63	8.86
1946	9.31	10.46
1947	10.32	11.86
1948	11.09	13.02

<u>Wages Per Month of 24 Days</u>	<u>1 9 4 8</u>	<u>1 9 4 7</u>	<u>Incr.</u>	<u>Decr.</u>
Surface	266.16	247.68	18.48	
Underground	312.48	284.64	27.84	
Total	295.20	273.60	21.60	

<u>Wages Per Month of 22 Days</u>				
Surface	243.98	227.04	16.94	
Underground	286.44	260.92	25.52	
Total	270.60	250.80	19.80	

<u>Product Per Man Per Day</u>				
Surface	10.47	23.16		12.69
Underground	6.27	9.90		3.63
Total	3.92	6.93		3.01

<u>Labor Cost Per Ton</u>				
Surface	1.059	.446	.613	
Underground	2.075	1.197	.878	
Total	3.134	1.643	1.491	

<u>Average Product Stopping</u>	26.25	40.86		14.61
---------------------------------	-------	-------	--	-------

<u>Average Wages Contract Miners</u>	13.76	13.61	.15	
--------------------------------------	-------	-------	-----	--

LLOYD MINE
ANNUAL REPORT
YEAR 1948

5. LABOR AND WAGES (Cont.)

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

<u>Total Number of Days</u>	<u>1 9 4 8</u>	<u>1 9 4 7</u>	<u>Incr.</u>	<u>Decr.</u>
Surface	9,385 $\frac{1}{2}$	10,963 $\frac{1}{4}$		1,577 $\frac{3}{4}$
Underground	15,664 $\frac{1}{4}$	25,651		9,986 $\frac{3}{4}$
Total	25,049 $\frac{3}{4}$	36,614 $\frac{1}{4}$		11,564 $\frac{1}{2}$
<u>Amount of Labor</u>				
Surface	104,110.01	113,188.60		9,078.59
Underground	203,970.72	304,150.18		100,179.46
Total	308,080.73	417,338.78		109,258.05

Proportion of Surface to Underground Men

1944 - 1 to 3.24
1945 - 1 to 2.88
1946 - 1 to 3.59
1947 - 1 to 2.80
1948 - 1 to 2.60

6. SURFACE

a. Buildings

There were no new buildings constructed or additions erected to existing buildings. Very little repairs have been required to maintain the buildings in good condition.

All of the wood trim and window sash on the engine house was painted and the composition roof was given a coat of asphalt to insure longer life.

Some minor changes were made to the roof over the small extension for the blacksmith shop on the east side of the shop building. A gable roof was constructed to replace the shanty type roof.

Some changes were made to the doorway on the garage that houses the truck and tractor. One set of doors was widened to allow more clearance for passage of the new mine truck.

b. Stocking Grounds

All the Silica grade that was in stockpile in the area to the east of the shaft was cleaned out and approximately 50% of the pile of this grade to the north of the shaft was also shipped. A relatively small tonnage of Silica grade remains in stockpile to the west of the shaft but no loading was done from this pile in 1948.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

6. SURFACE (Cont.)

b. Stocking Grounds (Cont.)

The small amount of Lloydale grade that was stocked in the area to the east of the shaft was also cleaned out early in the season. Two parallel trestles were re-erected in this area for stocking both Lloydale and Silica grades. The latter grade is stocked at the shaft end of both trestles and the Lloydale grade at the east end. A total of 39 bents of trestle were erected to provide stocking capacity during the winter months.

A Bucyrus 54B electric shovel was transferred from the Negaunee Mine to replace the old steam shovels that were used for many years for stockpile loading. This shovel is much faster in operation than the steam shovel and the mobility of the shovel makes it possible to do all the stockpile loading with one unit compared with two of the steam shovel type.

Three additional bents were erected to extend the rock trestle further to the south of the shaft. A large portion of this pile has been bulldozed into the adjacent cave to save erection of more trestle.

c. Roads

There was no new road construction around the surface plant. During the summer months the existing roads were graded occasionally with the tractor to maintain them in good condition.

7. UNDERGROUND

a. Shaft Sinking

In the first week of January the winze from the 8th to 9th Levels was sunk an additional 3' to complete it to a depth of 164'. After the winze was completed and the initial opening excavated at the bottom to enable crews to start drifting, the cage and counterweight were installed. The counterweight is comprised of a bucket that runs on guides similar to the cage and it is loaded with the proper weight so the hoist operates in balance.

After the winze hoist had been in operation for several months hoisting rock from the development program, it became apparent that the slow speed of the hoist would be a factor limiting production from the 9th Level. Late in the year a change in the size of the gearing was made increasing the speed from 157' to 313' per minute.

b. Development

The development program was confined almost entirely to the 9th Level and a large part of this work was in rock. The portion of this development that was confined to the main level was under E & A cc-159 and the ore development above the level was charged to operating.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

b. Development under E & A cc-159

After completing the winze to the 9th Level in the footwall west of the orebody a plat was excavated in rock to the east and west of the winze for a total distance of 300'. Sufficient width was excavated to enable installation of a double track lay-out in both directions. A footwall drift was then advanced east 720' and two crosscuts were driven from this drift branching to the south. The most westerly crosscut was driven through the orebody where a width of 70' of ore was proven and the crosscut was continued further south through the dike into the slate footwall. A small amount of ore was also penetrated on the south side of the dike proving a further westerly extent to the sulphurous deposit than expected. The most easterly crosscut encountered no ore north of the dike indicating a much shorter length to the main deposit than was hoped but upon penetrating the dike the crosscut entered high sulphur ore and proved 130' of this grade before the slate footwall was reached. The level development has proved a larger area of sulphur ore than expected but the size of the main orebody was disappointing because of the short length along the strike.

In addition to the main level drifting a raise was put up from the end of the most westerly crosscut in the south footwall to the 8th Level for ventilation purposes. A small pump house was also excavated along the north side of the footwall drift at the east end of the plat and a sump drift 130' in length was driven at an elevation of 12' below the level.

In the footwall slate west of the orebody on the 8th Level 350' of rock drift was advanced to the southeast starting near the old powder house as part of the ventilation connection between the 8th and 9th Levels. As previously mentioned, a raise was put up in the footwall from the 9th Level to hole to the end of this drift. Additional development for ventilation on the 8th Level consisted of putting up No. 803 Raise from the south side of the main haulage drift to a height of 30' above the level and 140' of small drift was advanced at this elevation northwest to hole to No. 801 Raise. The rock development on the 8th Level and above was done to provide permanent connections for ventilation that will serve for the remaining life of the mine.

The development excluding the work under E & A cc-159 was also confined mostly to the 9th Level. After the main level drifting was completed, ore development for sub caving was conducted in the main orebody and the sulphurous deposit was developed for sub level stoping.

In the main orebody two raises, No's 910A and 910B, were put up from the most westerly crosscut to a vertical height of 117' above the 9th Level. Two raises were also put up into the main orebody from the east crosscut, No. 921 from the west side and No. 922 on the east side, and each of these was advanced to a height of 117' vertically above the level. Two sub caving areas were developed in the east half of the orebody from the latter raises on the 145' Sub Level. After a connecting drift 90' in length was driven between the raises a scraping drift was advanced 140' to the east from No. 922 Raise to the ore limits at this end of the deposit. A scraping drift was also driven to the west of No. 921 Raise for a distance of 140' to reach a point about midway in the orebody. The development above the scraping drifts in each case consisted of putting up numerous mills to a height of 20' and then connecting the mills to complete the development for caving a block of ore that extends to a height of 50' above the drift.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

b. Development (Cont.)

In the west half of the deposit scraping drifts were advanced for a distance of 100' to the west of No. 910B Raise to the ore limits and to the east of No. 910A Raise for a distance of 135'. The balance of the development here also consisted of putting up numerous mills and connecting them at a height of 20' above the drift to complete the development for caving the pillar above.

In the sulphurous deposit development was conducted for three separate stopes. The transfer drifts for the stopes were driven from loading slides constructed directly over both crosscuts. At the west end of the orebody a transfer 170' in length was advanced to the southeast to connect with the end of the transfer that was driven to the west from a loading slide constructed over the east crosscut. A third transfer was advanced from the loading slide over the east crosscut to the northeast to the ore limits in this direction. The balance of the development for each stope consisted of putting up numerous mills to a height of 25' above the transfer and driving two of the mills located at the ends of each stope to a height of 100' and then connecting the mills with intermediate sub drifts at 25' intervals. The development for sub level stoping was completed for the stopes at the east and west end so that mining could be started in these areas before the close of the year. The development for the stope in the center of the orebody was still underway at the close of the year.

Some ore development was also done on the 8th Level in the first half of the year before mining was completed at this elevation. The development consisted of driving a short scraping drift for one caving operation and two short transfer drifts were driven for scam stopes. Near the center of the orebody a scraping drift 110' in length was advanced in ore along the north side of the old haulage drift to recover a small pillar directly above by caving. To the east of this area a transfer 50' in length was advanced and two mills put up and connected at an elevation of 20' above as development for a small scam stope. At the west end of the orebody another scam stope was developed and a transfer drift 70' in length was advanced to the southeast from a loading slide and numerous mills were put up and connected at an elevation of 20' above the transfer.

c. Stoping

Caving and stoping methods have been employed exclusively. While development on the 9th Level was underway mining was continued from the 8th Level recovering small pillars directly above the level by scam stope and caving operations. At the beginning of the year mining operations had reached within 20' of the level elevation and recovery of the remaining reserves down to the level elevation was accomplished by conducting operations directly from the old haulage drift and crosscuts.

81

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

In the main deposit sub level stoping cannot be conducted satisfactory on a large scale because the diabase dike on the south side caves readily. Sub caving has proven a good substitute method and during the past two years various sub level intervals have been tried and a maximum of 50' has been caved with good results. The first sub above the 9th Level has been developed for caving a pillar of this height that extends to the floor of the 8th Level. In addition to the larger tonnage that can be recovered above the scraping drifts the 50' interval permits better use of the deep hole method of drilling and blasting.

The sulphurous deposit south of the dike is being developed entirely for sub stoping and the method was employed in this deposit above the 8th Level also.

Due to operations being concentrated mostly on development, mining was conducted on fewer sub levels than last year. There were six sub levels on which some mining was done and at the end of the year there were seven contracts employed compared with five a year ago. During a period of five months only one contract was on production and the balance of the contracts were on ore and rock development.

The following is a detailed description of the mining operations:

Subs above the 8th Level
210' Sub Level

Two contracts done a small amount of mining on this sub in the central part of the orebody. A slice was advanced east of No. 811 Raise following along the footwall and a small pillar that extended to the sub level above was recovered by caving. A slice drift was also advanced to the east of No. 808 Raise following the footwall jasper and a small pillar overlying the drift was recovered by caving. At the east end of the deposit an area 270' x 35' was recovered by caving that was conducted directly from the 8th Level. Near the west end of the orebody an area 90' x 35' was also recovered by caving that was conducted from the 8th Level.

8th Level

Three contracts conducted stoping and caving operations directly from the 8th Level in the first half of the year. At the east end of the orebody a loading slide was constructed in the old haulage drift and a caving operation was developed using a portion of the old haulage drift as a transfer. In addition to recovering the pillar directly above the drift the pillars lying along the north and south sides of the drift were also mined. In the central part of the orebody another caving area was developed from a scraping drift that was advanced to the east from the north crosscut. After recovering the pillar directly above, ore lying along the north and south sides of the scraping drift was mined. Directly west of this area a small scam stope was developed and an area about 45' x 20' was mined along the north footwall side. Another scam stope was developed near the west end of the orebody and in addition to recovering a small pillar directly above the level an area 65' x 35' was mined to recover the ore lying on each side of the transfer drift.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

Subs above the 9th Level
170' Sub Level

This is the top elevation of mining above the 9th Level and four caving areas were being developed on this sub in the main orebody. At the west end an area 60' x 75' was mined by caving above the scraping drift advanced to the west from No. 910B Raise on the sub level below. In the center of the deposit an area 40' x 50' was mined by caving directly above a scraping drift advanced to the east of No. 910A Raise. Adjoining this area on the east side another caving area was in the initial stages of mining and an area 15' x 15' was mined. At the east end the fourth caving operation was started at the close of the year and an area 40' x 20' was mined retreating west.

After caving in each of the areas had extended to the 8th Level water that drains from the old working above was encountered. This hindered the initial mining considerably but some improvement was realized after a drainage raise was driven at the extreme east end to the 8th Level to intercept and control the water that originates at this end of the orebody.

145' Sub Level

Most of the work on this sub in the main orebody was development for sub caving and it consisted of driving scraping drifts along the strike of the orebody to the limits of the block that will be caved. At the west end of the deposit mining was nearing completion above the scraping drift that was driven to the west to the ore limits from No. 910B Raise. As recovery of the pillar above the drift progressed, ore lying on each side of the scraping drift was also recovered. In the central part of the deposit ore lying along the north and south sides of the scraping drift that was driven to the east of No. 910A Raise was also recovered as mining retreated west.

In the sulphurous deposit a small amount of mining was done on this sub in two stopes. At the east end a small triangular shaped area was mined starting in the crotch that defines the east limits of the orebody. This is the top elevation of mining in each of the stopes and ore is being recovered to a height of approximately 30' above this elevation to reach within 25' of the 8th Level. A floor pillar is being left in the back of the stope to prevent a cave to the old workings on the 8th Level and above.

Two small areas were also mined on this sub in the center of the deposit while developing the initial opening for the most easterly and central stopes. Mining in the east stope has exposed the jasper hanging and slate footwall proving a width of only 25' of ore.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

c. Stoping (Cont.)

Subs above the 9th Level (Cont.)

120' Sub Level

A small amount of mining was done in each of the stopes in the sulphurous deposit on this sub also. At the east end an area 35' x 25' was mined in the crotch that forms the east limits of the deposit. In the central part of the orebody similarly as on the subs above two small separate areas were mined. An area 30' x 30' was mined in the most easterly stope to complete the initial opening to the full width of the ore. The most westerly mill for the center stope was enlarged to about 15' in diameter during the early stages of getting this stope into production.

95' Sub Level

A small amount of mining was done in each of the stopes in the sulphurous deposit on this sub also. At the east end an area 40' x 25' was mined starting at the east limits of the ore and retreating south. In the central part of the orebody two separate areas were again mined enlarging the most easterly mill for the stope at the west end to about 10' x 20' and the most westerly mill for the central stope to about 15' in diameter. The latter two stopes were in the early stages of mining at the close of the year and in each case all of the stope development had not been completed.

70' Sub Level

In the sulphurous deposit the work on this sub consisted almost entirely of development for the stopes. After the development in each area had advanced far enough so that mining could be started the mill raise that was put up in each case at block limits of the ore that will be stoped was enlarged starting from the lower subs and progressing to the top of the ore. On this sub the mining consisted only of enlarging the mill for each of the stopes to about 15' in diameter. This is the lowest elevation at which mining was conducted between the 9th and 8th Levels.

d. Timbering

The amount of timber, poles and lagging consumed was considerably less than last year due to the small production and the fact that operations were confined mostly on development work. The absence of a large timber repair program together with the wide use of caving and stoping methods is also reflected in the smaller consumption of these materials. There were substantial increases again in the price of timber supplies and this together with the small production accounts for the higher cost per ton for all timber.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

d. Timbering (Cont.)

In the first several months of the year some timber repair work was conducted on the 8th Level. Heavy crushing conditions were experienced in spots in the haulage drift due to mining approaching the level elevation and to maintain tramming for the last scam operations some timber repair work was required. After mining was completed on the 8th Level no major timber repairs were required other than occasional repairs in the ventilation drifts and raises. The 9th Level development excepting that portion in ore was in a hard slate formation that holds up well and required very little timber support. Since sub caving has come into use more extensively it has become advisable to use more of the large size timber. The timber used in the scraping drifts that are driven for each caving operation must withstand considerable crushing action and to get the best results it became necessary to revise the specifications on timber size to a minimum of 10" diameter. Steel sets made from 4" H-Beams have been used in small amounts in the main airways in rock wherever support is needed.

In several raises put up from the 9th Level some hardwood cribbing was used where resistance to abrasion is the factor that determines the life of the cribbing. In addition to lining the raises with hardwood plank after some wear has taken place, steel strap wearing plates will also be installed to insure longer life and minimize repair work.

The following is a comparative timber statement for the past two years:

	<u>Lineal</u> <u>Feet</u>	<u>Avg. Price</u> <u>Per Foot</u>	<u>Amount</u> <u>1948</u>	<u>Amount</u> <u>1947</u>
6" to 8" Cribbing Timber	7,467	.0799	596.88	597.30
8" to 10" Stull Timber	7,749	.1192	923.79	1018.35
10" to 12" " "	7,254	.1703	1235.61	2410.70
12" to 14" " "	<u>4,914</u>	<u>.2344</u>	<u>1152.18</u>	<u>1452.36</u>
Total Timber 1948	27,384	.1427	3908.46	
Total Timber 1947	41,624	.1318		5478.71
	<u>Per 100 Feet</u>			
7' Lagging	202,314	1.76	3552.10	4890.58
9½' Poles	<u>61,326</u>	<u>2.64</u>	<u>1618.44</u>	<u>1922.56</u>
Total Lagging & Poles	263,640	1.96	5170.54	6813.14
Product - Tons			98,284	253,976
Feet of Timber per Ton of Ore			.279	.164
Feet of Lagging per Ton of Ore			2.058	1.294
Feet of Lagging per Foot of Timber			7.388	7.898
Cost per Ton for Timber			.0398	.0216
Cost per Ton for Lagging			.0361	.0192
Cost per Ton for Poles			<u>.0165</u>	<u>.0076</u>
Cost per Ton for all Timber			<u>.0924</u>	<u>.0484</u>
Equivalent Stull Timber to Board Measure			50,352	91,862
Feet of Board Measure per Ton of Ore			.5123	.3617

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

d. Timbering (Cont.)

The following table shows a comparison of total cost of timbering for the past five years:

<u>Year</u>	<u>Amount</u>	<u>Cost Per Ton</u>
1944	44,893.17	.1192
1945	37,553.85	.1150
1946	23,571.68	.0951
1947	12,291.85	.0484
1948	9,079.00	.0924

e. Drifting and Raising

The total development footage is far in excess of the footage driven in the previous year. Nearly all of the drifting and raising was in connection with development of the 9th Level and a large part of this work was done under E & A cc-159. The main level development comprised the major part of the program although there was a slightly larger total footage of ore development driven for the stopes and caving areas above the level.

<u>Year</u>	<u>Development Footage Under E & A cc-159</u>						<u>Grand Total</u>
	<u>Drifting</u>			<u>Raising</u>			
	<u>Ore</u>	<u>Rock</u>	<u>Total</u>	<u>Ore</u>	<u>Rock</u>	<u>Total</u>	
1948	341'	2352'	2693'	74'	317'	391'	3084'
1947	-	195'	195'	-	51'	51'	246'

<u>Year</u>	<u>Development Above the 9th Level</u>						<u>Grand Total</u>
	<u>Drifting</u>			<u>Raising</u>			
	<u>Ore</u>	<u>Rock</u>	<u>Total</u>	<u>Ore</u>	<u>Rock</u>	<u>Total</u>	
1948	2865'	-	2865'	2318'	65'	2383'	5248'
1947	2826'	30'	2856'	1430'	52'	1482'	4338'

The following table shows a comparison of the development footage excluding the footage classified under small drift and raise:

<u>Year</u>	<u>Drifting</u>			<u>Raising</u>			<u>Grand Total</u>
	<u>Ore</u>	<u>Rock</u>	<u>Total</u>	<u>Ore</u>	<u>Rock</u>	<u>Total</u>	
	1948	991'	-	991'	354'	52'		406'	1397'
1947	1581'	30'	1611'	-	-	-	1611'

f. Explosives, Drilling and Blasting

There was a large increase in the amount of explosives consumed due to the underground program being confined mainly on development. The cost per ton was much higher than in the previous year due to the small production and the fact that a large part of the product was obtained from ore development. Price increases in all explosive supplies is also reflected in the higher cost.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

f. Explosives, Drilling and Blasting (Cont.)

In the mining and ore development Hercomite 2-X powder has continued to be used almost exclusively and only small amounts of the Gelamite and Gelatin powders were used when blasting the long holes employed in the caving and stoping methods. In the development under E & A cc-159 which was mostly in rock, Gelatin powder was used exclusively and electric blasting was also employed in the heading before the orebody was reached.

Late in the year when mining was started in several areas above the 9th Level a high pressure Gelatin powder was introduced for blasting chunks. This powder is supplied in five pound cartridges and it has found wide use in breaking chunks, particularly in stoping and caving operations. Master fuse lighters have continued to be used in all the raise work in preference to electric blasting and a small amount of Herculite No. 4 was again used in blasting the frozen stockpile during the start of the shipping season ahead of the loading operations.

In the development work when extremely hard ground was encountered carset bits were used to speed up the drilling. The advantages this bit offers over the steel bit is limited chiefly to drilling in hard ground. Consequently, the bit has not been accepted for general use but will continue to be used on a small scale whenever hard Silica grade ore is mined or when developing in hard ground.

The explosives statements are shown in the following tables:

<u>Breaking Ore</u>	<u>Quantity</u> <u>Lbs.</u>	<u>Average</u> <u>Price</u>	<u>Amount</u> <u>1948</u>	<u>Amount</u> <u>1947</u>
60% Gelatin	500	16.75 C	83.75	58.34
Hercomite 2-X	75,480	14.23 C	10740.82	8873.38
Herculite No. 4	500	12.50 C	62.50	43.75
60% Hi-Pressure Gelatin	1,250	20.00 C	250.00	-
Gelamite 1-X	500	15.25 C	76.25	67.50
	<u>78,230</u>	<u>15.75 C</u>	<u>11213.32</u>	<u>9042.97</u>
Fuse - Feet	52,529	8.46 M	444.40	1769.62
Tamptite Shells	1,750	7.55 M	13.21	4.20
No. 6 Blasting Caps	25,680	14.10 M	361.02	390.02
Primacord	-	-	-	32.00
Fuse Lighters	3,100	8.64 M	26.77	33.75
Tamping Bags	2,000	2.25 M	4.50	2.15
Fuse Cartridges	500	20.00 M	10.01	39.72
Total Fuse, Caps, Etc.			<u>859.91</u>	<u>2271.46</u>
Total Expense Breaking Ore			<u>12073.23</u>	<u>11314.43</u>
Product - Tons			98,284	253,976
Lbs. of Powder Per Ton of Ore			.126	.390
Cost Per Ton for Powder			.114	.035
Cost Per Ton for Fuse, Caps, Etc.			<u>.009</u>	<u>.008</u>
Cost Per Ton For All Explosives			<u>.122</u>	<u>.044</u>

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

f. Explosives, Drilling and Blasting (Cont.)

Development in Rock	Quantity Lbs.	Average Price	Amount 1948	Amount 1947
Hercomite 2-X	219	14.86 C	32.55	18.15
Fuse - Feet	600	8.72 M	5.23	3.93
No. 6 Blasting Caps	75	14.00 M	1.05	.36
Total Fuse, Caps, Etc.			6.28	4.29
Total Explosives			38.83	22.44

Development in Rock - E & A cc-159

60% Gelatin	77,158	16.75 C	12923.97	1457.30
Electric Blasting Caps - Delays	3,240	18.30 C	592.85	264.45
Connecting Wire			-	8.51
Fuse - Feet	136,112	10.15 M	1381.54	59.86
No. 6 Blasting Caps	27,224	13.72 M	373.62	10.94
Hot Wire Lighters	3,200	6.75 M	21.60	1.35
Tamptite Shells	2,800	7.55 M	21.13	-
No. 8 Bare Wire	63	3.19 C'	2.01	-
Powder Bags	10	1.82	18.18	20.16
Total Fuse, Caps, Etc.			2410.93	365.27
Total Explosives			15334.90	1822.57
Total Explosives Used in Mine			27446.96	13159.44
Average Price Per Lb. for Powder			.1553	.1417

g. Ventilation

The fan on the 4th Level at Section 6 Shaft has continued to give good service in ventilating the mine to the 8th Level. Upon development of the 9th Level, however, the mine resistance to the flow of air increased beyond the capacity of this fan to supply a sufficient volume of air. On this account it became necessary to install another fan in the system as a booster and operate it in series with the 4th Level fan. After a raise connection was driven between the 9th and 8th Levels an auxiliary fan was installed in the old powder house drift on the 8th Level. This fan has a capacity of approximately 15,000 C.F.M. and the fan house in which it was installed was constructed so the direction of the ventilating air can be reversed similarly as can be done with the fan at Section 6 Shaft. Installation of the fan was completed early in 1949 and a survey showed a volume of 18,000 C.F.M. being supplied to the 9th Level. A year ago the volume of air supplied to the 8th Level with the 4th Level fan was 10,000 C.F.M.

LLOYD MINE
ANNUAL REPORT
YEAR 1948

7. UNDERGROUND (Cont.)

g. Ventilation (Cont.)

During the period that mining was conducted on the 8th Level the ventilation in the few working places was dependant on the exhaust air reaching the upper levels through old workings. Before mining was completed this ventilation circuit was lost and it became necessary to install a booster fan so that operations could be continued until the mineable reserves were exhausted. When driving the 9th Level headings ventilation was maintained with a Sturtevant No. 45 Fan and 14" metal pipe that extended from the 8th Level down the winze and into the various headings on the new level. As the development expanded it became necessary to add another fan in the system and the new level was ventilated in this manner until the raise connection to the 8th Level was completed.

A large amount of rock development was driven to provide a suitable connection for ventilation between the 9th and 8th Levels. No. 917 Raise was put up in the footwall slate west of the orebody and 350' of rock drift was advanced on the 8th Level extending from the old powder house drift southeast to a point where the raise was holed. Development above the 8th Level consisted of putting up No. 803 Raise from the haulage drift to a height of 30' and driving 140' of drift to connect with No. 801 Raise that extends to the 7th Level. Most of the old ventilation connections in rock between the 8th and 4th Levels will continue to serve as airways for the remaining life of the mine. Occasional repairs have been required in these connections and on the 5th Level quite extensive caving has occurred in a section of the old haulage drift that serves as an airway. The airway has not been blocked by this caving but should this appear likely a new rock raise will be driven between the 5th and 4th Levels to bypass this point.

8. COST OF OPERATING

a. Comparative Mining Costs

	<u>1948</u>	<u>1947</u>
Product - Tons	98,284	253,976
Underground Costs	2.887	1.539
Surface Costs	.714	.303
General Mine Expense	1.030	.429
Cost of Production	<u>4.631</u>	<u>2.271</u>
Depreciation	.220	.077
Taxes	.117	.048
Loading and Shipping	.236	.154
Total Cost at Mine	<u>5.204</u>	<u>2.550</u>
Budget Estimated at Mine	4.086	2.813
No. of Shifts & Hours	2, 1-8 Hr.	3, 1-8 Hr.
	275, 2-8 Hr.	297, 2-8 Hr.
	24, 3-8 Hr.	
Total Operating Days	<u>301</u>	<u>300</u>
Average Daily Product	327	850

LLOYD MINE
ANNUAL REPORT
YEAR 1948

8. COST OF OPERATING (Cont.)

b. Detailed Cost Comparison

	<u>1948</u>		<u>1947</u>	
	<u>Amount</u>	<u>Per Ton</u>	<u>Amount</u>	<u>Per Ton</u>
1. Exploring in Mine	3,212.29	.033	10,654.21	.042
3. Development in Rock	2,065.14	.021	191.51	.001
4. Development in Ore	57,568.95	.586	22,036.60	.087
5. Stopping	58,870.76	.599	130,626.55	.514
6. Timbering	53,847.07	.548	103,069.47	.406
7. Tramming	34,452.15	.351	46,597.24	.183
8. Ventilation	1,812.06	.018	1,128.56	.004
9. Pumping	13,203.84	.134	15,418.89	.061
10. Compressors and Air Lines	20,232.38	.206	19,236.79	.076
12. Underground Superintendence	15,403.53	.157	22,864.54	.090
14. Maint: Comp. & Power Drills	796.80	.008	105.94	.000
15. Scrapers & Mech. Loaders	8,977.12	.091	9,026.15	.035
16. Tramming Equipment	12,577.54	.128	9,576.66	.038
17. Pumping Machinery	696.33	.007	600.83	.002
Total Underground Costs	283,715.96	2.887	390,922.06	1.539
18. Hoisting	27,069.35	.275	28,012.89	.110
19. Stocking Ore	9,716.17	.099	11,581.06	.046
20. Screening-Crushing at Mine	199.30	.002	460.88	.002
21. Dry House	13,134.99	.134	12,493.00	.049
22. General Surface Expense	13,600.32	.138	13,592.61	.054
23. Maint: Hoisting Equipment	2,879.07	.029	5,897.47	.023
24. Shaft	1,291.66	.013	2,619.48	.010
25. Top Tram Equipment	956.66	.010	1,538.94	.006
26. Docks, Trestles & Pockets	739.68	.008	599.63	.002
27. Mine Buildings	571.90	.006	228.73	.001
Total Surface Costs	70,159.10	.714	77,024.69	.303
28. Geological	882.13	.009	1,077.28	.004
29. Mining Engineering	4,955.90	.050	2,812.38	.011
30. Mech. & Elec. Engineering	448.55	.005	637.36	.003
31. Analysis & Grading	10,904.74	.111	13,483.44	.053
32. Safety Department	1,230.93	.013	1,543.89	.006
33. Tel. & Safety Devices	2,374.14	.024	2,115.77	.008
34. Local & General Welfare	1,314.13	.013	1,944.96	.008
35. Special Exp., Pensions & Allow.	2,355.19	.024	3,242.87	.013
36. Ishpeming Office	7,984.27	.081	10,080.64	.040
37. Mine Office	18,260.52	.186	18,256.34	.072
38. Insurance	6,624.43	.067	5,659.60	.022
39. Personal Injury	18,814.84	.192	12,807.71	.050
40. Social Security Taxes	8,172.73	.083	11,510.49	.045
41. Employees Vacation Pay	16,917.27	.172	23,795.21	.094
Total General Mine Expense	101,239.77	1.030	108,967.94	.429
Cost of Production	455,114.83	4.631	576,914.69	2.271