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GYPSUM.

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## GYPSUM PRODUCTION.

Table showing the amount of Land and Calcined Plaster produced in the years given and the aggregate for years previous:

Years.	Land Plaster, tons.	Stucco, bbls. 300 lbs each.	Years.	Land Plaster, tons.	Stucco, bbls. 300 lbs each.
Years previous to 1886 .....	100,000	80,000	1877 .....	40,000	55,000
1866 .....	14,604		1878 .....	40,000	48,346
1867 .....	17,439		1879 .....	43,658	50,800
1868 .....	25,837	34,996	1880 .....	49,570	106,004
1869 .....	29,996	41,187	1881 .....	33,178	112,313
1870 .....	31,437	46,179	1882 .....	37,821	135,655
1871 .....	41,126	8,685	1883 .....	33,225	201,133
1872 .....	43,536	59,768	1884 .....	27,888	156,677
1873 .....	44,972	82,457	1885 .....	28,181	141,575
1874 .....	39,126	82,449	1886 .....	29,398	153,274
1885 .....	37,019	61,120	1887 .....	28,794	170,145
1876 .....	39,131	64,356	1888 .....	22,177	196,698
			1889 .....	19,823	206,380
Totals .....				890,936	2,259,683

A description of plaster deposit quarries is given in previous reports, particularly in that of 1881.

*Table showing the amount of Land Plaster produced by the different Companies in Michigan in the years indicated.*

Name of Company.	Number of Tons of Land Plaster produced by Michigan Companies.										
	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
Godfrey & Bro. Grand Rapids Plaster Co. ....	9,117	9,000	6,422	6,080	5,682	4,593	4,467	4,560	3,937	3,157	3,150
Loren Day .....	8,970	12,000	6,375	7,512	5,013	3,044	4,143	3,382	4,517	2,745	3,220
Union Mills .....	7,000	10,000	6,093	6,301	4,400	3,052	4,059	3,714	3,585	2,950	2,850
	4,500	7,500	6,716	8,298	5,500	3,185	3,693	3,687	3,102	2,650	3,000
D. Noble & Co. Smith, Bullard & Co. ....	10,585	9,570	6,572	6,037	4,000	3,202	3,900	1,947	3,106	2,640	2,930
Alabastine Co. ....	1,586	1,500	1,000	2,993	4,600	4,122	4,346	6,039	5,589	3,750	1,043
Geo. H. White & Co. ....	1,900				4,032	6,590	3,606	5,608	4,958	4,278	3,630
Totals .....	43,658	49,570	33,178	37,821	33,225	27,888	23,181	29,398	28,794	22,177	19,823

Table showing the amount of Stucco produced by the different Companies in Michigan, in the years indicated.

Name of Company.	Number of Barrels of Stucco produced by Michigan Companies.*										
	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
Godfrey & Bro. Grand Rapids Plaster Co.	23,000	27,500	30,274	37,000	30,433	30,942	28,273	30,284	36,656	36,670	
Loren Day Union Mills	23,500	20,400	32,854	40,000	24,390	26,498	28,627	32,386	34,751	44,175	
D. Noble & Co. Smith, Bullard & Co. Alabastine Co.	35,000	34,913	23,074	30,000	23,176	15,654	18,027	21,979	30,971	31,935	
	24,504	30,000	27,093	38,000	30,288	26,344	28,770	34,235	33,121	38,940	
			11,817	30,961	23,961	20,797	27,113	21,152	25,036	12,900	
				13,172	11,321	10,147	11,147	14,934	17,157	24,400	
Totals	106,104	112,813	135,655	201,133	156,677	141,575	153,274	170,145	196,689	206,880	

\* Stucco is now reckoned at seven bbls. to the ton.

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COAL.

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## THE COAL PRODUCTION OF MICHIGAN.

The coal production of Michigan does not increase. New discoveries of coal are made frequently in various localities and some local excitement is occasioned, but no good mines grow out of the discoveries. Recently they were investigating the coal deposits at Sebawaing in Huron county. Mr. W. L. Webber and J. C. Liken were having holes bored to ascertain the extent of the underlying coal bed.

There is some increase of mining at Grand Ledge and a new mine added at Jackson.

The total production of the State for every year given has been as follows:

	Tons.		Tons.
1887.....	350,000	1888.....	71,206
1877.....	68,647	1884.....	36,712
1878.....	85,312	1885.....	58,676
1879.....	82,015	1886.....	49,843
1880.....	128,053	1887.....	36,545
1881.....	130,190	1888.....	59,231
1882.....	135,339	1889.....	57,665

The following are the companies that produced coal in Michigan in 1889:

Name of Company.	Product in 1889. Tons.	Aggregate product. Tons.
R. H. Emerson & Co., Jackson, Mich.....	17,282	534,216
Standard Mining Co., Jackson, Mich.....	9,882	35,622
Bennett Sewer Pipe Co., Jackson, Mich.....	5,000	11,980
Poole Mining Co., Jackson, Mich.....	10,120	10,120
Corunna Coal Co., Corunna, Mich.....	15,000	148,398
Star Coal Co., Grand Ledge, Mich.....	325	625
Starke Mine, Grand Ledge, Mich.....	30	344
Eureka Coal Co., Grand Ledge, Mich.....	100	275
Grand Ledge Coal Mining Co.....	360	360

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SALT.

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## SALT.

There are 122 salt manufacturing companies in the State, 97 of which were in operation in the year 1889, having a capacity of production of 5,950,000 barrels.

The salt-producing territory is divided by the Inspector into 9 districts, consisting of: 1, Saginaw county; 2, Bay; 3, Huron; 4, St. Clair; 5, Iosco; 6, Midland; 7, Manistee; 8, Mason; 9, Gratiot.

The total capital invested in the business of manufacture is \$4,700,000 and the number of employés is 3,600.

In 1889 the number of salt wells pumped was 254.

*Comparative Table of Yearly Production.*

Year.	Fine.	Packers.	Solar.	Second quality.	Common coarse.	Total.
1869.....	513,908	123,908	15,264	19,177		516,288
1870.....	568,326	17,869	15,507	19,650		621,352
1871.....	655,923	14,677	37,645	19,930		728,225
1872.....	672,034	11,110	31,461	19,876		724,481
1873.....	746,702	23,671	32,267	20,706		823,346
1874.....	960,757	20,090	29,391	16,741		1,026,979
1875.....	1,027,866	10,233	24,336	19,410		1,081,856
1876.....	1,402,410	14,233	24,233	21,668		1,462,729
1877.....	1,590,841	20,339	22,818	26,818		1,660,997
1878.....	1,770,361	19,267	33,541	32,615		1,855,884
1879.....	1,997,350	15,641	18,020	29,027		2,058,040
1880.....	2,589,087	16,691	22,237	48,623		2,676,588
1881.....	2,673,910	13,885	9,633	52,821		2,750,299
1882.....	2,923,542	17,208	31,935	60,222		3,032,917
1883.....	2,823,967	15,424	16,735	33,525		2,894,672
1884.....	3,087,084	19,308	16,957	33,508		3,161,866
1885.....	3,230,626	15,480	19,849	31,428		3,297,403
1886.....	3,548,731	22,221	31,177	71,235	3,893	3,677,257
1887.....	3,198,070	19,385	13,903	73,905	173,373	3,444,909
1888.....	3,720,319	18,126	26,174	87,694	13,915	3,866,228
1889.....	3,721,099	19,780	17,617	93,455	4,973	3,846,979
Total.....						45,753,985
Salt manufactured prior to 1869.....						3,282,117
Total amount of salt produced in Michigan to date.....						49,036,102

The following figures show the average net price per barrel received by manufacturers for salt:

Year.	Price.	Year.	Price.
1866.....	\$1 80	1878.....	\$0 85
1867.....	1 77	1879.....	1 02
1868.....	1 85	1880.....	75
1869.....	1 58	1881.....	83½
1870.....	1 82	1882.....	70
1871.....	1 46	1883.....	81
1872.....	1 46	1884.....	75½
1873.....	1 37	1885.....	70
1874.....	1 19	1886.....	66
1875.....	1 10	1887.....	57.4
1876.....	1 05	1888.....	58.5
1877.....	85	1889.....	54.3

G. W. Hill, State Salt Inspector; W. R. Burt, President State Salt Association.

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## INSPECTION OF MINES.

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## MINE INSPECTORS' REPORTS.

We have now in Michigan a law which provides for the appointment of an inspector of mines in each county by the board of supervisors of the county. Among his duties it is to investigate all accidents in the mines and to file an annual report of the same with the county clerk each year. The following are thus taken from the reports of the several mine inspectors:

MENOMINEE COUNTY.—J. B. KNIGHT, *Inspector.*

### *Record of Deaths from Accidents.*

Mine.	Date.	Name.	Occupation.	*Cause of Accident.
West Vulcan...	Oct. 12, 1888...	Antonio Tolamani	Miner.....	Fell from bucket while ascending winze.
West Vulcan...	Nov. 2, 1888...	John Anderson...	Ropeman...	Fell 18 feet in shafthouse.
West Vulcan...	Dec. 8, 1888...	Thomas Beard...	Miner.....	Fell 100 feet in shaft.
West Vulcan...	March 9, 1889...	Joseph Crissoti...	Miner.....	Fall of rock in drift.
Central Vulcan	Feb. 18, 1889...	Richard Bray.....	Miner.....	Breaking of lagging and fall of ground in room.
Curry.....	Aug. 30, 1889...	Samuel George...	Timberman.	Fall of ground while timbering level.
Curry.....	Sept. 14, 1889...	Adolph Anderson	Miner.....	Premature discharge of hole in drift.
Pewabic.....	Aug. 16, 1889...	Wm. Gustafson...	Miner.....	Fall of ground from back of room after blasting.
Chapin.....	Oct. 1, 1888...	Karl Erick Karlson	Miner.....	Tried to get on cage after it was rung up.
Chapin.....	Dec. 8, 1888...	Peter A. Johnson	Miner.....	Explosion of dynamite in thawer on surface.
Cyclops.....	May 16, 1889...	Wm. H. Stanton...	Miner.....	Fall of rock in drift.
Walpole.....	May 16, 1889...	Zanella Marcellio	Miner.....	Fell 100 feet in shaft.
New Ludington	Jan. 14, 1890...	John Bengson....	Timberman.	Fell into winze.
" "	May 17, 1889...	John Polenski....	Timberman.	Fall of ground while timbering room.
" "	Sept. 18, 1889...	Matthew Kraack..	Pumpman..	Struck by cage while crossing shaft, fell 400 feet.

\* In each case the verdict of the jury was "Accidental death."

Record of Accidents.

Name of Mine.	No. men employed.	No. fatal accidents.	No. non-fatal accidents.	No. persons killed by fatal accidents.	No. persons injured by non-fatal accidents.	No. men employed to each man killed.	No. men employed to each man injured.
East Vulcan.....	204		3				68
Central Vulcan.....	21	1	1	1	3	21	21
West Vulcan.....	390	4	9	4	9	98	43
Curry.....	84	2	1	2	1	42	84
Aragon.....	68						
Perkins.....	36						
Norway.....	192		3		3		64
Cyclops.....	11	1		1		21	
Pewabic.....	41	1		1		41	
Walpole.....	39	1		1		39	
Millie.....	84		2		2		37
Chapin.....	1,165	2	56	2	56	582	20
Old Ludington.....	15						
New Ludington.....	260	3	3	3	3	87	87
Hamilton.....	67						
Smaller Mines.....	75						
Totals.....	2,752	15	78	15	78	188	35

MARQUETTE COUNTY.—ANTHONY BROAD, Inspector.

Annual Report of Men Killed and Permanently Disabled in the Mines of Marquette County.

Mine.	Number of men employed.	Number of men killed.	Number men permanently disabled.	Mine.	Number of men employed.	Number of men killed.	Number men permanently disabled.
Queen.....	202	3	1	Republic.....	847	5	
Champion.....	775	6		North Champion.....	80		
Lucy.....	87	1		Sampson.....	60		
Cleveland.....	736	2		Northwest Republic.....	42		
Cleveland Hamatite.....	150	1		Riverside.....	70	1	
Salisbury.....	202	1		Standard.....	22		
Wheat.....	85			The Hank Shouldice.....	27		
East Jackson.....	34			Humboldt.....	140	3	
Furst, Jacobs & Co., Sandstone Quarry.....	902			Negaunee.....	260	1	
Gillet's Sandstone Quarry.....	105			Lilley.....	190	1	
Prince of Wales.....	42			Cambria.....	185	1	
Milwaukee.....	167			East New York.....	105		
Buffalo.....	156			Exploration.....	200		
Volunteer.....	242			Jackson.....	575	3	
Foster.....	40			Hartford.....	35		
South Buffalo.....	175			Detroit.....	70		
Lake Superior.....	725	3		Lake Angeline.....	550		
Mitchell.....	84			West Rolling Mill.....	16		
Barnum.....	325			Wick.....	14		
Winthrop.....	450			West Republic.....	20		
Saginaw.....	26			Powell Exploration.....	9		
Merryweather.....	16			<i>Gold Mines and Explorations:</i>			
Dexter.....	55			Ropes.....	120	1	
American.....	120			Superior, Michigan, Gitche-Gumme, Finn & Case, Peninsular, Grummet, Grayling, Grand Rapids, Ishpeming.....	150	1	
Bessie.....	14						
Michigamme.....	240						

In summarizing the accompanying report, it will be found that of the forty-seven iron mines, eight gold mines and two stone quarries, employing 10,047 men, there were but thirty fatal accidents, which shows a gratifying decrease in the fatality as compared with the report of last year, being but about one-half the per cent.

Mr. Broad states as follows: I have attended all inquests held, and from a careful consideration of the evidence adduced, have coincided with verdicts which have, in every instance, exonerated the mining companies from all blame.

KEWEENAW COUNTY.—JOSEPH RICKARD, Inspector.

List of Fatal Accidents During year 1889.

Date.	Name of mine.	Name of person.	Cause of death.	Remarks.
Jan. 9.....	Copper Falls.....	John Balm.....	Struck by skip.....	Company exonerated.
March 30.....	Copper Falls.....	Peter Johnson.....	Killed by a blast.....	He tamped the blast.
April 30.....	Allouez.....	John Palonicini.....	Riding in skip.....	Company exonerated.
June 19.....	Copper Falls.....	Eric Bokkals.....	Killed by a blast.....	Company exonerated.
Sept. 21.....	Allouez.....	Hans Erlandson.....	Riding in skip.....	Company exonerated.

LIST OF FATAL ACCIDENTS AT THE MINES IN HOUGHTON COUNTY.

JOSIAH HULL, Inspector.

From September 30, 1888, to September 30, 1889, giving date, person's name, his occupation, place employed and manner of accident.

Date.	Name of person.	Occupation.	Name of mine.	Cause of death.	Nationality.
Oct. 19, 1888	Thomas Eagger.....	Laborer.....	Franklin.....	Running mill.....	Irish.
Nov. 29,	Mike Kezjan.....	Miner.....	Calumet.....	Hanging trap fell.....	Finlander.
Feb. 4, 1889	B. Leahy.....	Miner.....	Quincy.....	Fell from stage into shaft.....	Irish.
Feb. 7,	C. Abramson.....	Miner.....	Tamarack.....	Fell out of bucket into winze.....	Swede.
Feb. 16,	P. Jarney.....	Trammer.....	Tamarack.....	Walked into shaft.....	Finlander.
Feb. 16,	F. Hawes.....	Miner.....	Osceola.....	Suffocated.....	English.
March 18,	Jacob Karlo.....	Laborer.....	S. Hecla.....	Fall of rock.....	Polander.
March 19,	William James.....	Miner.....	Calumet.....	Blasting.....	English.
April 2,	Thomas Luke.....	Miner.....	Tamarack, Jr.....	Fall of cross-head.....	English.
April 16,	Erick Kijula.....	Miner.....	Kearsarge.....	Drilling old hole.....	Friedlander.
May 1,	A. Pehlapoma.....	Boy.....	Osceola.....	Blasting, holing pillar.....	Friedlander.
May 11,	A. Ponzetto.....	Trammer.....	Huron.....	Hanging rock.....	Italian.
May 14,	John Turk.....	Trammer.....	Osceola.....	Blast, holing winze.....	Austrian.
May 17,	John Hautala.....	Trammer.....	Franklin.....	Fell in shaft.....	Finlander.
June 19,	Frank Butcher.....	Trammer.....	Osceola.....	Fell off road.....	Austrian.
June 24,	James Chellew.....	Laborer.....	Hecla.....	Fell into shaft.....	English.
July 10,	John Miller.....	Laborer.....	S. Hecla.....	Hanging-wall rock.....	Polander.
Aug. 13,	Henry Hohner.....	Trammer.....	S. Hecla.....	Prying down rock.....	German.
Sept. 23,	Mike Carno.....	Laborer.....	Calumet.....	Rock down shaft.....	Italian.
Sept. 23,	Frank Donald.....	Laborer.....	Osceola.....	Riding in skip.....	English.

Total number of men employed in the mines of Houghton county, working twenty-six days per month, 6,480.

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IRON.

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## THE IRON MINING INDUSTRY IN MICHIGAN, IN 1889 AND FIRST HALF OF 1890.

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It is pleasant to note the greatly improved condition of the iron ore market in the past few months, or during the latter half of the year 1889, and to further observe the signs that seem to insure the indefinite continuance of the present activity. There has been no such favorable outlook for the iron mining interests of Lake Superior, for several years, as now exists. It is the first time for a long period when the contracts for ore have been made with the mining companies, so soon as at the close of the year preceding the one in which the deliveries are to be made.

It is reported that even now, Dec. 1889, the contracts for the coming year's product of Bessemer ore, are all made; at a price fully one dollar in advance of that realized the past season. Usually, at this season of the year, after the time when shipping has ceased, there is a comparative cessation of activity; the larger mines get ready for winter and moderately push the work of opening up the mines in readiness for the ensuing year.

The lesser companies not infrequently shut down entirely, or at best, work but little during the winter. They wait to see what the next year will bring forth in the way of business, what the demand for ore will be, how much they can sell, and at what price, before venturing to do much mining. For a number of years past there has been, every winter, an uncertainty regarding the succeeding year. Furnace men have held to a hand to mouth system of buying; that is, they only bought to supply immediate want, and not at all for the future. And even in 1889, there existed during the winter and early spring months, the usual depressed condition. Not much ore had been sold up to the time of the opening of navigation, and for some time afterward the stock piles of ore at the mines, in most cases, lessened very slowly. The mines having Bessemer ore, held for a greater price than furnace men were willing to give, and thus until early summer, there was somewhat of a dead-lock. Finally, however, later in the season, in August, and thereafter, the aspect of the market had entirely changed and there was the most active demand for every ton of ore that could be produced. As a result it has been one of the most active seasons of mining in the iron districts that has ever been experienced. The activity thus inaugurated gives every indication of continuance, certainly through 1890. All the mines are working to their utmost capacity, and every effort will be made to get out all the ore possible during the present winter, in readiness for shipment at the opening of navigation. The product of 1889 was in excess of that of any previous year and will be much exceeded in 1890. How much ore will be produced the coming year it is impossible to predict; but if all is accomplished that is now declared in the way of pro-

duction, the total output will be enormous; probably between eight and ten million tons.

In 1889 the first sales of ore for future delivery took place in March, to Chicago consumers, at prices about the same as prevailed during the previous year. At the opening of navigation charters were made with the vessel men for the season's carrying of ore at 90 cents to \$1.00, from Escanaba; \$1.10 to \$1.15 from Marquette and \$1.25 from Ashland. In the fall, these rates, as usual, were advanced; in September to \$1.05, \$1.20 and \$1.40; in October and later, to \$1.25, \$1.50 and \$1.90. As early as November, furnace companies in Ohio and Pennsylvania purchased all the Bessemer ore that they could contract for for 1890 at \$1.00 to \$1.25 advance above the prices of 1889.

These contracts for future delivery of ore thus early made are not confined to ores suitable for steel making but include the non-Bessemer ores as well, which have been largely contracted for at an advance over previous year's prices very nearly the same as for Bessemer ores or at about \$1.00 per ton advance for good ores.

Ore sold in 1889—delivered in lower lake ports at about as follows: Republic \$5.50 to \$6.00; Lake Angeline, hard ore, at \$6.25; possibly Champion first class, at \$6.25 also; Chapin \$4.50 to \$5.00; Cleveland No. 1—non Bessemer—at \$5.00; 62 to 63% ores, non Bessemer, at \$4.50; 60% hematites sold at about \$3.75.

The sales for delivery in 1890 are at \$1.00 advance over these prices.

No doubt there will also be an advance in Lake freights and on this subject there exists some apprehension, notwithstanding that the year closes with the most confident feeling among the mining men as to the probable general result.

Some vessel contracts have been made at \$1.10 from Escanaba, \$1.25 from Marquette, \$1.40 from Ashland and Two Harbors. It is feared that rates will be in excess of these figures when the season opens. They are sure to do so unless there shall be a large increase of vessel capacity. There is considerable talk of tonnage construction the present winter and it is important that it should equal at least the increased demand that is sure to occur next season. The carrying problem may be an embarrassing one; if the increased production of ore shall amount to 2,000,000 tons, the disposition of it will test the capacity of the railroads to the utmost, also of the ore docks, of the vessels and of the facilities for handling at the lower lake ports. Very fortunately the railroad companies are preparing for the emergency in the matter of ore docks. The C. & N. W. Co. has built a 4th one at Escanaba which is said to be the largest in the world. One has been built at the new village of Gladstone on Bay de Noquette, while at Marquette the D., S. S. & A. R. R. Co. has completed an extension of 300 feet to No. 3 dock and has contracted for the construction of a 4th dock to be done in June next. This dock will have 200 pockets and a loading length of 1,200 feet; its total length to be 1,760 feet. Altogether these additions will double the capacity for handling ore at Marquette.

A great stimulus has been given to exploration as well as to mining and some valuable "finds" of ore have been made, notably in the Saginaw range west of Ishpeming. East of Negaunee and in the Crystal Falls district, seldom, or never before, has there been so great a degree of activity in exploring for ore as at present prevails. The winter is favorable for such work in an unusual degree, and where delayed or held in abeyance

on account of the weather, the work will be pushed forward with increased vigor in the spring.

Every year the area of the iron producing portion of the peninsula is enlarged, that is, discoveries of ore are made and mines opened in localities where previously the ore was not known to exist. It is seen that conditions that apply in one place may be greatly modified in another, but still the only proper indications to study are the rocks themselves and where the rocks are apparently all right is the proper place to look for ore.

A few years ago and the working mines were confined to the vicinity of Negaunee and Ishpeming. Then the producing section was extended west to Champion, to Michigamme and southwest to Republic; and soon after the Menominee region was opened and has been rapidly and greatly extended; and later still the Gogebic range has astonished the country by the extraordinary quantity and quality of the ore which it was found to contain. It is likely that discoveries will be made during the coming year, new mines will be opened and railroad branches built to them and ore sent out.

An important change of ownership of iron mines has been made in the past year, being a syndicate represented by Ferdinand Schlesinger, of Milwaukee, Wis. Mr. Schlesinger has purchased several mines, all were Bessemer hematites, and is pushing the mining work vigorously. He now controls the Chapin, Dunn, Armenia, Florence, Iron River, Youngstown, Queen, Buffalo, South Buffalo, Prince of Wales, and several new properties west of Michigamme lake, in sections 22 and 23, T. 46, R. 33, known as the Ohio, Norwood, Fowle, and Stewart. They are all leased mines held by the several companies on royalties; being from 25 cents to 50 cents per ton for the ore mined. The change in ownership has made no difference in the local management of the mines, the instructions are to get out all the ore possible.

The prices paid for these several leases is reported to be: Dunn, \$100,000; Armenia, \$40,000; Florence, \$350,000; Iron River, \$250,000; Youngstown, \$125,000; Chapin, \$2,000,000; Queen, Buffalo, South Buffalo and Prince of Wales, \$850,000. The Michigamme group were got of Mr. J. C. Fowle at a mere nominal figure.

Other mines have changed owners within the past year, as the Aurora, Palms, Pabst, Michigamme and Palmer—all important mines, to which, more recently, may be added the Wetmore.

Through these sales, particularly of those mines at Negaunee—the Queen, etc.—a number of men in that city have realized considerable fortunes. They were all, previously, comparatively poor men, but the fortunate discoveries of ore which they have made has brought them wealth.

In seeking for other minerals besides iron ore there has been considerable activity. Explorers for gold have not been idle, and while their efforts have not been crowned with any conspicuous success, the results are of an encouraging character.

The Michigan affords so much rich rock that it seems probable that when it comes to be worked for a mine sufficient good rock will be found to make the enterprise a profitable one. The Michigan is the most promising of the new gold mines.

An increased value attaches to the sandstone quarrying industry. The production of sandstone in the upper peninsula is but in its infancy and is already a permanent and important business.

Effort is making to awaken interest in the Serpentine deposits near Ish-

peming and the marble in Felch Mountain. The deposits of both these minerals in the localities mentioned are extensive and valuable.

The following table shows the shipments of iron ore from the several Lake Superior ports in 1889:

*Recapitulation.*

Shipments for season from Marquette.....	1,376,335
“ “ “ Escanaba.....	3,003,632
“ “ “ St. Ignace.....	51,853
“ “ “ Ashland.....	1,484,802
“ “ “ Two Harbors.....	819,639
“ “ “ Gladstone.....	73,847
Grand total of lake Shipments.....	6,810,108

THE MENOMINEE RANGE MINES.

The Menominee Range Mines, it is needless to say, are in a prosperous condition. They have all of them, produced more ore the past year than was expected, and are in shape to duplicate or even exceed the like amount, another year. Some of the mines in the Menominee district have never been pushed to the utmost limit of their capacity. These have yielded larger this year, 1889, than ever before; but they could have furnished much more if steps to accomplish such a result had been earlier begun. Now they are preparing for a maximum product, and in some of them one is astonished at the great amount of ore in sight.

The Menominee range affords one of the best fields for exploration of any portion of the peninsula, the indications prevail so extensively; there is such a wide field for investigation and good results are of so frequent occurrence that the field is a safe one. There are several notable examples of important success that has attended exploration in the Menominee range recently, among which may be mentioned the Aragon, Harrison, Caledonia (or Mansfield), Hemlock River, etc. I look to see further important finds the coming year, particularly in the vicinity of Norway and of Crystal Falls. Exploration is continued at Waucedah, at the east end of the Menominee range. Nothing new of value has been developed in this late exploratory work. It is proposed now to use a diamond drill.

THE PENN IRON MINING CO.

The mines of this company are the first at the east end of the range, and constitute the East Vulcan, West Vulcan, Curry, Briar Hill, Norway and Cyclops mines, with the Harrison, recently added. The mines are really owned by the Cambria Iron Co., of Johnstown, Pa., where the ore is sent to be smelted. The great flood which destroyed the Cambria works in June last, had the effect also to cripple the mines, somewhat abridging the work for a brief time. However, they were soon in full operation, only all explorations were cut off and such other work dispensed with as could be deferred to a more convenient season.

The Penn Co. is a well conducted corporation, its mines are well managed and well worked. There are seldom any changes in any department. The mining captains are efficient and remain at their posts year after year. The laborers are contented and rarely go elsewhere. I am pretty familiar with the people and with the mines of the Penn Co., and I esteem the former highly and regard the latter as valuable.

I have so fully described these mines in former reports that I do not deem it necessary to be otherwise than brief at this time. Commencing with

THE EAST VULCAN,

which is now, perhaps, the company's most important mine although there is nothing new to chronicle, no discoveries of ore beyond what was known to exist, yet the course of preparation has been so long in making, has been so costly and complete—all done with reference to known conditions, that the mine is in condition to accomplish a good deal now. They can secure, now, a good deal of ore at a comparatively low cost. The mine has been an expensive one to the company. The ore has cost more than it was worth, but that matter is no one's fault. The work has all been cheaply and well done; it simply happens that there was a good deal to do. The ore is of the very best; in No. 1 shaft it is the finest Bessemer ore, that is not easy to obtain in the market. It could not be expected that a strong company like the Cambria needing Bessemer ore would give up a mine like the East Vulcan that gave such an excellent quality of that article and afforded so many indications of ultimate improvement in quantity. The formation is made up of clay slates and jasper slates and hard jasper that stand up at a high angle, dipping south and striking east and west. The ore occurs in irregular pockets in the jasper.

The new No. 1 shaft has been completed to the 6th level, 600 feet vertical, and the drift opened east to the ore, also 600 feet in length. There are two ore bodies east of the shaft; the first one is a chimney of ore that, in the 6th level, is near the shaft and takes an irregular course upward, getting 500 feet away in the first level. Old No. 1 shaft is 500 feet deep, but the ore, which in the second and third levels was east of the shaft, was found to be in the fifth level upwards of 200 feet west of it and running very flat to the west. It was for this reason that the new shaft was sunk 800 feet west of No. 1.

A fair body of ore was found west of the new shaft in the fifth and sixth levels, in the latter of which it has been worked west 400 feet.

They have the main body of ore now opened to, and assuming that it continues as large as it was in the fifth level, this body alone from the fifth to the sixth level will give 40,000 tons of the best of ore. The other pits, No. 2 and No. 3, show about as they were last year, as particularly described in the report of 1888. They furnish non-Bessemer ore, otherwise high grade. Altogether the East Vulcan will yield, it is estimated, 75,000 tons in 1889.

Capt. John U. Curnow, who for ten years has been superintendent of the mine, is one of the most faithful and capable mining captains in the country and his superior officers fully appreciate his value.

Going west, the explorations that were in progress in the spring on section ten were discontinued after the Johnstown disaster that so seriously affected the company, but have again within a few days been renewed. There is every seeming probability that deposits of ore will be found, ultimately, in this ground west from the East Vulcan. The sand is deep over the rocks, making it slow exploring.

There is no ore mined now before

## THE WEST VULCAN

is reached, which, until within a year or two past, has been one of the best lenses of ore in the Menominee range. The main deposit—the south one—has averaged for ten years past about 600 feet in length and twenty to thirty feet in width of fine Bessemer ore. The mine has been all right down to the tenth level, when the ore body narrowed up greatly and portions of it were found to be mixed with limestone.

It is 1,000 feet deep now to the eleventh level. I descended to the bottom a few days ago. The eleventh level was not sufficiently opened so that it could be determined whether it would be better than the tenth or not. At the west end, near the new shaft, the ore is good. They had some trouble in finding it. They drifted along what they took to be the junction of the hanging and foot walls, but finally crosscutted west into the foot wall and found the ore, five to fifteen feet wide. There are two shafts. No. 2, double skip incline, is in the foot wall north of the ore, and the downright cage shaft sunk in the hanging wall.

The latter shaft, as explained in my last report, has given much trouble, by reason of the settling of the ground, crushing in the shaft and making it necessary to retimber it or to abandon it. The former plan has been pursued and the work is well under way now. They commenced twenty-five feet below the eighth level and retimber up, 600 feet, using the best pine timbers 16"x16", placed at 6" apart. The cost of this work is \$5,000 per 100 feet, \$30,000—a great expense coming when the mine is at its poorest. No. 2 shaft also had to be retimbered from the ninth level up, 125 feet, where it caved in by reason of the taking away of the pillars. 2,000 feet of drifting have been done in the mine in the year past, 595' of winzes sunk and 324 feet in rises made. The ore pillars, with the exception of those at the new shaft, have been nearly all removed, and the mine is filled with rock. The rock for filling, all that is required beyond what is obtained in the mine, is run down from the surface through a rock shaft made in the foot wall. There is some ground to stope below the ninth level yet and all the ore above the eleventh to the tenth that is now opened. They are already sinking below the eleventh level.

Since the above was written I have again been at the Vulcan mine and find that the work on the downright shaft is completed and that it is in fine working order. Also that the eleventh level is much better than the tenth and that the shaft is well on its way to the twelfth.

Still later, March 15, the shaft has just been greatly damaged by fire, which extended also to the timbers in the mine, a most unfortunate occurrence. No lives were lost, though some of the men were in great danger. The fire destroyed the shaft house and burned the timbers in the shaft so that it was found that away down from the surface the ground was caving in. Mr. Hagey, being apprehensive that the "caving" would, if allowed to proceed, unsettle the foundations of the machinery near by, has ordered the shaft to be filled with sand. I have been at the mine several times since the fire, and on April 11, the fire was still burning in the mine and the work of filling up the shaft was proceeding. This fire has thus caused a great loss to this company.

It is not likely that the shaft will be restored. It is in the hanging wall and the rock is very soft and unstable. Their experience with it thus far is that it is a very expensive and difficult matter to keep it in place. No. 2 shaft,

which is to the ninth level, and is double skip, could be sunk and made to do the hoisting but there is no room in it for plunger or pipes. What will be done has not yet, May 1, been decided.

## THE CURRY MINE.

bids fairly to take precedence of all other mines possessed by the Penn Company, in quantity, as it certainly does in quality of ore. This mine was given up a few years ago by its lessees on the supposition that it was of too little value to pay for working. The only stope of ore that they then had was a long way from the bottom of the shaft and so near to the west line of the property that it was not thought worth while to sink a new shaft. The Penn Company not only acquired possession of the Curry, but of the Briar Hill, the property adjoining on the west; and into this latter the ore has already been followed. The company is sinking a shaft to the west that will be more suitably placed for mining this ore. The new discovery—the body of ore near the highway at the foot of the hill south of the former company's workings, which promised so well from the first—two years ago, continues to sustain the high hopes entertained regarding it. The ore body is now 300 feet long and 10 to 38 feet wide, and constantly increasing in length, to the west. This shaft is in the south vein ore and analyses at .008% phos, average 63% iron. The north vein ore goes at .030% phos.

The indications here, and results obtained at the Aragon, and the Harrison have led the Penn Company people to set a very high value on the Curry and Briar Hill properties. Mr. Hagey thinks them to be the most promising of any portion of the company's estate. The new shaft to work the old deposit—No. 2 mine—is located 150 feet west of the Curry line on the Briar Hill property. They are now, December, stoping 60 feet west of the line in the old mine. The shaft is sinking to reach the ore further west.

## THE NORWAY MINE

affords no new features. They are simply working to get all the ore that there is left, in the cheapest manner they can. They know just where it all is and possess all the skill and experience to successfully solve the problem of extracting it.

The system they are following is to mine out the pillars, etc., and let in the surface. There are many thousand tons of ore yet in the mine that will be saved, but there is not likely to be any new finds. They are on the limestone bottom everywhere in the mine, and all the ore that remains is above in pillars and roof. The Norway mine has been a pretty profitable 40 acres.

Some exploring with the diamond drill is in progress.

## THE CYCLOPS MINE

comprises the 40 acre lot lying next west from the Norway. They are mining in the same pocket of ore described in my last report and it is now the only point on the property where ore is obtained.

The company has done some exploring, and the work will be continued further west and near the south line of the land. They have sunk 50 feet

in what seems to be foot wall slates or north deposit slates, just south of this point, across the railroad track, on the flat, Messrs. Colwell and others of Norway, are boring with diamond drill.

The Penn company, I believe, will do considerable exploring the coming year. They have secured the option of a portion of Sec. 6, west of Norway, which has been explored a good deal, but the Penn company will make a further try. Also on section 10 between East and West Vulcan, exploration will be pushed.

The products of the several mines of the Penn Iron Co. in 1889, were as follows:

East Vulcan.....	45,563 tons.
West Vulcan.....	105,373 "
Central Vulcan.....	2,970 "
Curry.....	28,722 "
Norway.....	68,044 "
Cyclops.....	6,101 "
Total.....	256,773 tons

The Vulcan mines are the oldest mines on the range and have sent out annually as follows:

Year.	Tons.	Year.	Tons.
1877.....	4,543	1884.....	101,722
1878.....	31,239	1885.....	124,120
1879.....	57,350	1886.....	143,930
1880.....	72,405	1887.....	205,127
1881.....	85,071	1888.....	123,832
1882.....	94,042	1889.....	*182,628
1883.....	79,874		
Total.....			1,311,433

\*This includes the Curry product.

The product of the Norway for each year is as follows:

Year.	Tons.	Year.	Tons.
1878.....	7,533	1884.....	71,515
1879.....	73,540	1885.....	57,741
1880.....	198,765	1886.....	93,878
1881.....	137,558	1887.....	95,558
1882.....	165,084	1888.....	87,164
1883.....	114,836	1889.....	*74,628
Total.....			1,126,970

\*This includes the Cyclops' product.

The officers are J. E. Hagey, General Manager, Penn Iron Co.; Wm. Kelly, Gen'l Sup't.; George Warren, Purchasing Agent; James Hoskins, Mining Capt., Norway; John U. Curnow, Mining Capt., East Vulcan; Tom. Oliver, Mining Capt., Curry; Frank A. Jansen, Mining Engineer; Frank Copeland, Cashier; Wm. Bond, Mining Capt., West Vulcan.

THE PERKINS MINE

still affords some ore, but it is nearly exhausted; 12,302 tons were mined last year, making a total of 388,602 tons.

The mine adjoins the Norway on the east and the workings of the two mines run into each other. The Norway being the deeper, drains the Perkins.

Capt. Perkins expects to mine 16,000 tons in 1890.

THE ARAGON MINE

lying in the group, west of the Briar Hill and south of the Norway, is turning out well in one respect, it gives the best of ore. There is a body of hard ore in the mine that contains 70% iron and .028% phos. The ore of the mine averages 65% metallic iron and about .030% phos.

Now that the shaft is down, there is not an excessive amount of water.

The shaft is 230 feet deep, 60 feet below the 2d level, that is, it was at the time I went down into it, about Dec. 1. The mine is not largely opened yet. The work has been mainly preparatory. They have drifted in ore 50 or 60 feet, west, and crosscutted 30 feet. The ore is cut off in the mine, on the west, by a fault in the formation which has thrown the ore to the north. That is, this is the way matters look now. Sanguine stockholders of the Aragon estimate the next year's product at 100,000 tons. If that amount is obtained there will be a large profit.

The company employs 100 men and the management of the mine is in skillful hands. Mr. Larsson has demonstrated his ability to overcome difficulties by sinking No. 1 shaft after others had failed to accomplish it. I have described all this in my last report. There are some diamond drill borings, which insure a considerable extension of the ore when they get the mine opened to it. The stock is held by a few men and they are not disposed to sell it. Probably none could be bought for less than the par value. Thus far there has been shipped from the mine 1,747 tons of ore.

The officers are Augus Smith, President and Treasurer, Milwaukee, 71 New Insurance Building; A. H. Wilkins, Secretary, Milwaukee, 71 New Insurance Building; Per Larsson, Superintendent, Norway, Mich.

The estate comprises N.  $\frac{1}{2}$  of N. E.  $\frac{1}{4}$  of Sec. 8 and N.  $\frac{1}{2}$  of N. W.  $\frac{1}{4}$  of Sec. 9, T. 39, R. 29.

Thus far the mine is a small one, but the ore is of extraordinary excellence and of course will sell for a large price.

THE HARRISON

is the name given to a valuable exploration just south of the Aragon. In fact it is probable that the Aragon is in the north vein vulcan ore and the Harrison is in the south vein. In these mines there seems to be two sets of lenses of ore parallel with each other. The south vein is, so far as observed, the largest. The Harrison, has only been tested with the diamond drill, three borings have been made inclining down to the north, the first hole is 269 ft. in length and cuts 35 ft. of ore, the second boring is 270 ft. long and cuts 51 ft. of ore, the No. 3 hole is still boring. Analysis of the drill core, soft dirt, some sand in the ore, it could not be got perfectly clean ore, gave 57% metallic iron, .0012% phos. The description is the S.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 8, and the borings are made near the N. and E.

lines. The lease is owned by J. G. Butler, Jr., J. N. Porter and J. G. Hagey. Mr. Butler owns one-half, each of the others one-fourth.

Since the above was written the option for the lease of the 12 forties of land on Sec. 8, T. 39, R. 29, held by the gentlemen above mentioned, has been transferred to the Penn Iron Mining Co. The company will at once proceed to sink a shaft to mine the ore.

There are several other explorations in progress at Norway, mainly with diamond drill, south and west of the village. Byron N. White has started a drill for Angus Smith *et al.* in N. E.  $\frac{1}{4}$ , N. W.  $\frac{1}{4}$ , Sec. 8. Situation is favorable for finding ore.

Also Messrs. H. J. Colwell & Co., of Norway, are operating a drill in the N. W.  $\frac{1}{4}$ , N. W.  $\frac{1}{4}$ , Sec. 8, under the superintendence of Isaac Wilkinson. One hole has been bored at an angle of 70° N., 400 feet deep, located at the center of the 40. It is all in slates. The last time I visited the place they were boring the 2d hole, 600 feet north from the first one, and were then in slates.

The Penn Co.'s exploration on Sec. 5, Cyclops land, is just north of this of Colwell's.

When the spring opens, considerable exploring will be done west of Norway. In fact, every portion of the range from Norway to Iron Mountain is under option and will be explored for ore during the coming summer.

#### THE SMITH-WHITE

exploration adjoining the Aragon on the west, being the N. E.  $\frac{1}{4}$  of the N. W.  $\frac{1}{4}$ , Sec. 8, 39, 29, previously mentioned, is proving a fortunate enterprise.

I learn that ore has been found with the drill at a depth of 460 feet. The drill continued in ore for 10 feet when the hole caved in so much as to fasten the rods so that they cannot revolve them or draw them out. The drill, just before reaching the ore passed through 10 feet of jasper.

#### THE CHAPIN MINE

with the exception of the Norrie, is the largest producing mine in the State. It is a matter of much conjecture among interested parties, which mine will make the greatest output in 1890. Neither will fall short of producing 800,000 tons and even a million tons is talked of as the possible yield of either of these mines.

The Chapin could easily send out a million tons this year if the shafts were all ready, but the new shafts in the west part of the mine are not completed yet. Nearly all the ore comes up through B. and C. the down-right, hanging wall shafts. And of these much the greater portion is hoisted in C. the westerly shaft, nearly all from the sixth level. The ore is trammed and hoisted very rapidly at the Chapin. No other mine is so well equipped for expeditious work in handling the ore after it is broken in the mine. Underground in the sixth level, at C shaft, the tram cars are run to and from the shaft by an endless cable moving perpetually in the track. The cages go up and down with great rapidity. The transfer of cars is made expeditiously and the run of the cars to the stock pile or ore pocket and the discharge of its contents and return to the shaft is accomplished with marvellous celerity.

B shaft is sunk to the eighth level and C is nearly there also. A crosscut

at B in the seventh level was 60 feet in ore, but 3 feet east of it was rock; the east side of the lease as it underlies to the northwest. In the eighth level the ore has gone west of the crosscut, south. In the seventh level at C shaft the ore is 100 feet in width and so continues to be so, or nearly that for many hundred feet each way. C shaft is 1,700 feet from the west line and B shaft is 775 feet further east, No. 2 foot wall shaft is 700 feet west of C, and D shaft is 1,100 feet west of C or 600 feet east from the west line. There is another shaft at which they are now working, which is only 150 feet from the west line and is designated as E. At the east end of the mine away up on the hill are A shaft and others; here the deposit is split into what are called the north and south viens; besides which there are outlying pockets of ore. In this part of the mine is found what is termed the crescent ore, a high grade article that yields 67.50 to 68.50 per cent metallic iron and .003 per cent phos.

No. 2 foot wall shaft will be the first important addition. It is a five compartment shaft, four for cages and one for pipes and ladder way. It is now to the fifth level and will soon be used for hoisting and timber. The underground work in the mine already extends west of this shaft and to send the tram cars 700 or 800 feet to C shaft, is a long distance.

D shaft has been sunk from the surface to the ledge and a winze carried down in one corner to the fifth level. In another year the shaft will be ready to use. They are laying the foundations for the huge pumping plant that, at this shaft, will raise all the water of the mine. As preliminary to the foundations a heavy thickness of concrete and broken stone was laid last fall and heavily covered with dirt suitable to protect it from freezing during the winter. This covering has been removed and the great dressed blocks of sandstone are on the ground ready to be laid. Further west, E shaft was begun years ago but the ground was too wet to succeed with it. Now the swamp has been made dry and the shaft can be sunk. No doubt a large amount of ore will be taken out at the west end of the mine against the Ludington mine and possibly also the Hamilton mine this season. The Ludington mine has had the greatest width of ore along adjacent to its east line and in mining it they have even, inadvertently, crossed the line on the Chapin side, so it is certain that the Chapin Co. has a body of ore against its west line. This they propose to attack now and make it add to the season's product. They may strip the surface and mine it in open pit.

They mine in the sixth level by cutting out rooms 20 feet wide in the ore, leaving pillars of ore between, 18 feet wide. They cut out the full width of the room 7 or 8 feet high and fill up as they rise. The "mills" for running down the ore are carried up through the filling and the winzes for bringing the rock down are first made through the ore. The ore is so firm that no timber is required in the rooms. It is not the purpose to disturb the seventh level to a great extent. At first the plan was to leave it intact,—100 feet in width and depth, of pillar to preserve the mine, keep it unremoved; but it is now thought that this stability can be secured by judiciously leaving the greater portion of the ore and allowing some of it to be taken.

B and C shafts are in the hanging wall. In the eighth level at B shaft, it is 50 feet to the ore from the shaft. The plan is to run ropes down B shaft to operate the underground tram cable in the levels below the 6th. The machinery will be in the engine house instead of down in the mine as at C shaft in the sixth level.

Another feature of the underground work is that there are two intermediate shafts, one between B and C, and another west of C. They are used to hoist the ore, cut in the drifts, in the seventh level. Each of these shafts has a hoisting plant placed underground to operate it. They work with skip, and dump the ore into a pocket from which it is drawn out into a car that takes it to the main hoisting shaft.

They are stoping ore in every level in the mine, all the way from the first down. In the upper levels, above the fourth, it is mainly in pillars that they are working. Gradually they are taking out the old pillars and probably will save nearly all the ore. There is ultimate danger that the hanging wall side of the mine will settle to such an extent as to disturb the foundations of the machinery and the shafts. Nothing of this kind has appeared as yet; but in the nature of things, when the hanging wall all becomes undercut, it must give way to some extent. It is hoped that the fact of the mine being kept filled will prevent this disturbance from affecting the work.

There are, I am told, 1,700 names on the pay roll, and about 1,200 men regularly employed.

The annual product of the Chapin has been as follows:

Year.	Tons.	Year.	Tons.
1880 .....	31,556	1885 .....	177,987
1881 .....	134,717	1886 .....	198,871
1882 .....	247,505	1887 .....	334,025
1883 .....	265,830	1888 .....	290,872
1884 .....	290,865	1889 .....	518,990
Total .....		2,494,210	

The capital stock is \$2,000,000, divided into 80,000 shares, and the recent purchasers took the stock at its par value, \$25 per share.

C. H. Cady, Agent, Iron Mountain, Mich.; Wm. Oliver, Mining Capt., Iron Mountain, Mich.; Ferdinand Schlesinger, President, Milwaukee, Wis.

#### THE LUDINGTON MINE,

which joins the Chapin on the west, has undergone some notable changes in the past year. Mr. Banks, the new Superintendent, has accomplished quite a little in the way of surface improvement, much to the advantage of the location. A large space of ground on the foot wall side has been cleared off and made smooth for ore, stocking timber, yard for storing unused material, etc. Also in same side, and conveniently located, a new machine and blacksmith shop has been built, having brick walls and an iron roof. It is 120' x 30' in size.

Mr. Banks is also making a new shaft in the foot wall, south of A shaft. The inclination is 75° to the north. The shaft is to the ninth level, where it is 100 feet south of the ore. It will come down under A shaft at the thirteenth level. This new shaft will be used mainly, at present, to take out the pillars of ore, which are nearly the only available resource for ore until the mine is opened further down, in A shaft. A shaft is 60 feet below the twelfth level now, April 9; 1,100 feet vertically down from the surface. It being

in the hanging wall, gives a good deal of trouble through the settling of the ground. It is proposed to substitute skips for the cages that are now used. Why this shaft was ever located in the hanging wall and why the engine house was similarly placed, it is now difficult to imagine. The company has abundant room on the foot wall side, and the surface there is much smoother. No. 5 shaft was 13½ feet out of plumb; it has been straightened for 400 feet in length. It is sinking and the west end of the mine is looking as well as usual; but what was once the large body of ore in the east end of the mine, is practically gone. In the tenth and eleventh levels, under the ore, above, is now nearly all rock. Mr. Banks confidently expects to find an abundance of ore north of A shaft, the ore that the Hamilton Ore Company has reached. The Ludington Company is sure to get some ore west of the Hamilton line; but how much, future developments will determine. A shaft and the Hamilton shaft are 250 feet apart, and in the 1,225 foot level they are now drifting each way to connect. The drift west from the Hamilton is in ore, and is in the Ludington property. The Chapin ore underlies to the northwest; if the ore in the Hamilton shaft does also, and continues to do so to much greater depth, it will be altogether to the advantage of the Ludington. It is the purpose to work a diamond drill down in the bottom of the Hamilton and explore the Ludington ground west of their line and north of the foot wall.

Mr. Banks is anxious to get A shaft down as soon as possible, to reach this ore that comes into their land from the Hamilton, when he hopes for good results. The C. & N. W. and the M. and N. R. R. Cos., are building a joint bridge over the mine to the foot wall side, where the ore will be mainly sent hereafter. Mr. Banks speaks very hopefully of the future of the mine, based mainly on the Hamilton ore lense. They designate the shafts now, as A, the new one B, No. 5 as C, and old No. 1, D.

Last year, Mr. Banks says, was a successful year for the company. Better wages were paid to the men and more money was made by the company. The ore was mined cheaper than ever before. The main deposit has been getting smaller from the eighth level down. The new shaft is two compartment, double-balance skip and pipe, ladder way, etc. It is in contemplation to get a new plant of machinery for B shaft—two 18 ft. drums. Mr. Banks estimates the product for 1890, at 150,000 tons of ore.

The Ludington mine has annually produced as follows:

Year.	Tons.	Year.	Tons.
1880 .....	8,876	1885 .....	124,194
1881 .....	3,365	1886 .....	76,983
1882 .....	52,519	1887 .....	104,289
1883 .....	102,632	1888 .....	61,883
1884 .....	101,165	1889 .....	116,300
Total .....		752,206	

The mine is in the northeast corner of the S. ½, S. E. ¼, S. 25, T. 40, R. 31. Robt. Banks, General Manager, Iron Mountain, Mich. Of the Chicago office, 59 Dearborn St., A. A. Carpenter, President.

THE HAMILTON ORE COMPANY

has one of the most remarkable undertakings in the whole mining region. Already it has one shaft down to a vertical depth of 1,325 feet, and has begun to sink another 825 feet easterly from No. 1 that it is estimated must penetrate vertically down 2,000 feet before the ore is reached. This new shaft is 7x24 feet, in size, inside the timbers. It is sinking now in limestone and was lowered 60 feet in March, which is rapid sinking. The mine is in the N. W.  $\frac{1}{4}$ , S. W.  $\frac{1}{4}$ , Sec. 31, T. 40, R. 30, and No. 1 shaft is right in the S. W. corner of the land. The strike of the ore formation is about N. 60° W. and the sides of the shaft were made, as near as might be, at right angles and parallel with the formation.

As this corner of the shaft is on the north and south boundary line, the company can have but little extent of ore west even at great depth.

Mr. Jones is confident that the ore extends east and that it continues down to great depth.

He also thinks that the dip of the formation continues to the north and that it runs very flat. The dip, in the shaft, of the formation has continued at about 63°; but at the 1,325 feet level he opened a crosscut to the hanging wall and bored a vertical hole to the foot, from which data he figures the angle of depression to be 45°. At the 1,225 feet level the width of ore was found to be 155 feet; and at the 1,325 feet level it is 110 feet wide, the diminution in width being due, Mr. Jones states, to the flattening of the foot wall. Ore was reached in this shaft at about 800 feet from the surface, and continued in ore for about 500 feet further before the foot wall was reached.

Mr. Jones estimates that he has 2,000,000 tons of ore "in sight." The water is raised by the Ludington costing \$25 per day. As soon as connection is made with the Ludington much less apprehension will be felt. One cannot escape an uneasy feeling for men who are down 1,325 feet below the surface, with only one avenue of escape. A fire that should burn the large shaft house would probably smother them as well as cut off all means of egress from out of the mine. A great deal of faith and courage is shown in the undertaking of sinking the No. 2 shaft. Mr. Jones estimates that he will produce 35,000 tons of ore in 1890.

The officers are Norman Hall, President, Sharon, Pa.; P. L. Kimberly, V. P., Cleveland, Ohio; O. K. Williamson, Secretary and Treasurer, Chicago, Ill.; J. T. Jones, Superintendent; Frank Corbis, Mining Captain, Iron Mountain, Mich.

The yearly production has been as follows:

1886	.....	872 tons of ore
1887	.....	514 tons of ore
1888	.....	8,301 tons of ore
1889	.....	8,368 tons of ore
Total	.....	18,555

The mine, like the Chapin and Ludington, is in the city of Iron Mountain.

THE WALPOLE MINE.

This mine is just east of the Chapin in the same vein of ore. The work has been carried on for several years under the direction of Capt. C. H. Cady for Pickands, Mather & Co., of Cleveland, Ohio, in an exploratory way rather than as a mine. The equipment is adequate for the work that

is doing and the ore is so valuable that the exploration is persisted in. The shaft is 390 feet deep and they have mixed ore 50 feet in width—10 feet wide clean ore—so that it is considered that the outlook for a mine has improved.

Product, 1889, 9,614 tons; total product, 12,224.

Location, E.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 31; and S. E.  $\frac{1}{4}$ , Sec. 30; S. W.  $\frac{1}{4}$ , Sec. 29; T. 40, R. 30.

Quality of ore, .66% iron; .010% phos.

THE MILLIE MINE.

This mine is situated just south of the east end of the Chapin, that is, it is in the east end of the Chapin foot wall.

It has always been a small mine, having one or more lenses of excellent ore. It was formerly operated by the Hewett Mining Company, named after the owner of the fee of the land. This Company, however, believing to have exhausted the mine, relinquished the lease a few years ago and the property was taken by the present company, that has succeeded admirably, considering that it was an abandoned mine.

The mine is in the N. W.  $\frac{1}{4}$ , N. E.  $\frac{1}{4}$ , Sec. 31, 40, 30, and it is looking better than it has at almost any period in its history. Mr. C. W. Kennedy, the superintendent, declares that he will be able to produce 30,000 tons of ore in 1890, nearly double the amount that was obtained in 1888. It is the best of Bessemer ore.

The greatest depth is 250 feet.

D. G. Dessau, Pres't, New York; C. W. Kennedy, Gen'l Manager, Iron Mountain, Mich.

The production in 1889 was 18,916, and total is, 70,408 tons.

THE PEWABIC COMPANY

is the name of an organization engaged in opening a mine in the N. W.  $\frac{1}{4}$  of Sec. 32, east of the Millie. The management is the same as that known as the Menominee Mining Co., that formerly held the Chapin, etc. The Pewabic is now all in readiness for shipping the ore. The C. & N. W. Co. has built a track to the mine or through the valley south of the shaft, and the mining company has made a long, high trestle extending from the mine to it. This track will be operated with rope and winding machinery. At the extremity of the elevated trestle, over the railroad is a double ore pocket to receive the contents of the tram cars and to discharge into those on the railroad.

The shaft is in the side hill which rises above it to the north and descends to the railroad on the south. It is sunk vertically 500 feet, is double cage like those at the East Vulcan. At 350 feet in depth, a drift was made across the formation northeast to the limestone 881 feet from the shaft. At about 800 feet in the crosscut a drift was made west and a body of ore 9 feet wide was found in which a winze has been sunk to the next level.

Two hundred and nine feet in from the shaft a drift east, 190 feet long, came into a fine body of ore, which has been worked out up to the sandstone, 20 to 50 feet high. A winze has been sunk in the ore and from the bottom of the shaft, 500 feet level, a drift was started to reach this ore, but a stream of water was cut that flows nearly all that the pumps can

master, so that they are delaying the drift until they have in a larger pump.

They have 10,000 tons of ore in stock now and ship, probably 30,000 tons. The ore contains 65% metallic iron, .009% phos. So that it is gilt edge.

Geo. H. VanDyke, Sec'y and Treas., Milwaukee; N. B. Hulst, Gen'l Manager, Milwaukee; E. F. Brown, Supt., Iron Mountain, Mich.

THE COMMONWEALTH MINE

situated about a mile east of of Florence in Wisconsin, has much improved in the past year. There is now far more ore in sight than has appeared for several years. Supt. Davidson has been very successful in his efforts. The new body of ore is not a recent discovery. It was found several years ago, but in the past year the company has undertaken to develop it. The shipments for the year just closing, amount, 102,871 tons, making a total for all the years, 595,665 tons.

O. C. Davidson, Supt.

Products of Commonwealth Mine:

Year.	Tons.	Year.	Tons.
1881.....	97,410	1886.....	51,189
1882.....	115,865	1887.....	57,000
1883.....	21,943	1888.....	61,818
1884.....	34,822	1889.....	102,665
1885.....	42,947		
Total.....			595,665

THE FLORENCE MINE

is now one of the Schlesinger group. It was purchased last summer with the Iron River and Youngstown mines, and the three are now designated as the mines of the Florence Iron River Company. In the transfer the owner conveyed three-quarters interest in the fee, the remaining quarter interest being owned by H. D. Fisher, of Florence. The consideration was \$350,000 cash. The Florence mine is proving to be a very valuable one; all developments made tend to enhance its value and very recently there has been much shown up in its favor, which, with the fact of the increase of price of iron ore and the increased demand for it, have augmented the value of the mine to such an extent that if it were to be sold now the price would be a much higher figure. The Florence is an off ore. The best is good ore of the kind—62% in iron, but having a high percentage of phosphorus.

The extreme length of the mine from the east end to No. 7 shaft is 1,920 ft. No. 7 is 330 ft. west of No. 5. No. 5 shaft is sunk to the third level, 230 ft deep. The ore has a maximum width of 100 ft., and is thus far opened in the second level 230 ft., and in the third 197 ft.

In the old mine, east of the shafts above mentioned, they are preparing to take out the ore pillars above the old bottom. They are stripping the ore, that is, running the sand that overlies it down to the second level, 153 ft., after which they will "rise up" on the sand filling and take out the "ore

backs" in the levels above. No. 4 shaft is to sixth level 350 ft. deep. The ore is 50 ft. wide. There is a great deal of ore in sight in the old mine—the east end—and it can be cheaply mined, but it is not a good hard times ore. It is the company's Eagle ore. Mr. Porter has instructions to get out *all* the ore he can, and he is just the man to do it. He will get out 350,000 tons in 1890, and will have 100,000 tons in stock by spring.

Year.	Tons.	Year.	Tons.
1880.....	14,143	1887.....	79,899
1881.....	100,501	1888.....	142,585
1883.....	160,155	1889.....	171,862
1886.....	840		
Total.....			710,718

Ferdinand Schlesinger, President; J. N. Porter, General Manager, Stambaugh, Mich.; S. T. Beattie, Superintendent, Florence, Wis.; Edward Ball, Mining Captain.

THE IRON RIVER MINE

has yielded an unprecedented product in the last year. A good deal of effort has been required to get it, owing to the fact that the preliminary work for so great a product was not done during the winter, or before the opening of navigation. The company did not expect to mine so much ore and had not made the openings for it. Later in the season it became necessary to push things, to mine all the ore that they finally sold.

The north end of the mine has greatly improved of late. No. 3 shaft is at the north end, and at 200 feet north of the shaft a crosscut shows the ore to be 60 feet in width, and the drift 100 feet further north is all in ore, 30 feet wide at the end. This is the west lense of ore, parallel with the old Corbett lense, at the north end. It was discovered, as described in my last Report, in driving the crosscut in the second level east from No. 3 shaft. This new ore body has since opened finely. It is the best Iron River ore.

The company had no trouble in filling its contracts for Iron River ore; the difficulty experienced was to secure enough Corbett ore to fill out their sales before navigation closed. Of course the Iron River ore could have been substituted, but it is better quality and worth more and it was not desirable to make it take the place of lower grade ore at a correspondingly less price. The Iron River mine has never been extensively worked. There has always been ore enough in sight, with the limited amount of opening work done, to fill the small sales that were annually made. The mine is in the strong ore formation and all that one can observe indicates well for the future of the mine. Considerable difficulty was experienced this season from lack of steam. The increase in the work of hoisting taxed the limited boiler capacity at the north end of the mine to its utmost. The proper remedy has been applied; a new boiler house has been built on the river bank, just west of No. 3 shaft, supplied with two fine steel boilers. No. 2 shaft is sunk to the 300 foot level, but the ore had not been reached the last time I was down in the mine, December. The Isabella pit, a mile further south, continues to hold its own in the matter of production, and in

the prospect which it affords for the future. It is 280 feet deep and will produce 100,000 tons in 1890.

The Iron River mine is well managed and well worked. It has the best of superintendence. The ore is cheaply mined.

Since the foregoing was written I have again been at the Iron River mine, and find that they have 90,000 tons of ore in stock, April 1, and the body of ore at the north end has been opened 600 feet in length. The north extremity is now underneath the river and still going on, 30 feet wide. Have begun to sink No. 4 shaft, between the north line of the property and No. 3. Also are preparing for the foundations of a new engine house, for Nos. 3 and 4 shafts.

The annual product has been as follows:

Year.	Tons.	Year.	Tons.
1882.....	29,115	1886.....	78,591
1883.....	100,369	1887.....	82,464
1884.....	52,584	1888.....	109,952
1885.....	55,693	1889.....	179,238
Total.....			688,006

The Iron River ore averages 60 to 61 per cent—the new ore. The new ore and the south end, or Isabella ore, averaged 60 per cent iron; phos., .33 per cent.

J. N. Porter, General Manager; Otto Riebel, Superintendent.

The Iron River mine is at Stambaugh, Mich., in Sections 35 and 36, T. 43, R. 35, Mich.

THE SELDEN MINE

comprising the N. E. ¼, S. E. ¼, S. 35, T. 43, R. 35, near the Isabella pit of the Iron River mine, is now held and worked by the Iron River Co. The St. Clair Bros. operated it in 1886, but it has not since been mined. The fee belongs to the Messrs. Selden, of Stambaugh. The ore thus far found is of poor quality. Mr. Porter is pushing the exploring work in this 40.

THE NANAIMO MINE,

situated across the river from Stambaugh, within the precincts of Iron River village, in Sec. 26, N. W. ¼, S. W. ¼, T. 43, R. 35 W., is idle and has remained so since it was shut down in the summer of 1888. There is still ore in the bottom and perhaps under the improved condition of the iron ore market, the mine could be worked to better advantage now than heretofore. The ore runs about 58% in metallic iron and .25% to .33% phos., with a large percentage of lime also of water.

The fee simple is owned by the McKibbon Bros., of Iron River, Mich. In all, the mine company has produced, since 1882, 110,915 tons of ore.

The lease has been surrendered to the fee owners, and since writing the above the mine has recently (March 10) been again leased, together with the Beta, which joins it and is also owned by the McKibbon Bros., to

H. Neunamacher, of Milwaukee, and others, of Escanaba. The lease runs 20 years. They will put in machinery and proceed to pump out the water and sink the shaft, etc.

Joshua May appears as Mining Captain; E. H. Jones, Supt.

THE SHERIDAN MINE,

also situated in Iron River village, lying southeast of the Nanaimo, between it and the Iron River mine, is, apparently, improving. I saw a small stock pile of first-class ore when I last went to the mine.

The Chicago & Northwestern R. R. Co. has built a spur to the mine, so that Mr. Sheridan is now in shape to ship all the ore he can find and mine out. The ore is, when clean, identical with Iron River ore. The shipment for 1889 was 504 tons. The land is owned by McKibbon Bros., Iron River. Mr. Peter Sheridan held the lease and has made the development. He is now sinking a shaft and is already 100 feet deep. The indications are sufficiently favorable to warrant further work.

In fact I see no reason why, in this stretch of ground, from the river to the Nanaimo, there should not be workable deposits of ore. I understand that the mine is controlled by an organized company, composed of Escanaba men, with Peter Sheridan, President.

OTHER EXPLORATIONS AT IRON RIVER.

Just north of the Iron River mine, over the line on the next section, S. W. ¼, Sec. 25, 43, 35, locally known as the Fred Miller homestead, parties, of whom Mr. J. N. Porter is one, are exploring by sinking a shaft, which is 90 feet deep, and the drift from it is in ore.

Also further west, bordering the village, in Sec. 26, in the J. B. Weimer homestead, parties have taken an option to explore.

In Sec. 35, west of the Iron River mine, on the Selden homestead, Mr. Cornelius Palmer has been exploring. The Brule River Mining and Exploring Co. is preparing to operate on S. ½, N. E. ¼, Sec. 20, 42, 35. F. A. Morrison, Iron River, President.

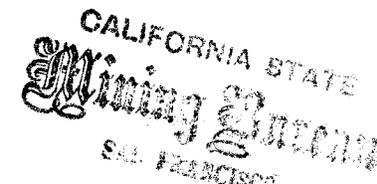
THE CHICAGON LAKE MINE,

in Sec. 26, 43, 34, is now being further examined. There is likely to be a new railroad near it. It is reported that Geo. M. Wakefield, of Milwaukee, has purchased the mine of Mr. N. Boardman. Capt. Alexander Wood is now in charge of the work. Ore was found here, and considerable work done; but the ore was of poor quality.

IN THE CRYSTAL FALLS DISTRICT

the rocks present the uniform characteristics, identical with those at Iron River—a wide belt of dioritic, slaty schists—with jaspery schists in which ore occurs.

The area in which ore is found is many miles wide north and south while the general trend through east and west varies greatly, locally; the ore formation, seemingly lying in many localities north and south following the long outcrops of diorite, which control the local trend of the slates.



The lines of magnetic attraction are more generally north and south, or northwest and southeast than otherwise.

An unusual degree of activity prevails in the region, of which Crystal Falls is the initial point, in the work of exploring; and this activity is likely to continue and increase as the new year advances.

One of the best things in the way of discovery of ore was recently made in Sec. 11, T. 43, R. 31, being the land held on a lease by the Caledonia Mining Company, but since the late discovery of ore at this place

#### THE MANSFIELD IRON MINING COMPANY

has been organized to open and operate the new mine where the ore is found in the west bank of the Michigamme river. Some exploring, done here six years ago, led to the discovery of what was claimed to be a deposit of Bessemer ore. Since then other parties have taken an option on the property and pumped the water out of the shaft, which was 100 feet deep, and have further explored it. But actual inspection of the shaft and cross-cut did not confirm the reports of the value of the mine, and all who undertook to explore the mine gave it up, until last fall, in October, Mr. W. S. Calhoun, a veteran explorer, well known in the region, undertook, in behalf of the owners of the lease, or a portion of them, to examine the property, and his efforts have been crowned with the most gratifying success.

Relinquishing further effort at the shaft, Mr. Calhoun sunk a pit 500 feet south from the old workings; also on the east bank of the river. Going through 8 feet of earth stripping, ore was encountered in which the shaft has since continued to the present depth of 105 feet. They have shown a width of ore of 30 feet, and have drifted 100 feet north and 100 feet south, all in ore. The work of examination will be still continued. The outlook is exceedingly promising. The ore is a rich, soft, brown hematite, the quality of which is shown by the following analyses of samples taken at different points in the shaft: 65.20% metallic iron, .028% phos.; 64.00% iron, .025% phos., 3.90% silica; 64.00% iron, .019% phos.

The mine is in the south 40 of lot 8, Sec. 20, 43, 31, owned in part, I believe, by the estate of the late Geo. Wilson, of Republic, and held on a lease by the Caledonia Iron Mining Company, which has sub-leased to the Mansfield Iron Mining Company.

The C. & N. W. R. R. Company will extend its spur from the Armenia to the Mansfield.

The company is now making all preparations to mine, erecting the necessary buildings, machinery, etc.

Probably 50,000 tons and upwards of ore will be shipped from the mine in 1890. Capt. Edward Ball, formerly of the Florence mine, superintends matters.

#### THE BOHEMIA

is the name given to an exploration for iron ore, conducted close to the Michigamme River, on the east bank, opposite the Caledonia. It is in lot 1, Sec. 20, 43, 31. Messrs Guensburg, Lustfield, Moore and others are the parties interested. They hope to find the Mansfield deposit. The land is owned by the Canal Company.

Also a better prospect is that of

#### THE MAMMOTH,

the name given to an exploration conducted by B. N. White for Angus Smith *et al.*, of Milwaukee, on Sec. 17, N. W.  $\frac{1}{4}$ , S. W.  $\frac{1}{4}$ , T. 43, R. 31. Just north of the Caledonia, some parties are working also in S. W.  $\frac{1}{4}$ , N. W.  $\frac{1}{4}$ , Sec. 20; both adjoin the Mansfield.

Capt. Morrison, an old explorer, is attending to the work. Are 40 feet deep now and have many test pits, showing well.

#### THE HEMLOCK RIVER MINING COMPANY

is second only in importance of the new developments that are reached from Crystal Falls that have been made up to this time—December. The ore is found in the S. W.  $\frac{1}{4}$  of Sec. 4, T. 44 N., R. 33 W.

Land owned by Peter Pascoe, Mat Gibson, the estate of Geo. Wilson and others, who having done all the work so far, have, within a few weeks past, given a lease to Pickands, Mather & Co., of Cleveland, Ohio. The consideration paid being \$40,000 with a fixed royalty on all ore that shall be mined. Mr. Henry Warner, of Marquette, late Superintendent of the Grand Rapids mine, now supervises matters at the Hemlock. The exploring work was done under the superintendency of Capt. E. S. Roberts, now at the Mastodon.

The ore is crossed by the north and south eighth line, it is near the Hemlock river, which runs southwesterly, diagonally across the quarter section. The trend of the ore is in the same direction. The location is rather low ground bordering the river. The general elevation being about 12 ft. above it.

Up to this time—December—they have developed a length of ore of 250 ft., leaving a width at the north shaft of about 45 ft. at right angles to the long axis of the ore. At the south end the ore is 30 ft. wide. The shafts are 260 ft. apart and 60 ft. deep. The ore is non-Bessemer, hematite averages 60% or upward in metallic iron. It was first found in the river. The place is reached by a wagon road from Crystal Falls, from which it is thus distant about 16 miles. Probably a railroad will be made to it the coming year, in time to send away ore before the close of navigation. The new company is engaged in erecting buildings, preparing the surface, getting in machinery and placing it, etc.

JAMES PICKANDS, *Treasurer*,  
Cleveland, Ohio.

#### THE OTHER EXPLORATIONS

in this locality have not shown up very much as yet except perhaps one eight miles north of the Hemlock mine, in the E.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 28, T. 46, R. 33, made two years ago by Mr. J. C. Fowle and others and which I described in my report of 1887.

Possibly a shipping mine could be opened here as soon as railroad facilities were provided. Exploring work is now in progress at this location. Mr. J. G. Butler has the option.

Hon. George Wagner of Marquette, with others interested, is exploring for ore, east of the Shafer. They hold the S. E.  $\frac{1}{4}$ , Sec. 30, and S. W.  $\frac{1}{4}$ , Sec. 29, 43, 32. They are in a good ore formation.

East of the Great Western mine in the E.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 4, 43, 31, Mr.

B. N. White, Superintendent Florida and others interested, are conducting an exploration for ore. They have sunk 70 feet and are already in ore. Also in the S. E.  $\frac{1}{4}$ , S. E.  $\frac{1}{4}$ , Sec. 25, 43, 32, just west of the Shafer mine, Mr. J. G. Butler, Jr., is exploring for ore. C. L. Lawton directs the work.

#### THE NIGHT HAWK

is the name given to an exploration in the N. W.  $\frac{1}{4}$ , N. W.  $\frac{1}{4}$ , Sec. 18, 42, 32, near the Mastodon mine. 50 feet of ore has been sunk in, in a shaft which is now, March 1, 63 feet deep. The proprietors now propose to crosscut and drift in the ore. The ore is similar to Mastodon ore.

#### THE MASTODON MINE

lying four miles south of Crystal Falls, in the northeast  $\frac{1}{4}$  of Sec. 13, S.  $\frac{1}{2}$ , 42, 31, has been so fully described in former reports, that it requires no extended mention here. It has proved to be a valuable mine, a fine lense of excellent non-Bessemer ore that has been cheaply mined and readily sold. The method of working the mine has been peculiar. The stability of the inclosing rock formation is remarkable; allowing very large chambers to be formed by removing the ore, the roof holding its place without requiring any timbers to support it.

Not much exploring work has been done, as the main deposit has given ore enough to meet the sales.

So far it seems to be a lense of ore inclining down to the northwest; its horizontal section being about 200x300 feet. The shaft is now, March, 340 feet deep, and will soon reach the body of ore that was found with the diamond drill a few years ago. It is situated north of the open pit. They will sink in the ore to the 300 foot level and open south in the ore. The ore also will be found north and east of the shaft. The intention is to open well by navigation time and be prepared to mine and ship 100,000 tons next year. Capt. C. T. Roberts continues to operate the mine on contract, that is, he mines the ore at a certain price per ton. The mine is kept in good shape and the location has much improved of late years. New machinery has been added, new buildings erected, etc.

C. T. Roberts, Agent, Crystal Falls, Mich.; Joseph Austrian, Secretary and Treasurer, 7 Rush St., Chicago.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882.....	3,477	1886.....	41,640
1883.....	18,577	1887.....	49,115
1884.....	18,020	1888.....	51,293
1885.....	11,773	1889.....	63,086
Total.....			256,945

The company is exploring in the W.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 13, 43, 32, north of the mine.

There are 25,000 tons of ore in stock.

#### THE SOUTH MASTODON MINE

lying immediately south of the Mastodon is a promising property. It is separated from its neighbor by the rock that underlies the Mastodon lense. Undoubtedly they must look for another lense of ore than the Mastodon. Possibly conditions might be found similar to those at the Dunn where the ore body is divided by a crossing of rock. The mine is about 250 feet deep. The shaft is in a strong ore formation that affords the best of indications for ore but while there is good ore found there has as yet been no large body of entirely clean ore encountered. There are drifts in various directions—all of them showing more or less ore. Mr. Edward Blake, the manager, and the parties interested with him, have shown a good deal of persistence in the work at the South Mastodon. The indications are all favorable; but still no considerable body of ore entirely free of rock is found.

The product in 1888 was.....	Tons.	2,722
The product in 1889 was.....		4,006
Total.....		6,748

Edward Blake, Superintendent, Mastodon, Mich.  
The description is N.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 13, 42, 32.

#### THE ALPHA MINE,

in the S. W.  $\frac{1}{4}$ , S. W.  $\frac{1}{4}$ , Sec. 12, 42, 33, a short distance northwest from the Mastodon, is now working. Frank Brotherton is operating it. He has a deposit of hematite ore, 10 feet wide, which he is working, and is, at the same time, further exploring for more ore. The shaft is about 85 feet deep; at further depth they will crosscut the formation.

#### THE DELPHIC MINE,

in the N. E.  $\frac{1}{4}$ , S. W.  $\frac{1}{4}$ , Sec. 24, 42, 33, which has been idle for several years, has been freed of water and they are sinking to greater depth and purpose to more thoroughly explore the property. It is a fine location, with suitable buildings, machinery, spur from the Mastodon Branch Railroad, etc.

When worked, the ore deposits were never large, and, finally, nearly disappeared altogether. Subsequent efforts, made with a diamond drill by the Whittlesey Bros., failed to discover much ore. The purpose now is to sink and crosscut, etc.

The mine was opened in 1882 and worked down to 1887, during which time it furnished 33,246 tons of ore.

#### THE ATLAS,

so-called, is an exploration that Capt. C. T. Roberts is conducting near Mastodon.

#### THE DUNN MINE

is a property that has turned out exceedingly well; when it was purchased by Mr. Schlesinger, three years ago, there was not much to indicate that

there existed so great a body of ore as has since been developed. It has proved to be a large deposit of good non-Bessemer, hematite ore, that, thus far, has been cheaply mined. The ore exists, apparently, in two lenses separated by a thin barrier of rock, which may prove to be only a "horse" or pillar of rock and thus the ore be found to be continuous beneath it. However the two deposits lie north and south of each other, the north deposit having been worked in open pit so that now it is a great uncovered chasm, 160 feet deep, 200 feet long, and 150 feet wide. The formation is ferruginous schist, which strikes north and south and dips vertically. The body of ore is simply a great pocket or lense existing in the schist with its long axis inclining to the north. There is a skip road, which goes down the wall at the northeast corner of the pit and further north is a shaft passing through rock at first but reaching into ore further down. The intention now is to work the mine underground, taking out rooms and leaving pillars. The south lense is covered over yet but it has been roomed out beneath; the purpose is to mine the pillars and let the surface in, this has not been practicable so far owing to the position of engine house.

The company is now building a new engine house on the high ridge over to the west of the mine. It will contain four 10 ft. drums, hoisting engine, boilers and compressor, etc. I was told at the mine that the company expected to get out 200,000 tons of ore in 1890.

The mine is close to the east line of the property. The description is the W.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 1, 42, 33. The Dunn is one of the Schlesinger group of mines, operated by the York Iron Co.

Product	Tons.
1887.....	25,470
" 1888.....	118,091
" 1889.....	151,828
Total.....	295,389

Ferdinand Schlesinger, President, Milwaukee; E. Florada, Supt.; F. C. Bennett, Mining Cap't, Crystal Falls, Mich.

There are now, March 1, 27,000 tons of ore in stock. The mine is about 250 feet deep, 80 feet below the bottom of the open pit.

#### THE SHAFER MINE

is located a mile north of the Dunn, in the N. W.  $\frac{1}{4}$  of the N. W.  $\frac{1}{4}$ , Sec. 31, 43, 32. The mine is 500 paces from the N. W. corner of the section. There has been a great change here within the past year for the better. The mine from being one of doubtful value, is now in a fair way to be one of the best in the district. The land consisting of the west half of section 31, was owned by J. F. Shafer, of Iron Mountain, and Carl Shelden, of Houghton, who gave an option to Chicago parties for the purchase of Mr. Shafer's half of the estate for \$80,000, and the lease of the other half at 12 $\frac{1}{2}$  cents per ton royalty for the ore. The results of the examination, which was made, was so favorable that the purchase, etc., was consummated, and Mr. E. P. Jennings, Chemist and Engineer for the Florence Iron River Co., was appointed Superintendent, and the work at the mine has been pushed remarkably well ever since. Already there are now, March 1, 20,000 tons of ore in stock.

The ore occurs in the ferruginous slate or schist which constitutes the chief rock formation of this section of country. The trend is here

about N. 60° W. and dipping slightly N. E., that is the formation stands nearly vertical. The foot and hanging walls of the ore are the same. The mine was originally a narrow open cut, about 200 feet in length and 80 feet deep; but the ore was too much mixed with rock. At greater depth it has proved to be cleaner, but more particularly so to the east and north of the open pit. Apparently the ore is very wide and there is a good deal of it. A shaft has been started at 250 feet north and east of the open pit shaft. It was supposed that it would be in rock all the way, that ore was south of it, but at 75 feet in depth the shaft came into ore. The deposit was thus found to be much wider than was expected.

There is some Bessemer ore in the west end of the mine, but whether they will save out a Bessemer product I do not know. The ore is not high in phosphorus and contains upwards of 60% metallic iron, and is just above the Bessemer limit. The shaft in the pit is 85 feet below the open bottom, and the No. 2 shaft will be sunk to a depth of 200 feet, when the two will be connected at the bottom. A compressor has been added to the machinery. There are two five-foot hoisting drums. Sixty men are employed.

Kirke Himrod, President Shafer Iron Co., 517 Rookery Building, Chicago; E. P. Jennings, Superintendent; Capt. Jones, Mining Captain. There were shipped from the mine in 1889, 11,166 tons of ore, making a total to date of 65,818 gross tons.

#### THE JUNIATA MINE

situated in Crystal Falls in the E.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 29, 43, 32, has been resurrected by Mr. C. M. Wheeler of Marquette, who has had the water pumped out of the mine and is now engaged in sinking the shaft and otherwise exploring the mine. I described the mine in 1887; nothing has since been done until now. It is a good ore formation but thus far no considerable body of clean ore has been encountered. In April, I learned, when at Crystal Falls that all work at the mine had been suspended.

#### THE YOUNGSTOWN MINE

which had been idle for two years, has been partially worked during the latter part of 1889.

The mine is situated about a mile northwest from the village of Crystal Falls in the N. W.  $\frac{1}{4}$ , Sec. 20, 43, 32.

The mine is close to the west line of the section. The mine was held on a lease by the Briar Hill Iron and Coal Company of Youngstown, Ohio, that last spring relinquished the lease on the section 19 portion of leasehold which the company also held till then. It is rather poor ore, unsaleable in dull times, and the company thought that section, 20, gave them all of this quality of ore that they cared for. Subsequently, during the year, the mine was sold to Ferdinand Schlesinger.

Capt. C. T. Roberts took the contract to mine 80,000 tons of ore in section 20, and is now engaged in this work. Mr. C. L. Lawton represents the company at the mine to see that the terms of the contract are observed.

The mine was fully opened; no sinking was necessary.

The ore runs about 54 $\frac{1}{2}$ % in iron, 30% and upwards in phos. and 41% to 30% in manganese. It is now operated by the Florence Iron River Company, J. N. Porter, General Manager.

The product in 1889 was 7,470 tons, making a total of 110,057 tons. It might be valuable if ore with a certain percentage, sufficiently high, of maganese could be obtained. But the percentage of this element in the ore varies exceedingly. They are putting in a new hoisting plant.

#### THE CLARE IRON COMPANY

is an organization recently made to operate the section 19 mine, joining the Youngstown on the west. The lease was secured by Mr. Schlesinger and ultimately, no doubt, the two will be worked under one superintendence. Mr. E. S. Gilbert, late of the Florence mine, is now Superintendent of the Clare and is rapidly getting matters into shape to mine out ore. J. N. Porter, General Manager.

#### THE MONITOR MINE,

situated in lot 6, Sec. 20, east of the falls in the Paint river has turned out very well indeed so far as the quantity of ore is concerned. There is a large body of ore which is now quite fully opened up. The ore was first found by the Paint River Co., having been worked into west of the line from the east. After the Monitor Iron Co. was formed, a shaft was made from the surface just west of the boundary and the ore was hoisted through it. During the past year another shaft has been sunk away to the west and north of the ore and the engine house and machinery placed north of it on the higher ground. The formation is iron schist, standing about vertical, with a strike nearly east and west. The surface arrangements have been much improved in the past year and the mine seems to be fairly well equipped now, new machinery has been supplied, which includes a compressor. The shaft has reached a depth of nearly 200 ft.

The ore is about 50% iron, and 35 to 80% phos.

Product 1889, 21,620 tons; total 14,533.

W. S. Coffman, President, 185 Dearborn St., Chicago, Ill.

#### THE PAINT RIVER MINE

is close to the west line of the land adjoining the Monitor; both are in the same deposit of ore—the one east and the other west of the line separating the properties. The Paint River mine has two shafts, A and B, the latter being very near the Monitor line. It is upwards of 200 feet deep, vertically down. The ore is from 20 to 60 feet in width for a length of more than 200 feet. The mine has good machinery and can produce a much larger product of ore than has ever been sent out from it, if there is demand for it; but the ore is of a quality that must sell at a low price and thus cannot always, probably, be produced at a profit.

The mine is now worked on company account.

Frank Scadden, Superintendent; Robt. Phillips, Mining Capt.; Madison La Monte, President, Chicago.

Three thousand tons of ore in stock and many thousands of tons are broken and ready to hoist, underground.

The annual production has been as follows:

Year.	Tons.	Year.	Tons.
1882.....	4,615	1886.....	13,933
1883.....	5,971	1887.....	10,240
1884.....	11,546	1888.....	12,506
1885.....	2,374	1889.....	32,161
Total.....		103,346	

#### THE LINCOLN MINING CO.

is a recent organization formed to explore and operate the Fairbanks mine, situated between the Paint River and the Great Western mines, being in the west half of the S. W.  $\frac{1}{4}$  of Sec. 21, T. 43, R. 32. The headquarters of the new company is at Escanaba. H. A. Barr, President; F. H. Brotherton, Secretary and Treasurer.

Mr. J. B. Swartz has been exploring lately to find the continuation of the ore and has sunk a shaft 65 feet in depth, which he states is in ore of good quality.

Capt. Swartz will continue as Superintendent and is now engaged in overhauling the old machinery and getting matters into readiness to prosecute systematic mining work. The Fairbanks mine was opened in 1882 and soon worked out; that is, the ore which was at first found was soon exhausted. The present find is further north and east; the old mine was on the section line, 80 rods north of the section corner.

#### THE GREAT WESTERN MINE

in the E $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , Sec. 21, 43, 32, holds its own remarkably well. The owners have the advantage in the fact that this mine affords some of the best of ore. It is a pretty wet mine and has been an expensive one to work, owing to the fact that the ore has occurred in distinct pockets, that required considerable rock drifting to reach. The pockets have not proved to be persistent, they disappeared after a level or two and ore had to be found in some other place.

A year ago when I was at the mine it was nearly full of water, but the water was finally got rid of and a product of 37,855 tons of ore mined and shipped away. The mine is to the sixth level, 315 feet deep. That is No. 1 shaft has been sunk 60 feet, to the sixth level; in the fifth level the main body of ore, at No. 1, was 100 feet wide, and Capt. Hooper finds so far as he has opened in the sixth, that it will be equally as large. The Great Western is a better mine than it has had credit of being. The work has been slow and expensive owing to the want of adequate pumping plant and of a compressor, both of which machines have been lately supplied. The water is much less troublesome now that there is a large pump, new Worthington, to take care of it; and the walls of hard rock and of hard ore are far less a barrier now that they can use power drills to demolish them.

Analysis of the ore in the bottom at No. 1 shaft show 65 per cent iron; .196 per cent phos., and 64.60 per cent iron, .22 per cent phos., thus showing it to be high grade non-Bessemer ore. The mine is in low ground and gets a good deal of surface water, but Capt. Hooper has supplied a launder that carries it away nicely. The compressor is a duplex Rand, long stroke; also

two new boilers, all in a new building. The mine will give a larger product in 1890 than ever before.

J. M. Turner, Lansing, President; Wm. Hooper, Superintendent, Crystal Falls, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882.....	587	1887.....	23,239
1883.....	22,825	1888.....	21,861
1884.....	20,722	1889.....	37,855
1886.....	25,725		
Total.....			152,813

The location is about a mile in direct line from the village of Crystal. The corporation is now the Iron Star Mining Co.

Since writing the above, on April 11, a sad accident occurred in the mine causing the death of the Superintendent, Capt. Wm. Hooper, and injuring several others, two of them seriously. Capt. Hooper was esteemed a good miner and a very intelligent, reliable man.

#### THE ARMENIA

is another of the so-called Schlesinger mines. It is a new mine, having been opened in the beginning of 1889. It has done very well for the first year, having produced 44,670 tons of ore. The company expects to greatly increase this amount in 1890, but to what extent they may succeed in doing so it is difficult to judge. It needs further work to determine the extent of the ore; even in a comparative limited degree. The mine is in the center of the E.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 23, 43, 32, three miles east of Crystal Falls. It is directly east from the Youngstown, Paint River, and Great Western mines. But here in this locality the trend of the ore is north and south or nearly so, corresponding with the direction of the diorite outcrops, which occur also.

Considerable interest attaches to the Armenia, as there are other incipient mines in the vicinity, having the same kind of ore and having the same characteristics of formation, etc., which will be valued somewhat by the outcome at the Armenia. The ore is about 60% iron, slightly non-Bessemer; thus a good saleable hematite. The mine is well equipped with machinery, etc. An extension east of the Great Western mine railroad branch, reaches the mine, the corporate title is the Armenia Mining Co.

Ed. Florada, Supt.; A. J. Carlin, Mining Capt.; Ferdinand Schlesinger, President.

Product, 1889, 47,775 tons.

#### THE HOLLISTER MINE

is directly north of the Armenia one mile, being in the W.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , Sec. 13, 43, 32; it is evidently in the same "run of ore." Some mining was done at the Hollister last season and a few hundred tons of ore put in

stock on the surface, but as there is no railroad at the mine it could not be shipped away.

There are two parallel deposits of ore, one, however, is of poor quality, the other, an excellent dark brown hematite, probably non-Bessemer, though it seems to be only about at the limit in phos. This deposit is 10 ft. and upwards in width for a length of 200 ft. so far as developed. The other deposit of poorer ore is much larger. Work was discontinued in September last, so that at the time I was at the mine the pits were full of water. I am informed that a company has been formed in Milwaukee to work the mine and that operations will begin about the first of March. Heretofore it has been operated by S. D. Hollister, who held the lease, explored the land, etc.

#### THE BLANEY MINE,

more recently the Wauneta, is in the N. W.  $\frac{1}{4}$ , S. E.  $\frac{1}{4}$ , Sec. 27, 43, 32, the estate comprising the entire  $\frac{1}{4}$  section. I have fully described all that has been done here and the results, so far as finding ore mattered, in previous reports—1886-1887, nothing has since been done. I think those who did the work, finding it unsatisfactory, surrendered the lease to the canal company who owns the fee.

A shaft was sunk on this property 110 ft. deep, much drifting done and some good ore found. It is reported that Mr. H. J. Benjamin and other Milwaukee parties, have taken an option of the Wauneta and will further explore it.

#### THE LEE PECK MINE

is about half a mile northeast from the Blaney, in the W.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 26, 43, 32, not far from the center of the section. Under the recent stimulus in mining and exploring work in this locality the Lee Peck is undergoing further examination. Some systematic work was done prior to 1888, that is the exploratory work was discontinued in the beginning of 1888. Some very good ore was found, but not in large quantity. Further exploration may give better results. The ore is about 80 rods west of an out crop of diorite, which extends north and south.

#### JOHN L. BUELL

is exploring in this vicinity—reexamining some old explorations, among others, the James-Rahrer option in Sec. 28, 43, 32.

It would be needless to indicate all the exploration in progress in the Menominee region, there is so much of it.

#### THE ESCANABA RIVER LAND & IRON COMPANY

has been organized and will examine the Cheshire and Swanzey mines that have been idle for a year or two past. The company also contemplates making exploration of some lands in the vicinity.

Frank Brotherton, one of the company, an able explorer, will do the examining work.

## THE MINES OF THE MARQUETTE RANGE.

with scarcely an exception, have furnished as much ore in 1889, as ever before, some of them even a greater product; and they afford the evidence necessary to give assurance that they will not fall short in 1890.

## OF THE JACKSON MINE

there is nothing new to add. It is an old mine; the ground, to a limited depth, has been pretty well perforated with shafts, tunnels, drifts, cross-cuts, chambers and drill borings.

For several years past there has been no large body of ore anywhere to work upon. The product has been kept up, but the ore has been obtained from a good many places.

I have described, in the last report, the hard ore deposit, which had been opened into northwest of the old north pit. At the time I saw it a year ago, it was looking very favorable. It did not, however, hold out. The ore deposit, instead of proving to be what was expected, wedged out. The incline shaft that was so troublesome to sink, and which ended, as it seemed, against this same fold of ore that they were mining in further north, is now all in rock at the bottom; the ore has disappeared.

It is a very curious formation. It is full of pockets of ore but they work out. It did seem from all the data, that they were in a fold of ore lying in jasper and under the quartzite that possessed permanence and magnitude. Still further on to the west, if the old borings are to be trusted, they are sure to find a big deposit of ore.

This north pit, working still, gives a good deal of ore, as is seen by the large stock pile, which is daily increasing.

The company is also tramming in the old Pioneer pit, in fact almost everywhere in the old mine. No. 8 pit has been extended nearly to the east line, and a rise made up to the surface has been turned into a shaft through which ore is now hoisted. Borings made in several places develop the existence of underlying deposits of ore; alternating jasper, soap rock and ore.

The company owns the mining right under a portion of the city—the N. E. part of Sec. 1 and drill borings show that ore exists there which it is contemplated to sink a shaft to reach.

In the South Jackson, the Moyle is the main pit still. It is sunk 200 feet below the tunnel. The ore is 7' to 20' wide and 200 feet long. The ore averages about 55% iron and .080% phos.

The east end pit contains a manganese ore that goes 7% manganese, which with the iron, goes 61% iron and .048% phos. The deposit is 10 feet wide 225 to 200 feet long. They make a separate product of this manganese ore. Jackson mine is in the City of Negaunee.

Annual products of the Jackson mine are given in the following table:

Year.	Tons.	Year.	Tons.
Previous to 1856 (estimated) .....	25,000	1873 .....	130,131
1856 .....	417	1874 .....	94,708
1857 .....	12,442	1875 .....	87,283
1858 .....	10,909	1876 .....	98,480
1859 .....	23,377	1877 .....	80,340
1860 .....	41,295	1878 .....	89,120
1861 .....	12,919	1879 .....	112,921
1862 .....	46,046	1880 .....	120,622
1863 .....	77,237	1881 .....	118,939
1864 .....	83,905	1882 .....	98,670
1865 .....	65,505	1883 .....	71,278
1866 .....	92,287	1884 .....	76,626
1867 .....	127,491	1885 .....	67,657
1868 .....	130,324	1886 .....	89,525
1869 .....	125,908	1887 .....	108,947
1870 .....	127,642	1888 .....	101,720
1871 .....	132,297	1889 .....	128,892
1872 .....	114,910		
Total .....			2,925,451

Samuel Mitchell, President and General Manager, Negaunee, Mich.

## THE CLEVELAND IRON COMPANY.

If the certainty of possessing a vast quantity of ore, enough to keep up a great product through many years to come, suffices to assure a long lease of life, then the Cleveland mine is only in the zenith of its career. Its owners can look forward to as many years of prosperity as are embraced in the history of its past. There is nothing new or important developed in the old mine, the Incline, the Moro, the No. 3, etc., pits, these all show the customary features and look neither better nor worse than they have for several years past. But the new mine under Lake Angeline is proving far better than was hoped for. Apparently this is one of the largest deposits of hematite that has ever been found on Lake Superior.

A brief description of the situation may be necessary to fully understand the matter.

The Cleveland mine, in the city of Ishpeming, is in a broad fold of the formation, running east and west, which contains the Cleveland, New York, Cliff, Barnum and Lake Superior hard ore mines. This one main synclinal embraces several minor folds, which contain the different pits of the several mines. The Cleveland mine is at the east end of this basin, where on the south, east and north the jasper underlying the ore comes to the surface and protrudes above it, in places, to a high elevation.

South of the jasper, at the Cleveland mine, is a steep, narrow bluff of diorite which, on the south side, drops abruptly to the surface of Lake Angeline. This basin of water is in section 10, and is a mile in length east and west and about half a mile across at the widest place, where the north and south center line crosses it. It contains a depth of water in the center of 30' to 37 ft., and for several years, until within a few weeks, it has been the source of supply of the city for water.

The diorite again out crops to a considerable height south of the lake and forms a synclinal beneath it but far down under the ore, which rests on it.

The trend of the axis of the trough or basin, under the lake is slightly north of west and southeast, extending beyond the west end of the lake where it is the ore basin of the Lake Superior hematite mine. Thus we have here in this synclinal trough a deposit of ore a mile in length, across Sec. 10, one half mile in the Cleveland Cos. land, and an equal distance in the lands of the Lake Superior Iron Co.

Three years ago the Cleveland Company thinking that the Lake Superior Cos. hematite basin of ore must continue easterly under the lake, decided to test the matter, borings were made through the ice, as explained in the Report for 1887. The result verified all that had been conjectured regarding the existence of ore and since that time preparations have been making to develop a mine under the lake. In fact the mine is opened, not extensively as yet, but a great deal has been done beneath the surface and above it; and all in a most systematic manner. On the north side of the lake, the narrow margin between the high diorite bluff and the water has been widened and graded for railroad tracks, ground for stocking ore, timber, etc., shaft house, ore pockets, etc., erected. All is compact and convenient.

They are now putting up a mill near the shaft to be provided with all the machinery for framing the mine timbers. Such a mill has for some time been used in the Gogebic range and does this work admirably. It costs now \$1.80 to \$2.00 per set to frame the mine timbers, the same result will be accomplished by machinery for 18 cents per set. The cost of the mill is \$15,000. The shaft is in the north margin of the lake, dipping to the south at an angle of 50°, double track, ladder way, etc. The skips will be operated to balance one another; that is the empty car descending as the loaded one goes up; also a tail rope will be added.

Rock for filling the mine, will be brought from the waste dumps from the old mine, north of the bluff. A convenient rock pocket has been made into which the cars, loaded with rock will discharge their contents automatically. The rock in this pocket may be run into a chute, that extends down into the mine, or may be drawn into cars and run down on a track to the first level, thence to the place to be filled. All spaces that are made by the removal of ore will be first held with timbers and then filled with rock.

So far, the work below has been to sink the shaft, crosscut to the ore in the first and second levels, and drift on the deposit to mark off the rooms.

It is 240 feet along the line of the shaft to the first level. Thence south to the ore, 58'. Width of ore in this north fold is 71 feet; through dead ground 405 feet. Then south branch of the fold of ore, 75', thus making this crosscut in the first level 609 feet in length. At the center there are 71 feet of earth and rock between the drift and the water. The vertical distance below the collar of the shaft is 157 feet. At half-way of the crosscut, three borings were made: one to the north, depressed 45°, passed through 135 feet of earth, etc., then 70 feet of ore to the diorite. A vertical hole found also 135 feet of intervening material and then 170 feet of ore. A boring to the south, 45° down, first cut 225 feet of overlying material and then 136 feet of ore.

Thus we have a section of the ore at this place which pretty fully shows the dimensions of the fold. At the end of the crosscut in the first level, they have bored a horizontal hole to the south, 900 feet, to the Lake Angeline mine deposit. This boring cut four points of diorite, separated by soap rock; but no ore was found.

This and further borings and, also, test pits show that the Lake Angeline mine deposit, lying south of the lake, is shallow at the east end. The pitch of these folds is to the west; starting from the surface at the east, they increase in depth and magnitude to the west. The shaft of the Cleveland Co. will be 500 feet long to the bottom of the fold; 135 feet below the first level the crosscut will be all in ore—a body of ore 400 feet wide north and south. In the first level they have opened thus far, March 1, 400 feet east and 400 feet west of the crosscut. In the second level, the crosscut is in the ore in north branch 80 feet; will be 100 feet wide, probably; 380 feet through rock to south lense. The levels are 130 feet apart, measured on the incline. The outcrop of the ore is found on the south margin of the lake at the east end under the soil. Mr. Mills now has a drill working over on the south side and also has some men sinking test pits to find the ore. It is the intention to drain the lake before doing any work underground beyond drifting and exploration. The water will be pumped out, possibly, during the present year, 1890. Also, another shaft will be sunk towards the west, in place to properly divide the ground between the present shaft and the west line. The ore is identical with that of the Cleveland hematite, about 62% iron, and slightly non-Bessemer. The underground tramming will be by cable, as at the Chapin.

The Moro Pit is down to the twelfth level, about 800 feet deep. It is producing 10,000 tons of ore per month. It presents the same features as heretofore, a very good hard ore mine. The "back" in the Saw Mill pit has not been taken yet but they are prepared to do so soon.

The Incline is about as it has been for several years. It is an immense pit that has given a great many thousand tons of ore; now it is only a Scram. Still the diamond drill is at work, and there are late developments, which lead to the inference that the end of the Incline mine is not yet. No. 3 mine has much ore of a low grade and some good ore. It is the greatest producer, next to the Moro, of hard ore. A drill hole, just bored, in No. 3, dipping to southwest, cut 53 feet of ore, a fact that is looked upon as very encouraging.

The Cleveland Hematite, located about a mile to the north, has somewhat improved. The mine is 725 feet deep vertically down and a winze in the ore is still below this bottom.

The shaft will probably be sunk another hundred of feet and the drift made to the ore. The ore deposit is found to be larger now than it was.

Mr. Mills is exploring it to be satisfied that the ore holds out to fully pay for the sinking and drifting to get it.

It will be remembered that the ore body has, for the last several hundred feet down, inclined away from the shaft which is vertical, so that it is now as far from the bottom of the shaft to the ore as it is to the surface; and it is hard jasper, very expensive ground to sink or to drive in.

The Cleveland company holds here in one body about 2,000 acres of land, a very valuable estate.

The Cleveland mine produced in 1889.....	215,829 gross tons
The Cleveland Hematite mine produced in 1889.....	48,987 gross tons
The Lake mine produced in 1889.....	9,232 gross tons
Total.....	274,048 gross tons

The following shows the annual shipments:

Year.	Tons.	Year.	Tons.
1854	3,000	1872	151,724
1855	1,444	1873	133,265
1856	6,343	1874	105,855
1857	13,201	1875	129,881
1858	7,909	1876	145,661
1859	15,787	1877	151,554
1860	40,041	1878	148,320
1861	11,794	1879	113,108
1862	40,364	1880	187,254
1863	46,842	1881	207,843
1864	49,954	1882	204,341
1865	33,355	1883	218,219
1866	42,680	1884	224,479
1867	75,864	1885	218,632
1868	102,112	1886	209,356
1869	106,133	1887	204,828
1870	133,884	1888	182,733
1871	142,658	1889	274,048
Total.....			3,156,631

Samuel L. Mather, President and Treasurer, Cleveland, Ohio; Fred A. Morse, Secretary, Cleveland; F. P. Mills, Superintendent, Ishpeming, Mich.

THE LAKE SUPERIOR IRON CO.

has made but little new development within the past year. The company is constantly exploring with the diamond drill, and otherwise in the mine and wherever ore is found. Before deciding to sink or drift to it to mine it, it is first determined that there is enough to, at least, pay the cost of getting it and a safe margin in favor of profit. The policy of the company has ever been both conservative and progressive, an admirably managed corporation, that for many years has been uniformly prosperous. Like the Cleveland, it is an old company, one of the largest producers of ore, and its mines also within the city of Ishpeming.

The several mines or pits of this company that are now producing ore are No. 2, No. 7, A shaft, Sec. 16 mines, and the Hematite. The No. 2 has been the largest producing hard ore mine. It was a lense of ore in a fold of the formation, between the Jasper and the quartzite, which was opened down to a depth of 725 feet, and has not since been deepened, having reached, it is believed, not the bottom of the fold, but as far as it will pay to go. Jasper had taken the place of the ore. There is a little stoping done in the mine aside from the floors and pillars. About 40% of the ore remained in these and the work of removing them has begun. They work up from the bottom level, having taken out of the floors of the three lower levels and filled the space with rock. The rock is run down from the surface and the work progresses satisfactorily, though, of necessity, not rapidly. The pillars at No. 2 shaft have not been disturbed yet.

No. 7 the most westerly mine, has been sunk 60 feet, they have found that there is yet a deposit of good 65% hard ore. The pumps had been pulled out of this mine intending to run the water through a long drift at the bottom to No. 2, but it has been decided to restore the pumps, and a new Worthington is now going in.

A shaft has become a deep open pit, close to the highway. They have worked west under the road; but are leaving pillars so that the ground is

well supported. The deposit is apparently a fish-bellied basin that is nearly worked out. There ought to be ore deeper down and further east, since ore was found in the Union drill hole bored on the line, on the flat ground, by the Lake Superior and Cleveland companies, several years ago.

Section 16 mine is, thus far, not a large mine; it is close to the Pittsburgh and Lake Angeline mine, joining it on the west. The mine is 430 feet deep and the winze at the shaft is sunk 100 feet more, from the bottom of which they will rise up in the shaft and thus extend it down. The ore is mostly Bessemer, though there is a percentage of the product that is not. An imaginary vertical plane, east and west, through the mine divides the two grades. Some borings to the west discovered excellent ore and a shaft has been started 400 feet northwest of No. 1 to reach it. The shaft is now, March 1, 100 feet deep.

The following are several results of analyses of drill cores, which show the valuable quality of this ore: Iron 68.88%, phos. .070%; iron 67.78%, phos. .016%; iron 66.25%, phos. .014%.

The Lake Superior hematite, which lies west of Lake Angeline, has gradually been extended east until it is now under the margin of the lake. This is undoubtedly the same fold of ore in which the Cleveland company is opening further east. In a few years more this deposit will be mined beneath the whole length of the lake. The prospect is a very favorable one for both companies.

Another level has been opened in the east end 513 feet below datum or 70 feet lower than the general bottom of the mine. They had supposed that they were at the bottom of the ore. The fold in which it lies runs tolerably uniform the whole length of the mine. At the east end the ore gets thin in the main deposit, and the ore of this new level is separated from that above by 70 feet in thickness of intervening rock. The ore has a width of 50 or 60 feet. They have started to sink a shaft, located at 600 feet east of the cage shaft, this being not far from the lake margin.

Some analyses of the cores of ore obtained by boring east from the east end of the mine, gave—iron, 64.98 per cent, phos. .032 per cent; iron, 63.60 per cent, .032 per cent phos.

The company mined and sold in 1889 as follows:

Hard ore of all grades except Sec. 16 mine.....	140,453 gross tons
Hematite.....	127,802 gross tons
Sec. 16 mine.....	20,529 gross tons
Total product.....	288,784 gross tons

Year.	Tons.	Year.	Tons.
1858	4,658	1874	104,311
1859	24,668	1875	119,365
1860	33,015	1876	110,570
1861	25,145	1877	127,349
1862	87,704	1878	104,674
1863	78,976	1879	174,747
1864	86,773	1880	204,094
1865	56,201	1881	252,285
1866	68,002	1882	246,504
1867	114,935	1883	204,799
1868	105,745	1884	204,796
1869	125,560	1885	226,040
1870	166,582	1886	265,085
1871	158,074	1887	302,909
1872	145,070	1888	240,225
1873	169,428	1889	268,784
Total.....			4,669,006

Jos. L. Fay, Treas.; G. W. R. Matteson, Pres't; A. C. Tenney, Sec'y; office, 28 State St., Boston, Mass.; C. H. Hall, Agt.; W. H. Johnson, Supt.; H. B. Sturtevant, Engineer and Chemist; John McEnroe and James Trebilcock, Mining Captains, Ishpeming, Mich.

#### THE PITTSBURGH AND LAKE ANGELINE MINE,

it is unnecessary to say, is one of the best iron mines in the State. There is no better ore than that found in this mine and consequently it sells at the highest price. It is not an expensive mine to operate. There is, comparatively to some mines, very little dead work to do.

The mine is about 400 feet deep, to the sixth level, to which it was sunk several years ago, but the sixth level was not opened; more than half of the original amount of ore yet remained in the levels above and the product has, for three years, been derived from the upper levels of the soft ore portion of the mine and from the west end hard ore deposit. The levels are fifty feet apart and the openings in the ore were "rooms," eighteen feet wide across the deposit, leaving pillars of ore 18' wide between the rooms. The rooms were timbered well, after the usual manner, in "sets." In addition to the pillars, floors of ore were left, ten or twelve feet thick, forming arches between the pillars. The ore is so soft that, with other causes, the ground has settled and tended to fill the rooms by the coming together of the pillars and floors. By judicious skill Capt. Walters is able to obtain the ore with little loss. He says that he gets 90% of the ore. They allow the surface to settle and fill the space as the ore is removed.

They hoist ore in all four of the shafts, but by far the most from C, which is sunk in the rock in the southwest part of the mine.

There is a good deal of ore in the Lake Angeline mine, but one cannot reckon to a certainty upon its production for many years ahead. The lenses of ore pitch down to the west and the company is mining to the west line where its workings and those of the Lake Superior Co. are close together. But there is far more ore east of the line at the west end, apparently, than there is west of it. At the west end they are stoping in all the levels from the second to the fifth and have five shafts. This part of the mine is now more fully opened and shows to better advantage than ever before. This hard ore deposit is a chimney or lense; its axis inclining down to the west at a high angle.

The width is, approximately, 200 feet and the varying length of the horizontal section extends to the west line. Of course the width is not uniform, neither the length. The maximum length of the mine is about 2,200 feet, and it is opened the entire distance. There is ore all the way except that the successive lenses, lying the one over the other, towards the west, are separated by a few feet of rock. All this has been fully dwelt on in former reports, particularly in those for 1885 and 1886.

No. 1 hard, C shaft ore, averages above 67% in iron and below .010% in phosphorus.

The averages of the shipments to lower lake ports for the whole season 1889, are as follows:

No. 1 hard ore .....	66.44%	iron, .011%	phosphorus
Sheffield ore .....	61.79%	" .020%	"
Hematite ore .....	65.68%	" .085%	"
South Angeline ore .....	62.19%	" .120%	"
Columbia ore .....	57.70%	" .018%	"

The two last brands of ore represent but a small portion of the total output.

The following table shows the year's production of the several kinds:

Lake Angeline Hematite .....	82,099 tons
South Angeline ore .....	20,020 "
No. 1 hard ore .....	80,655 "
No. 2 hard ore .....	43,901 "
Columbia ore .....	2,395 "
Total .....	229,070

General Office, 105 Superior street, Cleveland, Ohio. W. J. Pollock, Secretary; A. Kidder, General Agent, Marquette, Mich.; Thomas Walters, Superintendent, Ishpeming; E. F. Bradt, Mining Engineer and Chemist.

#### Annual Products, Pittsburgh and Lake Angeline Mine.

Year.	Tons.	Year.	Tons.
1864 .....	19,500	1877 .....	19,113
1865 .....	20,151	1878 .....	28,161
1866 .....	24,073	1879 .....	25,420
1867 .....	46,607	1880 .....	14,794
1868 .....	26,651	1881 .....	18,000
1869 .....	39,644	1882 .....	14,518
1870 .....	53,467	1883 .....	27,259
1871 .....	33,645	1884 .....	87,018
1872 .....	35,221	1885 .....	111,051
1873 .....	43,933	1886 .....	131,384
1874 .....	30,499	1887 .....	191,121
1875 .....	30,281	1888 .....	220,600
1876 .....	22,539	1889 .....	229,070
Total .....		Total .....	1,543,831

Within fifteen months the company has declared \$35.50 dividends per share, making \$710,000. The capital stock is 20,000 shares: market value, \$175 each; par value, \$25 each.

#### IRON CLIFF COMPANY.

The estate and franchises of this important mining corporation have passed to the control of new owners.

By the purchase of 14,000 shares of the stock at \$125 per share, according to the information which I have received, by capitalists in Cleveland, the controlling interest is now held in that city. At the price at which the controlling interest was secured, the total value of the company's property would be about \$2,500,000. There are upwards of 50,000 acres of land held in fee simple by the Iron Cliff Co., much of which is well situated with reference to the occurrence of ore. There are several mines already worked in the property, and more may be found. To those conversant in the matter, the sale is a surprise; that is, people think that the price paid is a very low one. The gentlemen making the purchase are well known in Cleveland iron circles—S. L. and W. L. Montrose, J. H. Wade, Selah Chamberlain, George Howe, *et al.*

Generally also there is an expression of satisfaction that the sale has been made. The policy of the Iron Cliff Co. has been considered as an

illiberal one in the matter of leasing its lands. I think that it is not until recently that leases for mining would be given at all. They would pay a reward for the discovery of ore, so much per ton on all the ore the company would mine, to the party making the discovery. I have heard it frequently said for many years, by explorers, that they would not look for ore on the Iron Cliff Co's. lands. Any way it is very seldom that discoveries are made on the lands of this company, and they are certainly favorably situated for the occurrence of ore. It is no doubt far better for the country that a company holding a large tract of lands, lying idle, should be willing to lease them on suitable terms to persons or companies who wish to explore them for ore or to mine it. Tying up lands by an illiberal policy may retard the development of the country. So it is that one hears it said that the change of owners of the Iron Cliff will be, undoubtedly, of advantage to the country and to individuals. What effect the change will have, if any, in the local management of the company or of its mines does not appear. No one desires any change to be made, so far as I have heard, of local officers, they are all well liked. The policy of the company, shaped by the President and Directors is beyond the local agent and his subordinates, and it is this that people seem glad to have changed.

The mines of the company are the Cliff, Barnum, Salisbury, and Foster, all of which except the latter, are within the city of Ishpeming.

THE CLIFF is a valuable hard ore mine, in the northwest part of the city. The ore is a fold of the formation between jasper and quartzite. The shafts are two, A and B, of which the former is the furthest east, but both are to the same depth, 472 feet, and are 835 feet apart. They are vertical cage shafts, and if the hoisting machinery will equal to the wants of the mine these two shafts could send up a great deal of ore. The mine could produce 200,000 tons in 1890, may be it will any way; but the hoisting machinery, both engines and drums are inferior to the necessities of the mine. No doubt the new company will displace it with something better. They can break more ore now than they can hoist. The mine has not been greatly explored. The company does not seem to have been able or to have cared to sell much ore and so the mining work has not been pushed.

The stoping is mainly above the bottom of the mine in the north branch of the fold where it goes off quite flat to the north. The Cliff is an interesting mine, a pleasant one to examine; it is easy to get into and out of and to traverse through. The roll of the formation is so distinct, the walls, in places so smooth, the separation of the ore belt from the quartzite so entirely complete that one thus finds many things of interest to note. In parts of the mine there is too much jasper; it comes in too freely to take the place of the ore. At the east end the formation is broken up, and work in that direction has not proved very satisfactory. Not much has been done west of B shaft, but borings, etc., show that ore exists in that ground in quantity. I have described the mine so fully in past reports that I find nothing new to add.

THE BARNUM has the advantage of being drained by the Lake Superior mine, which it joins, and being supplied with air, for the drills, from the compressor at the Cliff, so that the cost of the ore is thus reduced to a point that the company can afford to mine it. Were it not for these advantages the Barnum would be an abandoned mine.

The product of the Cliff mine in 1889 was .....	Tons.
The product of the Barnum mine in 1889 was .....	134,616
	12,834
Total .....	147,450

These mines have together produced annually as follows:

Year.	Tons.	Year.	Tons.
1868 .....	14,386	1879 .....	24,911
1869 .....	37,503	1880 .....	24,921
1870 .....	44,793	1881 .....	27,281
1871 .....	45,939	1882 .....	41,424
1872 .....	88,381	1883 .....	62,752
1873 .....	44,368	1884 .....	67,782
1874 .....	40,255	1885 .....	47,458
1875 .....	40,914	1886 .....	82,686
1876 .....	37,750	1887 .....	95,586
1877 .....	38,314	1888 .....	88,731
1878 .....	26,680	1889 .....	147,450
Total .....			1,120,510

Wm. Sedgwick, Superintendent, Ishpeming, Mich.; Tom Barge, Clerk, Ishpeming, Mich.; Alex. Maitland, General Manager, Negaunee, Mich.

THE SALISBURY MINE,

situated south of the diorite bluff, which separates it from Lake Angeline is also owned and operated by the Iron Cliff Co. It is a hematite mine that has always been, I should judge, a profitable one. It is good ore and has been cheaply mined. Formerly the ore was close to the diorite and was mined out, leaving a great open pit. But following the diorite it has gone away off to the south, and the shaft, which starts from the surface at the southeast corner of the open pit, has been constantly inclined more and more to the south, to reach the ore which at each successive level has dipped away further to the south. A downright shaft was finally started, 600 feet south of the old one, and is now about ready to operate. It is 485 feet deep, 85 feet below the lowest level of the mine. It is 9'x20' outside measurement. A large, substantial shaft house has been erected over it. A new engine house built, supplied with two Corliss engines, 18''x48'' each, and two hoisting drums, 10' diameter. Also a new pumping plant, made by Allis & Co., consisting of two 14 inch plunger pumps. So far, they have operated with the old machinery. It will be seen that the Salisbury is now well equipped and can be operated more largely than heretofore. It is not a large deposit of ore so far, but holds its own admirably.

Alex. Maitland, General Manager; Thomas Buzzo, Superintendent and Mining Captain.

The following table shows the yearly product:

Year.	Tons.	Year.	Tons.
1872 .....	545	1881 .....	41,888
1873 .....	11,023	1882 .....	42,019
1874 .....	6,730	1883 .....	17,028
1875 .....	4,571	1884 .....	23,171
1876 .....	20,510	1885 .....	29,508
1877 .....	37,868	1886 .....	51,231
1878 .....	52,155	1887 .....	49,229
1879 .....	39,770	1888 .....	74,886
1880 .....	22,887	1889 .....	72,500
Total .....			600,349

## THE FOSTER

is an old hematite mine, owned and operated by the Iron Cliff Co. It is in sections 22, 23, 47, 27. It produced in 1889, 13,238 tons, making a total to date of 188,554 tons.

## THE BRAASTED

is the new appellation given to two old mines, the Winthrop and the Mitchell. These mines have quite recently passed to the ownership of Mark Hanna, of Cleveland, Ohio, and of Mr. Fred Braasted, of Ishpeming. The latter gentleman has controlled the mines for the past year and a half and the effect of his proprietorship became quickly apparent to the advantage of the mines.

Capt. W. J. Officer was placed in charge as superintendent and he rapidly made needed changes that greatly improved matters. He completed the sinking of the downright shaft that was started eight years ago and systematically opened up the ore deposit to the southwest, where it proved to be large and of excellent quality. He moved the engine house over on the foot wall side, did away with the unwieldy and inadequate pumping plant by substituting a large Worthington in its stead. This easily raises all the water in the mine. He has turned the stone pumping engine building into a compressor house, added steam power, put up a machine shop, and in all ways the mine has been put on a thorough going basis.

The Winthrop is an old mine and a good one. It should have always been a profitable one, because there was always the ore in sight and it was of a quality to be salable, when properly got out. But owing to the unfortunate method of working followed by the late owners, it has of late years been unduly expensive. The mine was worked as an open pit, it had become very deep, the surface caved in onto the ore and this dirt mixed with ore to the amount of many thousands of tons was hoisted and dumped on the surface south of the mine. All this was costly work and it also caused great delay just in the opening of the season. Then the pump was a wonder. The ropes reached from the pumping house the length of both mines—half a mile—and some part of the togglement was constantly giving out. The situation of the mines is admirable for catching all the water on the surface in time of heavy rain or melting snow. Hereafter this source of trouble is not likely to be serious. Capt. Officer has made a long launder, which conducts the water when once out of the mine far away from it. A second Worthington pump has recently been procured to be placed in a shaft in the Mitchell end of the mine. The new pump has a capacity, so stated, of 800 gallons of water raised 800 feet per minute, with a reserve power of 50 per cent addition to be applied in any case of emergency. These two pumps will very easily raise all the water from both mines. The water is no longer the *bête noire* as in former times.

The weight of the Worthington for the Mitchell is 50,522 lbs. It is the Lehigh pattern, having two 19 $\frac{1}{4}$ -inch high-pressure steam cylinders, two 33 $\frac{3}{8}$ -inch low pressure, four 10-inch plungers, all 24-inch stroke; has a No. 7 independent condenser, two steam cylinders 7 $\frac{1}{2}$  inch diameter, two water cylinders 10 $\frac{1}{4}$ -inch diameter, 10-inch stroke. The engine is supplied with Corliss dash relief valves, the Corliss valve motion, by the use of which attachment it is said that there is but one per cent lost motion. Both high and low-pressure cylinders are steam jacketed.

The product, 155,342 tons mined in 1889, was all from the Winthrop mine, the work in the Mitchell having only recently begun. There are four shafts, the extreme ones A and D, only, are now used.

The mine, underground, was in bad shape but this is being rapidly rectified and as at the Winthrop end it will be systematically worked. The surface arrangements have been changed to great advantage. It looks quite different and much improved.

The ore in both mines, is very soft, averages about 62% in iron and is slightly non-Bessemer.

Table Showing Combined Annual Product.

Year.	Tons.	Year.	Tons.
1870	2,469	1880	57,997
1871	7,314	1881	64,864
1872	14,436	1882	56,653
1873	39,702	1883	50,143
1874	47,950	1884	82,960
1875	8,642	1885	71,630
1876	32,832	1886	86,318
1877	16,446	1887	98,078
1878	27,999	1888	88,638
1879	38,500	1889	155,342
Total			1,017,499

The Winthrop is the S. W.  $\frac{1}{4}$ , Sec. 21; the Mitchell, the N. W.  $\frac{1}{4}$ , S. E.  $\frac{1}{4}$ , Sec. 21, and the mine is close to the north line of the property, each way from the center line of the section.

Fred Braasted, General Manager; W. J. Officer, Superintendent, Ishpeming, Mich.

## THE FITCH IRON CO.

is a corporation lately organized to operate a newly discovered mine, known as the Merrywether exploration, situated about two and one-half miles west of the Braasted, and one mile from the Saginaw mine, in the S. W.  $\frac{1}{4}$ , N. E.  $\frac{1}{4}$ , Sec. 24, T. 47, R. 28; belonging in fee to the Iron Cliff Co., but held on a lease by the Fitch Iron Co., the royalty being 40 cents per ton for the ore. The company was organized in January last with capital stock of \$1,100,000, divided into 40,000 shares.

Exploration was begun in April last, by Mr. C. Merrywether, John Jochim and others, of Ishpeming, and was so far successful that a deposit of the best hard specular ore has been found, which appears to be in sufficient quantity to insure the having of a working mine. Preparations are making to be in first-class condition for operating. Buildings are going up for holding the necessary machinery and for other purposes, so that the company will be early in the field in shipping ore, the ensuing season.

The location of the shaft is 300 feet from the east line of the property, and 500 feet from the north line. The ground is dry so no pump has been required in the work of exploration: The formation dips north and the strike is east and west.

This is a range in which are many abandoned mines. The New England, Lowthian, Saginaw, Sec. 19 mine, Goodrich and Albion. It is a strong ore formation giving a foot wall of banded jasper and hanging of quartzite.

In places, as the Sec. 19 mine, the hanging is a quartzite conglomerate. The ore is remarkably good working ore in the furnace, as it contains a percentage of silicate of alumina, a very necessary ingredient of furnace slag.

At the Fitch the ore is slate and black granular. The shaft, 8'x12' inside, is 85 feet deep, first passing through 16 feet of drift. At 55 feet in depth a crosscut found the ore 26 feet wide. The slate ore is along the foot. They had drifted along the foot about 30 feet in ore. Test pits on the surface, further east, discover the continuance of the ore. Analyses of samples of the ore result as follows: Slate ore, iron 68.96%, phos. .012%; iron 66.42%, phos. .063%; granular ore, iron 65.80%, phos. .100%.

The track from the Goodrich mine, which is but half a mile distant, will be extended to the Fitch. The chief stockholders are Pickands, Mather & Co., Cleveland; W. F. Fitch, Marquette; Louis Stegmiller, Escanaba; A. B. Eldrige, Ishpeming. Sixty men are employed.

Mr. J. F. Armstrong, late of the Cleveland Iron Mining Co. is Superintendent.

#### THE GOODRICH MINE

is located in the N. W.  $\frac{1}{4}$ , N. W.  $\frac{1}{4}$ , Sec. 19, and is the next east of the Fitch. It was operated from 1873 to 1882 by Capt. Goodrich of the Goodrich line of steamers. The total production was 51,479 tons of ore.

The formation is very irregular, and I suppose that the financial result was not satisfactory, still, I think, it is a good mine to explore; the indications are good. I described the mine in a former report, 1881 I think.

#### THE SAGINAW MINE

is again undergoing examination. Mr. Lee Peck has pumped out the water and is exploring the mine. The Saginaw was opened in 1871, by Messrs. Sam. Mitchell, Lonstorf and Maas, of Negaunee, who sold to the Cleveland Rolling Mill Co., for \$300,000, in the fall of 1872, and soon after the Saginaw Mining Co. was organized to operate the mine. The mine has been fully described in earlier reports.

It was closed down and abandoned in 1884, up to which time it had produced 439,328 tons of ore. It is proper for those to note who are re-examining this mine, that Capt. Mitchell explored it, as he thought, thoroughly, with a diamond drill, and that the result of all that he did was such as to cause him to abandon the property.

The mine is in the N. W.  $\frac{1}{4}$ , N. E.  $\frac{1}{4}$ , Sec. 19, 47, 27.

#### THE ALBION MINE

is situated between the Saginaw and the Goodrich mines. It was opened in 1871 by the St. Clair Bros., who leased the land of Messrs. Ed. Breitung and S. L. Smith. 4,592 tons of ore were mined and shipped.

#### THE SECTION NINETEEN MINE

was owned and operated by the Lake Superior Iron Company, having been first opened in 1871 and was worked ten years. There were two shafts: No. 1, near the boundary line of the Saginaw, was 100 feet deep, dipping

to the north 45°. No. 2 shaft, 480 feet east of No. 1, was 200 feet deep. The extent of underground opening when I was last in the mine, ten years ago, 450 feet east and west. West of the shaft the ore averaged ten feet wide; and east, 16 feet. The average dip was about 50°—jasper foot and quartzite conglomerate hanging. The ore was chiefly granular, rich in iron, with a percentage of alumina that was disseminated through it as a soft, whitish, greasy feeling mineral. The mine attained a depth of 300 feet, when the ore gave out and the mine was abandoned. Capt. P. T. Tracy, superintendent of the work.

I have thus briefly described these old mines for the reason that the discovery at the Fitch has awakened renewed interest in the range and it is probable that considerable exploring work will be done.

#### THE CAMBRIA

and Lillie mines are contiguous, and have the same owners and have had the same general manager. So that it would seem to be a good plan to consolidate them and operate them under one corporation.

The Cambria was started in 1876, the land being leased from the Teal Lake Iron Co. It lies west of Teal lake and the workings are now close to the margin, probably the ore extends under the lake.

The Cambria has been a good mine, and still continues to be. It has not been a large mine but a profitable one to its owners. Until within a few years the mine was further west and south, the workings joined those of the Lillie and extended by a series of pockets directly east. This deposit of ore has been exhausted and the mine is now in a belt of ore further north, where the ore deposit holds in magnitude and in quality now, as well as it has at any time since it was opened. The ore body has a length of 300 ft. and a width of 40 ft. In fact the company expects to get out 100,000 tons in 1890. There are now 17,000 tons in stock.

They are down to the fifth level, 350 ft. deep. The location is a mile northwest of Negaunee.

Analysis of the average of the ore gives 61% in iron, .032% phos. Alex. Maitland, General Manager; Charles Koch, Superintendent.

Table Showing Yearly Product of the Cambria Mine.

Year.	Tons.	Year.	Tons.
1876.....	6,324	1883.....	47,508
1877.....	10,082	1884.....	59,740
1878.....	3,754	1885.....	50,796
1879.....	6,860	1886.....	59,406
1880.....	7,232	1887.....	41,138
1881.....	18,837	1888.....	59,009
1882.....	47,545	1889.....	72,780
Total.....			491,075

#### THE LILLIE MINE

formerly the Bessemer, was also opened in 1876. The land consists of 70 acres located in S. E.  $\frac{1}{4}$  of Sec. 35, T. 48, R. 27, being fractional on Teal lake. The land is also owned by the Teal Lake Iron Co., but held on a

lease given to C. M. Wheeler and others who first worked the mine and assigned to Wm. H. Barnum and others, who organized the Lillie Mining Co.

The ore body that was originally mined was worked down to a considerable depth, leaving a large open pit. The ore now is south of the open pit under the hanging wall. The strike of this range is about east and west, dipping south at about 45°.

The body of ore has lateral dimension of about 275 feet each way. The shaft is in the ore and it requires too much ore to be left in pillars to support it so that a new shaft will be started in the foot wall, they purpose to rise and sink in the shaft.

The ore averages 61% iron and .070% phos.

*Statement of Annual Product.*

Year.	Tons.	Year.	Tons.
1875.....	144	1883.....	2,172
1876.....	6,801	1884.....	2,683
1877.....	10,127	1885.....	708
1878.....	8,586	1886.....	3,957
1879.....	21,681	1887.....	23,041
1880.....	18,347	1888.....	32,692
1881.....	16,718	1889.....	33,916
1882.....	28,221		
Total.....			212,156

A. Maitland, Gen'l Agent; Charles Koch, Supt.

Passing the Cleveland Hematite, which has been previously mentioned the next mine west is

THE DETROIT

of which there is not much to be said at present. The company is exploring for more ore, also sinking the shaft that was started a few years ago south of the mine, some ore was found at this point by boring with a diamond drill. So far as I know, no new body of ore has been found on the property the past year.

I have described the mine heretofore, and no important change has occurred in the past year. The product in 1889, was 10,113½ tons, making a total to date of 132,070 tons.

Jas. McMiller, President; W. K. Anderson, Sec'y and Treas., Detroit, Mich.

THE HARTFORD MINE

joins the Cambria on the east, and while work continues on this property not much progress is made towards making it into an ore producer. It is in the Teal lake range, affords good indications of ore, and there is more than half a mile of the formation. I have described it with sufficient fullness heretofore, especially in reports 1886-7.

Product 1889, 566 tons.

Ben. Neely, Proprietor, Negaunee, Mich.

THE LAKESIDE IRON CO.

is an organization made at Negaunee to explore east of the Hartford, in the northwest part of the city of Negaunee.

THE ELBA MINING CO.

is exploring in the City of Negaunee, north of the office of Iron Cliff Co. They have, March 1, a shaft down 60 feet deep in an ore formation. John Rowe, Superintends the work, Mr. A. Maitland and others are footing the bill.

THE NEGAUNEE MINE,

a mile east of the city, is a flat deposit of ore, dipping northwest at an angle of about 24° with the horizon; the upper edge of the ore is about 260 feet below the surface. The shaft is 438 feet from the surface down to foot wall of ore. The ore deposit has a maximum width, east and west, of 350 feet; it narrows somewhat suddenly at about half way up, so that it will only average 150 feet wide the rest of the way up. The length of the foot wall is about 500 feet. The thickness of the ore, perpendicular from foot to hanging, is from 16 feet to 35 feet, banded ore, having the exact resemblance to banded schist. I described the method of working the deposit in my last report. There is no change; they are extracting the pillars above the shaft and also now mining below the level of the point where the shaft intersected the ore. The same method is pursued as heretofore; the shaft has been sunk deeper and the ore is run to it through a crosscut in the foot. No timbers are used. In mining out the pillars they work from the upper end towards the shaft and thus remove all the ore. It is mostly soft hematite, 60 per cent and upwards in iron and all within the Bessemer limit.

The product was:

1887.....	5,359 tons
1888.....	45,304 tons
1889.....	78,318 tons
Total.....	128,981 tons

Samuel Mitchell, Manager, etc.; Albert Newcome, Superintendent, Negaunee, Mich.

Negaunee Mining Co. is the corporate name.

THE BARASSA.

East from the Negaunee mine and joining it, two different explorations are in progress, the one north of the other. The N. W. ¼, N. E. ¼, Sec. 5, 47, 26, is held by John F. Mack, of Marquette, who is working to find ore with the churn drill, south of this in the S. W. ¼, N. E. ¼.

THE U. S. GRANT IRON CO.

is also working just east of the Negaunee mine. They have a stand pipe to the ledge and have started a diamond drill. Their prospects of finding ore are excellent, and if found it is likely to be good Bessemer ore. Mr. Anthony Broad has charge of the work.

THE BUFFALO, SOUTH BUFFALO, QUEEN, AND PRINCE OF WALES MINES

are all in Sec. 5, 47, 26, and all together hold 145 acres of land. All the mines corner at the  $\frac{1}{2}$  post in the north and south center line, to the S.  $\frac{1}{2}$  of Sec. 5. The Buffalo being the N.  $\frac{1}{2}$ , and the South Buffalo the south forty of the W.  $\frac{1}{2}$  of the S. E.  $\frac{1}{4}$ , Sec. 5. The Prince of Wales the north part and the Queen the south part of the E.  $\frac{1}{2}$  of the S. W.  $\frac{1}{4}$ , Sec. 5.

The great deposit of ore that has given to these properties such extraordinary prominence and value, is in the low ground right about this common corner. They all share in it. It was plain to see that four mines operated by four separate companies, all working about a common point, were liable to get matters a good deal mixed. It was impossible that they could work to advantage, or even properly. A wide deposit of very soft ore cannot be safely and economically worked in the manner that this was undertaken by these companies. And it was not surprising that accidents already began to occur, and much greater danger and difficulty were foreshadowed.

Fortunately these mines are now all under one management; controlled and operated by a single proprietor. The stock had not been greatly scattered; it was gathered up and transferred to a single purchaser, Mr. Ferdinand Schlesinger, who now owns the four mines.

The transfer was made in the fall, and already a great change is manifest. It is one of the most active mining locations in the country, new shafts are sinking, shaft houses building, engine houses going up, and powerful machinery being placed in them, extensive ware house, machine shop, carpenter shop, blacksmith shop, boiler house, office, dwellings, etc., are building, and with all, the underground work, the mining and hoisting of ore goes on rapidly; 1,000 tons per day being the average production. There is a good deal to do to get things into shape, the ore is in a basin, a fold of the formation, which forms a valley running east and west in which is the ore. The ore has an extreme width of 400 feet, and a length of 1,000 feet and upwards. Of course it is not continuous but there is ore a long way, nearly the half mile of the length of the property. It generally has a good width, and near the center, at the north and south  $\frac{1}{4}$  line the ore is extraordinarily wide. There is certainly ore enough in sight in all the mines to insure a large out put.

They have adopted a sensible plan to work, having located four shafts in the south side in the foot wall, these will be 300 feet deep, and double skip shafts from which they will crosscut to the ore and through it, and take it all out, letting the surface settle as the ore is removed. The new buildings and machinery are first class. The engine houses are covered with corrugated iron and no pains or expense is spared to make the equipment equal to the best.

The Buffalo, the oldest of this group of mines, seemed, a year or two ago, to be pretty well worked out. It was first opened on its higher ground near the east line, but working west the Buffalo also has its share of ore near the common center.

There is a run of ore a little west and east of the main deposit, that is 200 feet long and 50 to 75 feet wide. The ore in these mines is all well up in iron, but more variable in phosphorus. It contains about 60% iron, 60 to 65%, and from .046% to .090% phosphorus.

Although worked under one management and as a single mine, each mine

will be credited with its share of the product, etc. There will still continue four corporations under one head.

Ferdinand Schlesinger, President; Thomas C. Cole, Supt., Negaunee, Mich.; J. B. Jeffery, Mining Capt., Negaunee, Mich.

These mines produced in the years indicated as follows:

Mines.	1886.	1887.	1888.	1889.
Buffalo.....	10,860	24,686	30,801	69,359
South Buffalo.....		4,914	24,707	64,122
Queen.....				
Prince of Wales.....				

The change of owners was made at three of the mines on Nov. 1, the South Buffalo on Dec. 1. The mines have the tracks of both C. & N. W. and D., S. S. & A. R. R.

THE LUCKY STAR

and other locations lying west of the Queen, etc., mines, are being further explored. At the Lucky Star the diamond drill is employed.

The old south side Negaunee hematites, the Grand Central, Rolling Mill, Manganese Mines, etc., are no longer worked. The active ones are:

THE LUCY,

the Milwaukee, the Grand Rapids, the South Jackson and the Pendill, or, as it is now called, the East Jackson, mines.

The Lucy was formerly known as the McComber, and has always been a pretty good hematite mine, yielding manganiferous ore. It was first opened in 1870 by Wm. C. McComber, on lands owned by James P. Pendill. The mine is in the N. W.  $\frac{1}{4}$ , N. W.  $\frac{1}{4}$  of Sec 7, 47, 26. There are five large open pits, made years ago, as the mining is all under the surface. As at the Jackson mine, the formation is very irregular and the strata very much folded. The ore has a banded, jasper appearing structure, precisely similar in appearance to the jasper, which contains it.

The underlying rock is diorite and the jasper and ore are contained in the folds, basins and hollows of the diorite. Here, at the Lucy, there is, dipping south, a belt of banded jasper and manganese ore. It makes a broad synclinal, coming up at the south in the sharp, irregular folds, of which the pockets of ore are found.

The ore in all the mines in this entire range, in which I include the Negaunee, etc., mines in section five, further east, has every appearance of having been derived from the jasper, which must have been highly silicious and greatly impregnated with felsite. Subsequent chemical forces of nature have removed the silica, while the alkaline bases, iron, manganese, etc., remain. The presence of feldspar as an original element in the rocks, is apparent, from the white, greasy feeling kaolinite that is found, more or less, in all the ore.

At the Lucy and south Jackson, which are antiguous, the ore all contains a percentage of manganese and some of it is highly manganiferous. Analyses of the ore vary greatly. One made by Mr. C. E. Wright, some years ago, of ore from No. 1 pit at the Lucy, gave:

Metallic iron.....	49.80
Metallic manganese.....	10.90
Phosphorus.....	.084
Sulphur.....	.021
Silica.....	2.050
Alumina.....	2.200

I noticed, when I was at the mine a few days ago, that they are making a separate stock pile of ore high in manganese. It yields 48 per cent and upwards in iron and 11.06 per cent manganese, .070 per cent phosphorus, silica, 7.51 per cent. Of this they will get 5,000 tons. They are making three grades of the ore. About half of the product yields 54 per cent iron, 5 per cent manganese, .04 per cent phosphorus.

The mine is looking extremely well, better than for years. At No. 5, the new shaft at the southeast, they have drifted in the ore 300 feet and have crossed it a width of 100 feet. The shaft is 300 feet deep. No. 3 is 270 feet perpendicular and the pit is showing a greater length of ore than it did a year ago. The product for 1890 will be about 60,000 tons.

Mr. A. Maitland, of Negaunee, General Manager; James Rowe, Mining Captain.

Year.	Tons.	Year.	Tons.
1870.....	4,856	1880.....	31,028
1871.....	15,442	1881.....	23,230
1872.....	25,030	1882.....	40,300
1873.....	38,332	1883.....	14,676
1874.....	2,612	1884.....	
1875.....	10,357	1885.....	
1876.....	17,232	1886.....	
1877.....	19,691	1887.....	11,584
1878.....	30,130	1888.....	22,276
1879.....	28,962	1889.....	32,982
Total.....			374,460

#### THE MILWAUKEE MINE

is but a short distance southeast from the Lucy, over the high greenstone ridge that intervenes. There is nothing new at the Milwaukee. The entire work is confined to the No. 9 pit, heretofore described in former Reports. It is probable that the ensuing year, 1890, will exhaust the mine.

They are working along close to the Grand Rapids mine where all the ore exists that is known of on the property. Carmichael Bros. continue to operate the mine for the company.

A. Kidder, Agent, Marquette; W. E. Stone, Treasurer, Boston, Mass.  
Product, 1889, was 52,728 tons, making an aggregate of 349,608 tons.

#### THE GRAND RAPIDS MINE

lies just west of the Milwaukee. The old workings are not promising; but further west the result of recent diamond drill borings indicate something more favorable for the future. It is contemplated to sink a shaft to reach the ore thus found. The Superintendent, Mr. Wm. B. Davis, estimates that the mine will produce 25,000 tons of ore in 1890, even if the new shaft is not sunk. There are the pillars of ore about No. 1 shaft and other pillars

and small stopes in the mine from which to derive the estimated product. However, the work of another year may change the outlook of matters.

The officers are L. H. Withey, President, Grand Rapids; J. C. Holt, Secretary and Treasurer, Grand Rapids; W. B. Davis, Superintendent.

The product in 1889 was 20,059 tons, making a total of 39,203 tons.

#### THE EAST JACKSON MINE

is an enterprise in which Negaunee and Houghton parties are interested. It comprises the estate of the old Pendill mine, south of and including the Union Depot grounds at Negaunee. The exploratory work has been in progress during the past year under the supervision of Capt. Jas. F. Foley.

Jas. M. Close, President; Wm. B. Northup, Secretary and Treasurer, Hancock, Mich.

The first work was to pump out the water in the old mine and explore it. No satisfactory results were derived from this operation and so they are now sinking a shaft over in the hollow, south of the mine and just west of the road leading to the Lucy. Ore was struck in this shaft at about 100 feet below the surface, and the shaft is now sinking in ore. A crosscut south, 14 feet long, is all in ore, so that further developments seem likely to give a good body of ore. Up to this time they had sunk and drifted in jasper, chloritic schist, paint rock, etc. The jasper holds quite a percentage of ore mixed with it. The situation is favorable for ore and it is more than probable that at least enough of it will be found to compensate for the effort that is made to ascertain it. It is said that the ore found contains 13% manganese.

One of the new hematite mines that is turning out well is the

#### EAST NEW YORK,

which is situated just east of the old New York mine, and close to the south line of the Cleveland Iron Cos. land. The mine is in the S. W. corner of what has long been known as the "old brass wire" property. The company holds the whole quarter section, being the S. W.  $\frac{1}{4}$ , Sec. 3, 47, 27. The ore is under a jasper knob that rises prominently above the surrounding level ground. The dip of the basin holding the ore is both south and north.

The average of the analysis of the ore shipped in 1889, as shown to me by Mr. Johnson, President of the company, is:

Sample.	Per cent.	Sample.	Per cent.
Metallic iron.....	60.10	Lime.....	.122
Silica.....	11.64	Alumina.....	1.11
Phosphorus.....	.055	Magnesia.....	.311
Sulphur.....	.029	Manganese.....	.41

Thus the ore is within the Bessemer limit. No. 2 shaft is at the southeast corner of the jasper knob; in the 150 foot level they have drifted north and also gone west 500 feet; much of all the ground represented in the opening is ore. Intervening in the ore is an altered diorite that is soft and white, like the dike material in the Gogebic mines. The company has been feeling its way, not quite understanding the situation—no one could—and

not knowing how much ore would be found, and of how good quality it would prove to be. The mine is better than most people, long familiar with this ground, and knowing how many futile efforts have been made in the past to find ore here in paying quantity, could believe. Few had much faith in a favorable outcome of any mining enterprise undertaken here.

No. 1 shaft is away south of the ore, with which it is connected by a drift. The shaft was sunk as an exploring pit and is too small to avail properly as a working shaft. They are now engaged in enlarging it into a double skip shaft, timbering it as it should be and sinking it, also. It will be sunk to 200 feet in depth, when they will drift north to the ore and east in the ore under No. 2, when they will rise up and thus bring No. 2 to the 200 foot level. The company works about 100 men; has now, March 1, 10,000 tons of ore in stock.

W. H. Johnson, President; C. R. Ely, Secretary and Treasurer; Geo. Bodana, Mining Captain; all of Ishpeming, Mich.

#### THE NEW YORK IRON MINE

lies close to the Cleveland mine; just north of the line which separates them. It was once a valuable mine, having produced annually a great product of hard ore at a large profit. The mine is in the south part of the S. W.  $\frac{1}{4}$  S. E.  $\frac{1}{4}$  Sec. 3, T. 47, 27, in the city of Ishpeming. It begins at the southeast corner of the section and runs west along the line to the limit of the property. The company has not worked as far west as this but the Cleveland company has and is deeper thus it is shown that the New York has some ore along the line to greater length and depth than it has worked.

The New York mine shut down in 1882, some ore has been shipped since then but it was all mined previously. The ore had also become of poorer quality than formerly, higher in silica and sulphur. In fact it was not readily salable and besides the stopes were small. The New York mine is in the north upturn of the ore basin which contains the Cleveland mine.

The company is pumping out the water now, March 1, and purposes to renew mining work.

August Beering still remains as Supt. of the mine. The entire shipment 1889, amounted to 14,325 tons of ore and the total production of the mine amounts to 1,065,474 tons. Fifteen men are now employed at the mine. It is not probable that the number will be greatly increased.

#### THE NONPARIEL MINE

in the S  $\frac{1}{2}$ , N. W.  $\frac{1}{4}$ , Sec. 5, 47, 27, is offered to be let on lease by Mr. John R. Wood who still holds the property. The mine is quite fully described in report for 1882, and it remains now about as then. The mine furnished 51,953 tons of ore.

John R. Wood, Agt.

#### THE DEXTER CONSOLIDATED MINING CO.

is still exploring at its mines in the E.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$  and W.  $\frac{1}{2}$ , N. W.  $\frac{1}{4}$  of Sec. 3, T. 47, R. 28. There is nothing in particular to record that I know of beyond the fact that the company produced 4,269 tons of ore in 1889. The company has expended considerable money and, as yet has not succeeded

in finding enough ore to constitute a good mine. The formation is favorable enough.

Edward A. Gott, Treas., 70 Griswold St., Detroit, Mich.

#### THE AMERICAN IRON CO.,

which owns the Sterling mine and also leases the Boston, that joins it, is working to a good purpose. In 1881 the old Sterling company bored a number of diamond drill holes under the swamp west of the mine, which passed through  $5\frac{1}{2}$  to 16 feet in thickness of ore. The borings seemed to show a length of ore of about 1,000 feet west of the line. As it was so wet it was nearly impossible to sink a shaft in this low ground, so that the new company has been gradually working west to reach these drill holes.

The shaft near the line is 350 feet deep and they are west 500 feet. The product in 1889, was 20,032 tons, and the aggregate, with that of previous years, is 48,844 tons. The formation is a typical one, ore lying on jasper and covered with quartzite, the walls standing at an angle of  $82^\circ$  to south. The foot wall is banded jasper and the hanging wall grey compact quartzite.

The description of the land is W.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , Sec. 32, T. 48, R. 28, and the Boston joins it on the east.

Wm. H. Johnson, President; C. R. Ely, Sec'y and Treas., Ishpeming, Mich.

They expect to produce 25,000 tons in 1890, possibly 50,000. Recent analyses of the stock pile of the ore give, metallic iron 65.84%, phos .048%, metallic iron 64.36%, phos .050%.

The Mat. Gibson, Pascoe, Phoenix mines have all been wholly idle during the past year. A very small amount of exploring has been done at the Phoenix with good result, so far as it went. I examined these mines in September last. There does not seem to be a large amount of ore that one can certainly count on.

#### THE PASCOE

however is likely to be operated the coming year. A few men are now engaged at the mine making preparation for future mining. There is a vein of ore plain to be seen; 10 feet or more in width, which if the quality could be improved would be valuable.

These mines are situated a mile north of Champion. The land belongs to the Atlantic Iron Co.

D. H. Merritt, Sec'y, etc., Duluth, Minn.

#### THE NORTH CHAMPION MINE

joins the Pascoe on the east. The description of the land is the E  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 29, T. 48, R. 29.

The location is a pleasant one. The mine is provided with suitable machinery and buildings; but, so far, the mine is not a large one. It supplies a moderate product of very good ore. It is high phosphorus ore, but contains other elements that are an advantage and make it an easy working furnace ore. The best runs about 56 per cent to 59 per cent in iron and .18 per cent to .20 per cent phosphorus.

The mine is all underground and is worked in a very quiet way. It is about a mile and a half distant, south of the Champion Station. The dip is slightly to the south. The foot wall is jasper, and the hanging, slate.

Product, 1887, 883 tons; 1888, 5,685 tons; 1889, 7,757 tons; total, 14,325 tons.

Office, 37 West Larned St., Detroit.

S. Brownell, Secretary and General Manager.

#### THE MICHIGAMME MINE.

is at the northwest corner of Michigamme Lake. It is a hard magnetic ore mine in the northerly outcrop of the jasper and quartzite fold, that dips south, forming a synclinal, beneath the lake. North of the jasper that underlies the ore, is the diorite; and, again north, the granite.

This jasper foot wall is very rich, a banded structure of ore and rock, that can be made to separate readily; that is, if broken up, the rock and ore tend to separate into independent fragments.

There are, also, sometimes, horses, etc., of jasper occurring in the ore that destroy the stope. This formation, as it is found at the Michigamme, extends along the range, west, two or three miles at least. The jasper belt is a wide one; they have bored into it, at the Michigamme mine, more than 100 feet, without getting through it.

Another troublesome feature, is the occurrence of particles of hornblende schist in the ore. The ore sometimes contains this and it is a great annoyance, as it is an ingredient that furnace men object to; the hornblend being so nearly non-fusible.

A new feature in the working of the Michigamme mine is the introduction, within the last year, of a magnetic machine to separate the ore and rock in the mixed ore. The machine used is the Venstrom Magnetic Ore Separator. Mr. Fowle, the Superintendent, has taken great interest in this matter and has given much time and attention to it, and is making it a success. The use of the separator will greatly magnify the output of the Michigamme mine, augment its value and importance. There is an endless quantity of this jasper foot wall that is rich in iron ore that can be cheaply mined, and after treatment through the magnetic machine gives a first-class product.

It will be remembered that the ore at the Michigamme is all magnetic, and that the jasper is banded, so that when crushed, the flakes of rock and ore fall apart, so that when run over the cylindrical dynamo, the rock drops away and the ore adheres and is discharged in the proper chute. There is a great deal of this mixed material that is unavoidably broken in the mine in the process of mining, that formerly has gone to waste, but now is treated and helps swell the product of good ore. Besides, there are thousands of tons of waste rock and lean ore that have accumulated during the past years, that may now be utilized. Mr. Fowle has experimented with a small dynamo machine, since June last, and feels sure now of having mastered the situation; certainly he has done a good deal and the experience acquired is an important one for the company and for the country also. The preparations now making will enable them to work quite largely, that is, to treat several hundred tons per day, and do it, as their work thus far assuredly indicates, at a low cost, not above 50 cents per ton, all told. The fine stuff is run directly to the separator from the mine, or if too wet, it is

dried by being passed over a fire, propelled slowly by an endless screw. The large stuff goes through a Blake crusher, of which there are, or will be, seven, whence it is taken up by elevators to the screens, which discharge the stuff, of different sizes, into respective pockets from which it is drawn out on the dynamo that makes the final separation. The rock, not adhering, falls off when the vertical tangent is reached, while the ore adheres and is carried around to the lowest point of the cylinder and discharged into a chute. The fine, powdered stuff is not cast directly upon the cylinder, since the rock, being so light, adheres somewhat with the ore and will not separate well; to secure the more perfect separation, this powdered stuff is carried on a belt that turns down over a small roller close to the face of the dynamo, the power of attraction takes the particles of ore from the carrier to the dynamo, while the particles of rock drop down when the carrier turns to go back. This arrangement is a complete success. They have ordered three large magnetic machines, which will have a capacity of 600 tons and upwards per day. The small machine which they now have has treated 13,000 tons.

From Mr. Fowle's statements, it seems that the work is done at a much less cost than one would imagine. For instance, he gives the cost of treating the rock taken from the old stock pile, at 6 cents per ton, making it, from material that is valueless, into 61% ore. There is a stock pile of 16,000 tons of Spersberg, hornblende ore, that is unsalable, they have offered it at \$1.00 per ton, for a mere trifle they are making it into good merchantable ore.

It is worth noting, that in this treatment, which raises the percentage of iron, the percentage of phosphorus is diminished. The phosphorus is contained largely in the rock. I have seen many analyses of the material, of different kinds, made before and after treatment, and they are of a very encouraging character. It seems nearly certain to open a new future for the Michigamme mine. Aside from what has been given, the mine proper has improved, that is it yields more clean ore than it has at any time for several years past.

In my last Report I described the ore going west from No. 5 shaft. They have continued stoping this body of ore west, until they are now 200 feet west of No. 6 shaft which they are sinking to connect with the mine under it. No. 6 is an old abandoned shaft, which was sunk in 1874. It is now 350 feet deep and will have to be sunk nearly as much more, and they are west of No. 5 probably, 700 feet. The ore is 14 to 16 feet wide, perfectly clean, no rock in it. There is a fine quartzite hanging and a complete separation between it and the ore. The ore has to be "trammed" 700 feet to the shaft. The No. 6 shaft should have been sunk long ago to have avoided much inconvenience to which they have been subjected in the underground work, and from motives of economy. Mr. Fowle has been anxious to do it, but was not allowed to. The control of the company has now passed into other hands. The chief owners now are the Messrs. Mather & Co., of Cleveland; the same parties who control the affairs of the Cleveland Iron Mining Co. The order of the new *regime* is to push things and to raise the product of the Michigamme mine to at least 100,000 tons in 1890.

For more particular description of the mine reference is made to former Reports.

The annual products have been as follows:

Year.	Tons.	Year.	Tons.
1872.....	141	1881.....	57,115
1873.....	28,966	1882.....	43,712
1874.....	45,218	1883.....	42,533
1875.....	44,756	1884.....	28,757
1876.....	20,074	1885.....	12,372
1877.....	28,238	1886.....	48,805
1878.....	58,622	1887.....	51,975
1879.....	56,985	1888.....	36,448
1880.....	52,944	1889.....	56,999
Total.....			661,310

The estate covers 1,400 acres of land owned by the company in fee.

Wm. G. Mather, Sec'y and Treas., Cleveland, Ohio; John C. Fowle, Supt., Michigamme.

#### THE IMPERIAL IRON CO.

is the name of the corporation to be organized to own and operate the Wetmore mine, west of Lake Michigamme, that has been recently purchased—February.

The company owns the lease of the mining right of the N. W.  $\frac{1}{4}$  of Sec. 25, T. 48, R. 31. A lengthy description of this property is given in my report for the year 1886. It has been pretty well explored and the ore shown up, but has not been greatly worked. Unquestionably, there is a large amount of ore in the succession of lenses that, apparently, lap one another as they extend east and west across the property, and it can be cheaply mined; its comparatively low percentage of iron and high percentage of phosphorus have rendered it unmerchantable, I presume, since but a small quantity has been produced annually.

It averages 58 per cent to 59 per cent iron, .14 per cent to .20 per cent phosphorus and 5 to 6 per cent silica. Probably the new owners, who have what Mr. Wetmore could not easily command, abundant funds, will mine a good deal of ore, and so do it at a small cost, and thus be able to sell it cheaply and, in that way dispose of a good deal.

The ore is said to smelt easily and to make a good flowing iron. Shipments of ore in 1889 amounted to 18,612 tons, making the total production 49,833 tons.

W. E. Stone, Secretary and Treasurer, 37 Franklin St., Boston, Mass.; Richard A. Parker, General Manager, Marquette, Mich.

#### THE WEBSTER MINE

joins the Imperial on the west. No work has been done at this mine in 1889 except to ship a small amount of ore that was in stock, mined two years before. Unfortunately for Messrs. Watson & Palmer, the proprietors of the mine, they had this ore mined on contract, by a party who was not a miner, and whose work was not properly superintended. The result was that the ore, so called, which this contractor mined and received pay for, contains too much rock to be merchantable. The stock pile is thus nearly valueless. The mine, however, has a good vein of ore, plain to be

seen, and can be made to produce clean ore of, I presume, as good quality as the other mines in this range. There are several good dwelling houses, engine house, suitable machinery, etc. The description is the N.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec 26, 48, 31. Amount of shipment, 1889, 448 tons, making a total of 15,116 tons of ore. Corporate title is the Webster Iron Co.

E. B. Palmer, Treasurer, Marquette, Mich.

#### THE OHIO AND NORWOOD,

and Section 23 mines that were sold under option and lease by Mr. J. C. Fowle and explored by him, are now owned by Mr. Ferdinand Schlesinger who is opening them extensively. Under the experienced supervision of Capt. Elisha Morcom. The location is rapidly taking on the appearance of a mine of large magnitude. The opening work of the mine and the construction on the surface go on simultaneously and both are of the character that signifies large operations.

There is, seemingly, a world of ore in these mines, such as it is, which make a, apparently, continuous belt of it, through all the three properties, three-fourths of a mile in length of ore of a width of 20 to 30 feet perpendicular between the walls. But the facts about the magnitude of the ore deposit its purity, etc., will be better known after the mine has been operated for a year or so. Samples of good ore can be got in this belt, but when a stock pile is examined it is invariably poor. There is too much rock in with the ore. And here when they come to mine it on a large scale it will be sure to be found to be low grade.

It is expected to ship 100,000 tons and upwards in 1890. Analyses of the ore from these mines give a result of 55% to 59% in iron and .14% to .27% phos. Probably when it comes to be shipped it will scarcely average above 50% in iron and below .25% or .30% phos.

#### THE BEAUFORT IRON MINING CO.

has surrendered the lease of the Beaufort mine to the feeholders, Mr. John Thoney, of Marquette, and Capt. John McEncroe of the Lake Superior mine, and others.

The estate consists of 160 acres, and has been re-leased to Mr. Schlesinger. The mine joins on the west the Norwood, one of the new Schlesinger mines. Beaufort is quite a mining location, having a school, postoffice, etc. It is three miles west of Michigamme, in the same belt of limonite ore in which are all of these mines west of the lake. The Beaufort is low grade, high phosphorus ore. The deposit is well defined, has a width of 20 feet, but the ore is not very clean and it will not pay to pick out the rock, it is too low price. Mr. Schlesinger having now such a length of this ore will be able to produce, possibly, as much as the market requires. Product 1889, 16,671 tons, making a total of 114,519 tons of ore.

The mine is in the N. W. part of the N. W.  $\frac{1}{4}$ , S. W.  $\frac{1}{4}$ , Sec. 22, 48, 31, and just across the line that divides them is

#### THE TITON MINE.

The two are in the same pit, and both are idle. The Titon has yielded 89,513 tons.

The Champion mine yielded in 1889 the largest product of any year in its history, which indicates pretty clearly that the mine has reserves of ore; that its stopes are far from exhausted.

The Champion is a valuable mine. It produces the best hard ore, rich in iron and low in phosphorus. No where else, perhaps, is so much pains taken in sorting and grading the ore as at the Champion. Mr. Kidder states that their success is greatly due to this matter of sorting the ore. There is no doubt but the Champion is an exceedingly well managed and well operated mine. The location is unusually pleasant, neat and orderly. The dwelling houses for the men are substantial with, generally, good yards and gardens. There are fine church buildings, a fine graded school, a fine opera house, public hall, library and reading room, that are first-class, to which all have access freely. In the change house for the men are eleven good bath rooms, supplied with hot and cold water, etc., pure water, pumped from lake Michigamme. An excellent hospital building that is admirably conducted. There is no sham, everything is thorough and well done. Another thing that Mr. Kidder observes, both at the Champion and the Pittsburgh and Lake Angeline mines, is that when an employee, of the company, who is the head of a family, is killed, the widow has the house in which she lives free of rent; has it as long as she continues a widow, as long as she desires to make it her home. In exceptional cases the company gives them fire wood, etc., also. Throughout, the policy of the company is a liberal and enlightened one.

The mine is a deep one, but it has seven shafts, three of which, 3, 4 and 5, are to the bottom, below the eighteenth level, 1,100 feet deep. The lenses of ore are set up on end, inclining down to the west, so that the tendency has been to find the ore in the shafts to west, further down, while losing it in the east. Sometimes there is disappointment when ore is expected it is not found, and again it occurs unexpectedly, and so on the whole, they are able to keep up the product uniformly.

The formation is one of the best defined of any in the country, a typical quartzite covering the ore that is underlaid by jasper.

I have written up this mine very fully in the past and I find nothing special to add.

The Champion has produced as follows:

Year.	Tons.	Year.	Tons.
1868.....	6,225	1879.....	98,203
1869.....	21,535	1880.....	112,410
1870.....	73,161	1881.....	144,025
1871.....	67,588	1882.....	157,516
1872.....	68,402	1883.....	104,960
1873.....	72,782	1884.....	208,156
1874.....	47,097	1885.....	173,914
1875.....	56,877	1886.....	137,593
1876.....	66,002	1887.....	146,330
1877.....	70,883	1888.....	174,681
1878.....	78,764	1889.....	215,098
Total.....			2,291,994

W. E. Stone, Treasurer, Boston; A. Kidder, General Manager, Marquette, Mich.; Walter Fitch, Superintendent; James Cundy, Mining Captain.

## THE SAMSON IRON MINING CO.

Mr. Parker has continued to explore with the diamond drill at the mine at Humboldt. The drill has operated mainly on the flat southeast of the mine. Several holes have been bored and some ore has been found, not apparently, I am informed, in large lenses. Mr. Parker states that it is contemplated to sink a shaft to reach ore thus found.

The ore shipments from the mine in 1889 were 2,797 tons, making a total to date of 263,253 tons.

Morris Sellers, President, Chicago, Ill.; Richard A. Parker, Secretary and Treasurer, Marquette, Mich.

## THE HUMBOLDT MINE

shows some improvement in the amount of ore. For two years they have only operated one shaft, No. 2, the one furthest to the southwest; have stoped a lense of ore, ten feet wide, lying still further to southwest. They find now, at their present depth, that there is a "run of ore" back to No. 3, and they are now, March 1, pumping the water out of No. 3, in order to sink it to this ore. No. 2 is 600 feet deep. They think now that they will have this ore all the way to No. 3 and north of it, which will give a length of ore of several hundred feet, instead of about 100, which is all they now have.

They have already worked as far north as No. 3 shaft, and have the ore above and below and, still, also in the breast. The Humboldt produces first-class non-Bessemer slate ore; also has black ore.

The Humboldt mine is about a mile from Humboldt station, on the Republic branch of the D. S. S. & A. R. R., in the center of the N. W.  $\frac{1}{4}$  of Sec. 11, 47, 29.

The mine is owned by the Washington Iron Co. and held on a lease by the Humboldt Co.

J. B. Maas, Agent; Ed. Maas, Superintendent, Humboldt, Mich.; G. A. Garretson, Secretary and treasurer, Cleveland, Ohio.

The Humboldt mine, including its predecessor, the old Washington, has produced, annually, as follows:

Year.	Tons.	Year.	Tons.
1865.....	4,782	1878.....	23,921
1866.....	15,150	1879.....	18,204
1867.....	25,440	1880.....	14,727
1868.....	37,757	1881.....	26,302
1869.....	58,462	1882.....	43,436
1870.....	79,712	1883.....	31,866
1871.....	48,725	1884.....	23,763
1872.....	38,841	1885.....	11,776
1873.....	38,014	1886.....	20,207
1874.....	27,890	1887.....	17,874
1875.....	9,642	1888.....	11,656
1876.....	3,333	1889.....	15,860
1877.....	16,546		
Total.....			671,935

## THE GERTIE

is the name of a new company that is exploring for ore in the W.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$  Sec. 35, T. 48, R. 29, situated about a mile northwest of Humboldt station. The parties are the Messrs. Maas and others. They have a shaft down now, March 1, 110 feet deep, and are in a hard hematite ore, a very similar ore, if not identical with that found at the Nonpariel mine.

## THE BESSIE MINING CO.

organized in Negaunee. Ed. Lobb, President; Ed. A. Maas, Vice-President; S. P. Kline, Sec'y and Treas., Negaunee; Wm. Pelmeur Humboldt, Chas. McGregor, E. A. Maas, S. P. Kline, and Ed. Lobb, Directors. They hold the 80 next to the Gertie, towit: E.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$  Sec. 35, 48, 29. Have thus far hematite ore but not as yet of very good quality.

## THE REPUBLIC IRON CO.

I find nothing strikingly new or suggestive at the Republic mine. It is simply a large mine yielding the best quality of magnetic and slate ores, situated in a bold, rugged range of beautiful banded jasper that rises to a height of 150 feet above the waters of the bay which it borders on the east and south, curving with the bends of the shore which it follows at a convenient distance away.

The deposit of ore partakes of the nature of a belt of the formation, beneath the jasper and the quartzite. The formation is much contorted, pressed together laterally so that it is "kinked" in places into sharp, deep minor folds. The ore following the formation, which contains it, into these narrow lateral folds gives to these portions the form and appearance of lenses of ore lying across the formation. This is the manner of the occurrence of the ore in the west end pits, the Morgan, Pascoe, Ely, etc., which are in the bend of the horse shoe form of curve to which the formation corresponds. Further north the formation is more regular; the ore deposit is wider and proportionately less cost has been necessary in mining it. Nearly every pit has been a separate affair, not connected underground, you had to come to the surface several times if you wished to visit all the pits of the mine. That is less the case now as the main pits at the west end are connected and so are also those at the north. The location is one of the most interesting and attractive in all the mining region. The mine extends for three-fourths of a mile along the side of the steep rugged jasper bluff, near the upper edge of which are the shaft openings. The buildings, which contain the hoisting machinery, pumps, steam boilers, machine shop, etc.

The dip of the formation is towards the bay, to the west, northwest and north, evidently forming the bottom of the basin, which holds the waters of the bay.

Thus the shafts are not parallel, they descend in the ore at right angles to its strike at the point of location, and of a consequence tend to approach each other as they go down. Naturally there is great irregularity in the ore, corresponding to that of the formation. And naturally too, these shafts have become deep, and after all these years of action mining there is a great deal less ore than there used to be.

The Republic still has good stopes of ore, if not as great as they used to be, and the pillars of ore and floors yet standing, are a final resource. The

greatest depth of the mine is at No. 6, which is 1,000 feet vertically down.

Reviewing the several pits in their order of occurrence from the west, there is some exploratory work in progress near the line, but no ore is mined until the Morgan pit is reached. The shaft has been sunk 60 feet during the year. The shaft yielded specular ore 26,217 tons, Magnetic ore 4,100 tons, Kingston 12,175 tons, total 42,492 gross tons. The estimate for 1890 is about the same.

The Pascoe pit shows a little falling off. The shaft will be sunk another "lift" though it is expected that the product will be 10% less than in 1889, when the pit yielded 233,355 tons of ore.

The Ely pit holds its own since it is about the same now as it was in the upper levels. The shaft was sunk in 1889, 122 feet, and the product was 19,478 tons, some of this however was taken from upper levels, pillars.

The Gibson is a small pit, the ore running back into the foot wall; a party of three men work it and got out in 1889, 1,128 tons of ore.

No. 1 turned out better than was expected. The shaft was sunk 59 feet, The magnetic ore which formerly predominated has given place to specular slate ore, so that the shaft will afford as much as usual. The product 1889 was of specular 22,808 tons, magnetic 15,500 tons, Kingston 7,500 tons, total 45,808 gross tons.

From No. 5 pit about 2,000 tons will be taken, mined from the pillars.

No. 6 gave a good deal of ore in 1889, and is likely to duplicate the result in 1890, though there is no certainty as to the outcome. The shaft was sunk 77 feet, and the total product was 60,785 tons. A recent fall of ground in Nos. 6 and 7, will delay matters and may affect the product. The fall was occasioned by the giving way of a pillar of ore due to a "crossing" in the formation that practically cut the pillar loose on the foot wall side, so that a heavy mass of ore falling on it from above, the whole went, causing a serious collapse.

Here again in No. 7, specular ore takes the place of magnetic, in about equal quantity. The shaft was sunk 79 feet, and other opening work made in proportion. The product was 51,831 tons.

No. 8 does not come up to its usual standard; unless it improves greatly there will be a falling off in its product in 1890, of fully 20%. The yield in 1890 was 17,250 tons. They are putting in a new pumping plant at No. 8. Have improved the machinery at water works, added new engine so that now the compressor power is kept up to the requirements.

The product in 1889 was greater than ever before, dividend paid to stockholders \$4.00 per share. Number shares 100,000, par value \$25, present market quotation \$50.

It is reported that the company will pay \$7 per share in 1890.

Chas. Hickox, President, Cleveland, Ohio; W. D. Rees, Secretary and Treasurer, Cleveland, Ohio; Morgan, Agent, Republic, Mich.; Peter Pascoe, Superintendent, Republic, Mich.

The product for each year has been as follows:

Year.	Tons.	Year.	Tons.
1872.....	11,625	1881.....	233,651
1873.....	105,435	1882.....	235,108
1874.....	122,639	1883.....	152,565
1875.....	114,726	1884.....	277,739
1876.....	120,045	1885.....	249,070
1877.....	165,836	1886.....	241,161
1878.....	176,221	1887.....	233,375
1879.....	155,131	1888.....	235,064
1880.....	235,385	1889.....	287,391
Total.....			3,306,657

#### THE WEST REPUBLIC MINE

was shut down two years ago; but the company has just begun to work in a shaft, which is just over the line from the Republic, about ten rods south from the margin of the bay. The shaft is about 100 feet deep and has some ore which it is proposed to mine, and also to go down with the shaft. 1,510 tons of ore were shipped in 1889, making a total to date of 133,496 tons. No mining was done in 1889. The ore sent away was culled from old stock piles or rock burros.

A. C. Saunders, Sec'y and Treas., Cleveland, Ohio.

#### THE REPUBLIC REDUCTION CO.

is an organization made to extract ore from the rock piles of the Republic mine. The matter was first undertaken by Peter Gottstein and S. D. North, of Houghton, who sold out to Messrs. D. H. Merritt, J. R. Deveraux and others, of Marquette. What has been done in this work has been described briefly in previous reports.

Messrs. Gottstein & North set out to grind up the rock and effect the separation of the ore from it by a process of "washing," not unlike the stamp mill work in separating copper. To this end they bought the old Isle Royal stamp mill and moved it from Houghton to Republic. The method of manipulation employed did not prove satisfactory, and hand sorting was resorted to with good results up to a certain point where it seems to be necessary to break up the ore by some cheaper and more expeditious process than hand labor.

Mr. Deveraux, who manages the business, has, finally, after some failures, hit upon a method which he states works satisfactorily. The trouble is that the material becomes dirty, covered with fine powdered ore, which adheres to it and makes the pieces of rock and ore alike appear to be ore. It thus becomes essential to wash it; and, to do this, it must be spread out in some way so that it can be worked and sorted. Mr. Deveraux's recent method is to cause the broken fragments to drop upon a carrier that moves slowly, where the pieces, spread out, are washed clean by water, applied with a hose, after which the material passes along, when the sorters on each side pick out the rock and the ore is carried on. Mr. Deveraux tells me that this plan works admirably, and they look forward with confidence to the results of the coming year's work. The product of 1889 was 22,102 tons; in 1888, 20,846, total, 42,948 tons.

D. H. Merritt, Secretary; J. H. Deveraux, Manager.

The machinery now used was made by the Link Belt Co., Chicago.

#### THE RIVERSIDE IRON CO.

has a small mine two miles northwest of Republic, on the Michigamme river, in Sec. 35, T. 47, R. 30. The company is exploring diligently; and, just at this time, February 20, have met with some trouble with the water. The product in 1889 was 3,573 tons; in 1888, 5,761; total, 8,334.

J. O. St. Clair, Secretary, Republic, Mich.

#### THE METROPOLIS

and other explorations along the Michigamme river to the northwest from Republic, are being worked, looking for ore. None of them have, as yet, ore enough to assure a mine of any commercial value. It seems easy to find small pockets, or lenses, of ore in this formation; but these deposits are generally small or the ore is too lean to be of any value. A great deal of exploring has been done northwest of Republic, but no good mine has ever been discovered. The indications are so good that there is every incentive to search. West of the Michigamme mine is

#### THE STEWARD

and, also, the King, both old properties, worked a little, years ago, without success; and there are others, of the magnetic black ore properties, that, in view of the success that is being attained at the Michigamme, in the separation of the ore and rock with the dynamo, possess, now, an increased value. The jasper foot wall, made up of magnetic ore and jasper, extends for three miles across 19 and 23. It has been traced and worked as far west as the Stewart, in Sec. 23.

#### THE SPURR MINE,

in Sec. 24, S.  $\frac{1}{2}$ , N. W.  $\frac{1}{4}$  and N.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , 48, 31, is wholly idle. If the magnetic separator process proves a success, the Spurr will be valuable. The mine has produced 164,941 tons of ore.

Capt. Wm. H. Stevens, Detroit, Mich., is one of the chief owners.

#### THE VOLUNTEER IRON CO.

owning and operating the West End or Palmer mine is preparing for extensive operations in the future. A full description of this valuable property is contained in my report of 1888, and there is nothing necessary to add at present. They are operating the three downright shafts designated as A, B and C. The first named being the most easterly one. It has also been decided to sink a fourth shaft about midway between B and C, as it has been found by boring, that the ore continues through this ground. The diamond drill has been used to the east and to the north of the mine, and has proved that the ore continues, undiminished in width, in both directions.

Mr. Kidder, the Agent, informs me that he expects to mine, etc., 100,000 tons in 1890, and 300,000 tons in 1892. As by that time the mine will be opened and machinery, shafts, and surface arrangements made adequate to the production of the larger output. The property comprising 1,800 acres, was purchased about a year ago from the Pittsburgh and Lake

Superior Iron Co., and the Volunteer Co. organized. The location is four miles south of Negaunee, at the west end of the Cascade range, and is reached by a branch of the C. & N. W. R. R., also from the D., S. S. & A.

A. C. McCaul, Sec'y, 3 Telegraph Block, Detroit, Mich.; A. Kidder, Agt., Marquette; Thomas Waters, Supt. Ishpeming.

Table of Production.

Year.	Tons.	Year.	Tons.
1871.....	4,171	1881.....	34,273
1872.....	34,495	1882.....	40,590
1873.....	41,204	1883.....	19,414
1874.....	16,106	1884.....	11,747
1875.....	4,070	1885.....	5,679
1876.....	15,324	1886.....	24,084
1877.....	20,211	1887.....	47,454
1878.....	4,704	1888.....	56,321
1879.....	24,141	1889.....	60,157
1880.....	38,595		
Total.....			512,798

## THE WHEAT MINE

situated east of the Volunteer in the S. E.  $\frac{1}{4}$ , S. E.  $\frac{1}{4}$ , Sec. 29, T. 47, R. 26, is a small hematite deposit of very good ore. Recent developments give to the mine a far better outlook than it has had for several years, at a depth of 225 feet a new vein of ore has been found, which is said to yield 67% in iron and to be Bessemer. So far it seems to have a width of 40 feet or more and to be clean.

Thomas Axworth, Sec'y, Cleveland, Ohio; Thomas Prout, Supt., Palmer, Mich.

The following is the table of production:

Year.	Tons.	Year.	Tons.
1879.....	850	1885.....	9,200
1880.....	3,324	1886.....	15,851
1881.....	9,040	1887.....	17,537
1882.....	9,554	1888.....	4,982
1883.....	6,625	1889.....	7,997
1884.....	6,824		
Total.....			95,005

## THE CASCADE RANGE

in which the last two described mines are situated, has been, from the earliest days of iron mining in the peninsula, the scene of much exploration.

There are many old mining locations in sections 27, 28, 29, 30, 31 and 32; and, while they did not prove valuable in the past, the indications are such as to induce further examination, from time to time in some of them.

Just now, under the stimulus of the active iron ore market, there are several parties exploring in the vicinity of the Wheat, I judge, in the valley north of the Jasper range.

## THE PLATT MINING CO.

is a new organization, operating just east of the wheat, in the N. W.  $\frac{1}{4}$  of the S. E.  $\frac{1}{4}$  of Sec. 29, 47, 26, of which land it holds a lease from the Henry Wick Banking Co., Cleveland, Ohio. Exploring has been in progress some time, under the supervision of M. P. Cook. Test pits indicate that they have found a wide deposit of ore and have tested it several hundred feet in length, also. The ore is identical with that of the wheat: about 60 per cent iron, .040 per cent phosphorus.

R. J. Whaley, President, Flint, Mich.

## THE MINOWAN IRON CO.

In the N.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 28, 47, 26, John R. McEvera is exploring and has found a deposit of hematite ore of good quality. It may be said that it is not difficult to find ore, either hard or soft ore in the Cascade range; but the trouble has been to find enough of it in a single deposit, and have it clean. Slate ore and hematite ore exist, of good quality; but it is too much mixed with rock to make it possible to mine it, etc., at a profit. It seems now that better results are likely to follow from the present efforts.

A. L. Conger, President, Akron, Ohio.

The location is a mile east of the Wheat. So far, these new hematite "finds" in the Cascade range seem very promising.

## THE GOGEBIC IRON RANGE

certainly shows as favorably as it did a year ago. There is nothing new, of a discouraging nature, relative to the magnitude or continuance of the ore deposits. In my last Report, I have endeavored to describe the ore formation and the occurrence of the numerous dikes, which seem to constitute the chief element of danger of the range. Since they form the bottom of the ore in the mines, the matter to be determined was, and is, whether the ore will be found in quantity under these dikes. If the main dike, which forms the bottom of the ore in any mine, is the limit of the deposit and the ore does not continue beneath it, then it is easy to see that these mines cannot be of long duration. On the contrary, the ore may be found under the dikes, and it is so in cases of smaller ones, and thus the deposit be of lasting duration. There are some facts, recently come to light, in this connection, that favor this latter supposition, and they will be referred to in the course of the description of the mines. Explorations conducted east of Sunday lake are looking much more favorable than they were; also, east of the Anvil, ore has been found in quantity sufficient to constitute a mine, for one year at least. Aside from these, no discoveries of importance have been made. The mines are looking well and will furnish more ore this year than ever in any season before. The plan of lighting the mines with electricity was tried recently, as an experiment, at the Ashland mine and was found to work admirably. It is a perfect success. All the mines in the vicinity of Ironwood will soon be furnished with all the necessary arrangements for underground lighting. The insulation of the wires is perfect and the light can be taken anywhere in the mine with the utmost facility. It seems certain that this method of lighting the mines will prove of much value. It will lessen the danger of accidents from fire, will render the men less liable to dan-

ger from falling into shafts, etc., and will enable them to accomplish much more work.

Nearly all the abandoned or idle properties are now again under option, and under much better auspices than formerly. There is a tendency to legitimate work, and not to boom for speculative purposes only.

#### THE ASHLAND MINE

is in admirable shape both on the surface and underground. The new structures over the shafts, mentioned in my last report, have been completed. The new hoisting machinery put into operation, in fact all the important changes and improvements held in contemplation a year ago have been carried out, and it is plain to see that the Ashland mine is now well equipped.

The underground work has been made to keep pace with the surface changes and there is no better looking mine in the State than the Ashland below surface.

There is no cleaner stock pile of ore—150,000 tons now ready to ship. There are eight shafts, numbered from the west end east, and they are hoisting ore in five of them—No. 4 to No. 8. A length of 1,800 ft., and from No. 5 east, in the sixth level, nearly all the distance the ore is 80 to 110 ft. wide.

The shafts are sunk to the seventh level. No. 4 shaft struck the dike before the sixth level was reached and the drift from the shaft east is through the dike.

From No. 5 east the ore body is fine. Nos. 5 to 6 is 443 ft., No. 6 to No. 7 is 300 ft., No. 7 to east line is 550 ft. The ore is clean and there is no trouble in keeping it so. The "cap rock" is very firm, and no where has any tendency to come down and mix with the ore. In the east end of each level the ore goes a long way under the cap rock, and this rock, it seems, would keep its place even if there were no timbers.

There is a main bottom dike that underlies the whole ore body, which comes up to the surface between No. 2 and No. 3 shafts. They sunk through it in No. 3 shaft and found ore 10 ft. wide, but non-Bessemer. They reached this dike below the fifth level in No. 4 shaft, and in the sixth level the dike is 50 ft. east of No. 5; thus the dike gradually cuts off the ore on the west as the mine deepens.

There are several minor dikes. One comes to the surface between Nos. 7 and 8 shafts and the ore above this was worked out between No. 8 and the east line in open pit. Below this is a dike that comes to the surface near No. 5 shaft, and they got ore above it west to the line. Now, below these is the main underlying dike that comes up at No. 2.

Under the two first mentioned dikes there is ore, but whether it will also be found under the main dike or not, in any amount, is not known as yet. In the meantime the Ashland people have ore enough in sight to last two or three years, assuming a large production. That for 1890 is estimated at 400,000 tons.

The following table will be of interest showing the quality of the ore shipped in 1889:

No. of Shaft.	Tons of Ore.	Percentage of Iron in Ore.	Percentage of Phosphorus in Ore.	Tons of Iron in Ore.	Tons of Phosphorus in the Ore.
Four.....	85,435	63.88	.0380	54,572.73	32,699.56
Six.....	65,769	63.55	.0445	41,799.71	29,268.4
Total stock piles.....	41,491	63.15	.0380	26,204.99	15,848.8
Total shipments exclusive of stock piles.....	172,302	63.75	.0430	109,849.66	74,373.17
Grand total.....	213,793	63.64	.0420	163,054.65	90,221.97

There are three 10 ft. drums in the new engine house and a fourth one is to be added, space having been left for it. Also a new pump house has been built south of No. 6 shaft, and they are now placing a new plunger pumping plant, 14' plunger on solid foundations. This pump will raise all the water in the mine.

An analysis of the dike material shows it to be mainly silicate of Aluminum.

The ore is all shipped by the Wis. Central R. R.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885.....	6,471	1888.....	164,134
1886.....	74,015	1889.....	256,830
1887.....	175,561		
Total.....			677,011

Joseph L. Colby, Sec'y and Treas., E. A. Hayes, Gen'l Manager, Ironwood, Mich.; John A. Taylor, Mining Capt.

#### THE NORRIE MINE,

next east of the Ashland, still holds the supremacy in the matter of production. It is wonderful that a mine should yield so much ore in only the fifth year after it was first undertaken. The product in 1889 was alone nearly equal to the total of all the previous years, and the output in 1890 will be greater still. The Norrie has a marvellous record. I do not recall its parallel in the history of iron mining in this country. The mine begins at the west line and is opened nearly the entire length of the property, three-fourths of a mile. It is one continuous run of ore through which one can walk and in which they are mining, from the Ashland almost to the Aurora line. It is also the widest deposit of ore yet found on the range. As has been explained in former Reports, there is a peculiarity about the foot wall at the Norrie mine which is an advantage, in one respect, in working so wide a deposit. The underlying quartzite instead of continuing down with a uniform dip is "benched" that is it goes off to the north horizontally 50 ft. or more and then dips down again. These broad horizontal shelves afford a convenient and solid foundation on which to rest the timbers in building up the sets to hold "the back."

The method of mining that has been pursued is the one practiced by all the mines along the range, opening a series of rooms and timbering them.

At the Norrie they are constantly mining the pillars also, and allowing the the overlying earth to fall in. Mr. Curry tells me that they lose very little ore. There are eight shafts, all working, they are one level deeper than a year ago, now to the sixth level about 500 ft. on the inclination of the shafts. The machinery was all small, never intended for the work of so large a mine.

A new plant of hoisting machinery, consisting of four 10 ft. drums has been put into operation during the year. Mr. Curry is boring with a diamond drill, north of the mine near the west line.

The Norrie and the East Norrie comprise the S.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 22, and W.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , Sec. 23, 47, 47.

They have not reached a dike except at the west end, where they are on the one that comes to the surface near No. 7, Ashland shaft.

The Norrie is operated by the Metropolitan Iron and Land Co.

The officers remain as heretofore: S. S. Curry, President, Metropolitan Iron and Land Co.; H. S. Haselton, Secretary; R. H. Hanna, Treasurer, Milwaukee; Jeff. D. Day, Superintendent; Wm. Trebilcock, Mining Supt., Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885.....	15,420	1888.....	410,763
1886.....	124,835	1889.....	674,290
1887.....	217,384		
Total.....			1,442,692

In the above is included the product of the East Norrie, which produced in 1889, 117,444.

#### THE AURORA MINE,

which joins the East Norrie, has changed owners; it is now controlled by the same gentlemen who hold the Colby and Palms, etc., mines. The new officers are:

Charles L. Colby, President, 36 Wall St., New York; Edwin H. Abbott, Vice President, Milwaukee; Joseph L. Colby, Treasurer, Milwaukee; Chas. H. Ropes, Secretary, 36 Wall St., New York; Alton L. Dickerman, Manager, Ironwood, Mich.; George Brewer, Superintendent, Ironwood, Mich.

The estate consists of the E.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$  and N.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 23, 47, 47.

The Aurora has ever been held to be one of the best mines in the range, and it still holds its place in the front rank, among the largest producers of the best ore. The mine extends all the way from the west line of the property, adjoining the East Norrie, to within seventy-five feet of the north line near the east boundary.

The west end of the mine is no longer productive of ore. It is open cut and the ore has all been removed down to the dike. The ore now is from No. 3 shaft easterly to the Pabst line, 1,100 feet in the fifth level. East from the shaft, the ore is twenty-one "sets" wide, and west it is fifteen "sets." West of the shaft they are rising up on the dike.

At the east end the ore becomes quite narrow. No. 4 shaft is to the sixth

level; but, in reaching it, they had to cut through the dike and also drift east through the dike for the level. The depth to the sixth level is 400 feet, 300 feet to the fifth. Immediately under the dike, at No. 4 shaft, good ore was found, 64 per cent in iron and Bessemer. They have drifted west in the ore thirty feet, but have not sunk nor crosscutted in it yet. This is an important fact and greatly adds to the probable value of the Aurora mine. No. 2 shaft was sunk below the dike 100 feet, all in cap rock, with a narrow deposit of ore. The plan is now to sink No. 3 shaft through the dike, since finding the ore under it, in No. 4, gives hope of good results. They are laying the foundations for a new plant of machinery, two ten-foot hoisting drums to operate Nos. 3 and 5 shafts. Some good ore has been found in the fourth level by drifting north eighteen feet. The ore is four sets wide, and they hope it continues up to the surface capping. It is expected to mine, this year, 300,000 tons of ore, and upwards.

The mine will soon be provided with the electric lighting system.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1886.....	101,037	1888.....	179,650
1887.....	154,095	1889.....	216,061
Total.....			650,843

#### THE NORTH AURORA.

Exploration here has been kept up by Mat Fitzsimmons. He has sunk another shaft a little further west and has what may be called ore, but not salable ore; it is not good enough to be of any value, except as indicative of better results to come. An option has been given on the property to the Aurora Iron mining Co., or to the Penokee and Gogebic Development Co., which controls the Aurora, and which will continue the exploration at the North Aurora. If the property develops into a mine, all parties interested will participate in the advantage. It is west of the Pabst and north of the Aurora.

#### THE PABST MINE

has also changed owners; it being now controlled by the Metropolitan Land and Iron Co., the owners of the Norrie mine. The Pabst has steadily improved each year ever since the ore was found in the north vein (to use a local expression to designate the north ore). The mine, first opened on the quartzite foot wall, did not prove to be valuable; but the north shaft, 360 ft. north of the foot wall, near the east line and in continuation west of the Iron King mine deposit of ore, quickly made the mine an important producer.

This A shaft having developed so well, it was decided to sink another—B shaft, 500 ft. west of the former, and now this latter is also in ore and they are hoisting from it at a lively rate. The shaft is 360 ft. deep and the ore is 17 "sets" wide, and further west, 1,000 ft., is a new shaft 200 ft., in which they also have the ore 5 or 6 "sets" wide—30 to 40 ft.

A shaft is sunk to the dike, 360 ft; in the 300 ft. level they have con-

nected it by a drift, with B shaft. The dike, as has been heretofore explained, seems to pitch west both in the Iron King and in the Pabst, contrary to their usual angle of depression, which is easterly. Away to the west, however, in the new shaft—which I think is called C—the pitch of the dike is easterly. The probability is, that the dike, being pretty flat, is somewhat folded and the so-called pitch at any point is due to the inclination of the fold at that point.

In the C shaft the bottom of the ore was found at 175 ft. depth. They went through the dike, under it, and drifted east, through it again at 200 ft. level, and are now in the ore, in this level, on the dike. West they are rising up in the dike, mining ore. This "new find," so far to the west of the mine, and north of the No. 6 Aurora shaft, is of much interest. It is quite possible that the ore continues, uninterruptedly, the whole length of the property, in this north vein. They are building a track to the C shaft and expect to send out in all this year, 150,000 tons of ore.

The officers are H. S. Haselton, Secretary; Wm. Trebilcock, Superintendent.

*Table of Production.*

Year.	Tons.	Year.	Tons.
1885.....	1,153	1888.....	49,977
1886.....	17,925	1889.....	96,990
1887.....	19,906		
Total.....			185,951

Adjoining the Pabst is

THE NEWPORT AND LAKE SUPERIOR LAND CO.,

the name of the corporation that now operates the Iron King mine, the name of which mine the new organization has changed to Mount Hope.

The Bessemer Consolidated Iron Co. mined 34,946 tons of ore up to July, when the change was made, and the remainder of the total product was credited to the Mount Hope mine, by the new proprietor, the Newport and Lake Superior Land Co. The change, however, has occasioned another lawsuit, brought by aggrieved stockholders. The Iron King, as an independent enterprise, and well managed, should have been a profitable mine; but it was one of the Burton group, and the only one that produced ore in any amount, so that for several years it has been a bone of contention; and, in many ways, through the misfortune of its early ownership, the property has been seriously hampered.

I have described the mine very fully in my last report and I do not find the prospects in the mine any more encouraging now than they were a year ago. The shafts are all down to the dike, and the ore above it is pretty well exhausted. The amount of ore in sight is not very great. They are hoisting, mainly in No. 1 and No. 4 shafts. In the south vein, are sinking, etc., near the Pabst line, and have developed quite a deposit of ore, which they will soon have opened ready to stope. They are also driving a crosscut south from a point between No. 3 and No. 2 shafts, in which some ore has been found. Exploration will, perhaps, result in discovering ore; possibly, a good deal of it. The estate is the N. W.  $\frac{1}{4}$ , Sec. 24, T. 47, 27.

Capt. W. W. Stephens, formerly at the Pabst, is now in charge of the mining work at its neighbor. Mason W. Burt, Superintendent, Ironwood, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886.....	27,343	1888.....	69,145
1887.....	74,609	1889.....	101,745
Total.....			272,842

Adjoining the last described mine, on the east, is

THE BONNIE,

at which no work has been done in the past year. Probably there would be exploring done if the property could be secured for the purpose. It is not yet freed of the complications growing out of the Burton affairs.

West of the Bonnie, and joining it, is

THE FIRST NATIONAL,

on which the Metropolitan Iron and Land Co. is doing some exploring. The estate is the N. W.  $\frac{1}{4}$ , Sec. 19, 47, 46. Joining this on the north is

THE GENEVA,

the S. W.  $\frac{1}{4}$ , Sec. 18, 47, 46, is held on an option by some residents of Ironwood. They are sinking a shaft just south of the county road, on the land.

North of the road, in the S. E.  $\frac{1}{4}$ , S. E.  $\frac{1}{4}$ , Sec. 13, 47, 46, is

THE NEWBERRY.

The water has been pumped out of the shaft recently, with the purpose of prosecuting further exploration. It is now called the Power, after Hon. John Power, of Escanaba, who is the one chiefly responsible for the work, I am told.

THE NORTH PABST

in the N.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 23, 47, 47, is an active exploration. They are sinking a shaft close to the Pabst line. The shaft is 300 ft. deep, all the way in slates. East of the Geneva and joining it is the

BLUE JACKET,

the S. E.  $\frac{1}{4}$ , Sec. 18. No work is doing there; but at

THE RUBY,

formerly the Puritan, which joins the Blue Jacket on the east, they are exploring and mining ore. They are mining in No. 4 shaft and are explor-

ing in the side hill to the north for the north vein. I have given an extended description of this property in the Com. Report for 1886. It would seem to be a favorable property to explore.

The discription is the S. W.  $\frac{1}{4}$ , Sec. 17, 47, 46.

Geo. H. Abeel, Supt., Hurley, Wis.; S. Hitchcock, Sec.; M. A. Hanna, Pres.; A. C. Saunders, Treas., office 101 St. Clair St., Cleveland, Ohio.

The title is the Ruby Iron Mining Co. The mine, while not disclosing much yet is certainly improved within the year. A year ago there was but a small body of ore in sight and it contained  $2\frac{1}{2}$  to 4% of manganese so that it was of not much value. They have found two other bodies of ore, one is very irregular, is 60 ft. north of the foot wall and so far does not amount to much. The ore lies on a dike which has been sunk through 38 ft. thick. The other body of ore is further east and looks promising. The company employes a small force, and Mr. Abeel looks closely after the work.

The following is the table of production:

Year.	Tons.	Year.	Tons.
1886.....	16,388	1888.....	3,056
1887.....	42,065	1889.....	9,472
Total.....			70,981

#### THE IRONTON MINE,

like the Ruby, has proved very disappointing. They both showed so well at first that great expectations were raised. They both were sold at high figures and while the sellers reaped a rich harvest the purchasers were correspondingly injured. There was a fine deposit of ore on the line between the properties, but it was worked out and nothing so good has been found to take its place. The property is the W.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 17, 47, 46, lying between the Ruby and the Federal.

During the past year and more they have been mining ore in the deposit which was found with the diamond drill as mentioned in a former Report. They are now 240 ft. deep and are still sinking and drifting in a deposit of ore that does not seem to be very large. They are working a few men.

It is quite probable that at greater depth than has yet been reached, ore will be found to the east below the hill on the flat land. The results at the Federal rather indicates it.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886.....	16,307	1888.....	1,755
1887.....	27,887	1889.....	9,449
Total.....			55,398

M. W. Burt, Agt., Ironwood, Mich.

#### THE FEDERAL MINE

formerly the Tontine, is improving. It promises to be a mine of value. It is only within two years that any ore was found on the property. In fact,

the Tontine Co. had become entirely discouraged and relinquished the lease of the land. The new proprietors pushed the work moderately and soon found ore, which has since continued to develop until now the "showing" is such as to make it nearly certain that the Federal will be a good mine. The situation is in the valley near the Ironton Bluff, the estate being the E.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 17, 47, 46.

There are now two shafts, which are 400 ft. apart, the new one being the east one and in the foot wall. It is 210 ft. deep. At the 200 ft. level they are crosscutting to the ore, north. They have drifted in ore for 200 ft. east of this shaft, besides which there is ore nearly all the way from No. 1 to No. 2.

No. 1, the west shaft, is 225 ft. deep, and also are crosscutting to the ore at the 200 ft. level.

They do not know very much about this deposit of ore yet, but when the crosscuts are made, etc., at the 200 ft. level and below, the development will tell the story.

R. S. Dingwell, Sec'y, Milwaukee, Wis.; D. A. Bennett, Supt.; R. Stepan, Mining Capt.

The product of the mine, 1888, was 3,182 tons, 1889, was 9,912 tons.

The lease of

#### THE VALLEY

mine estate, consisting of the N.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , and S.  $\frac{1}{2}$ , N. W.  $\frac{1}{4}$ , and N.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 16, 47, 46, having been relinquished by the Valley Iron Mining Co., has been taken under option by different holders who are preparing to explore the several subdivisions. The 80 first mentioned is held by the Metropolitan Iron & Land Co. and they are already vigorously at work. The 80 north of it to wit: the S.  $\frac{1}{2}$ , N. W.  $\frac{1}{4}$ , Sec. 16, was taken by Messrs. Swain & Riley, of Bessemer, and three-fourths interest transferred to Messrs. Ed. Ryan, Hermon Nunnemacher, and H. H. Benjamin. It was on this 80 that most of the mining work was done by the original company. In all 2,164 tons of ore were shipped.

This south 80 is owned by Capt. Nat Hibbert, Wm. H. Sedgewick, and Capt. Sam. Mitchell, I believe, and the north 80 by J. M. Longyear, of Marquette.

These properties start from near the foot of the Colby bluff and with the Federal, compose the valley to the Ironton bluff on the west.

#### THE COLBY MINE

has not been very strongly worked during the past year; for some reason, the company has seen fit to employ a comparatively light force. Now, however, the effort is to get out all the ore possible.

It has been a matter of a good deal of delay and trouble, etc., to get the surface rearranged and things put into their present more convenient and intelligent shape. Formerly, the machinery was all over the mine; now it is mostly on the foot wall. The outer buildings have been moved and placed in positions of greater safety, and the surface relieved of the stumps, logs, rocks, etc., that marred its appearance and impeded progress.

The stock pile ground is now all on the foot wall side, and the arrangements for storing and handling are adequate and convenient. In February last, the mine caved in down to the sixth level, so that, for several months,

there was only one shaft in the mine that could be used—No. 5, the double skip shaft, sunk in the foot wall, the most easterly shaft. The shafts that were crushed in are 3 and 4. The latter has been restored, so that it is now again used in hoisting. No. 3 will not be repaired. The compressor house foundations and machinery went down, but the machinery was rescued from the ruin without material injury and quickly set up again, over on the foot wall. The crush came suddenly, though premonitory symptoms were not wanting, and Capt. Dickinson had ordered all the miners out, so no one was caught in the crush. Only one man was hurt, and he by the concussion of air.

They have ore in all the levels, from the second, down. In east end of the mine, the new body of ore, described in the last Commissioner's Report, as having been found in the second level, in drifting from No. 4 to No. 5 shafts, has developed well. In puncturing the ground that inclosed the main deposit, minor pockets of ore are found, which are of importance. The mine is looking well at the east end, and there is a mile of ground yet to explore. The whole of Sec. 15, between the Colby and the Palms, is held by the company that controls the Colby.

At No. 5 shaft, in the mine, the ore goes off to the northeast, away from the foot wall, and, apparently, there is likely to be a good deal of it. Have gone in east 300 feet. No. 3 shaft strikes the dike at the sixth level; No. 4 at the seventh, and No. 5 has the dike in the eighth level. The angle of the slope down east is about 20°.

The product in 1890 will be 250,000 tons.

Of the product in 1889, 25,500 tons Sellwood ore averaged .0892 per cent in manganese; the combined iron and manganese was 63.52 per cent; 50,018 tons contained .0674 per cent manganese, and combined, gave 63.17 per cent; 75,578 tons contained .0748 per cent manganese, and combined, gave 63.28 per cent. These are returns from the purchaser.

The corporate title is the Penokee and Gogebic Development Co.; but the mine has the same proprietors as the Aurora, Palms and Eclipse.

Joseph L. Colby, Treasurer; Alton L. Dickerman, Manager; W. E. Dickinson, Superintendent.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1885.....	84,312	1888.....	285,195
1886.....	257,433	1889.....	138,019
1887.....	258,518		
Total.....			1,023,477

#### THE PALMS MINE

from a possibility has become a reality. At first the original company sank the four shafts to a depth of about 100 ft. and drifted to connect them but the work was all in "cap rock" and the ore that was found was "mixed" with rock.

When Capt. Christopher was called to take charge of the mine he speedily decided that if any ore was to be mined they must first find it, and the surest way to do that was to "go down" for it. He sank deeper and got limited pockets of good ore. Still he did not do enough, the policy of the

company was restrictive. They did not want to advance money for exploratory work. But they have been getting deeper all the while and the result has verified the conjectures made of the value of so doing. No. 4 shaft is 450 ft. deep and they have a length of ore of 800 ft., and still continuing both ways. At the west end the ore is five "sets" wide and growing wider. In some portions of the deposit it is eleven sets wide, 70 or 80 ft. It is sure to be a good mine, to give a product in 1890 of between 50,000 and 100,000 tons of ore.

The quality is shown by the following averages of analyses of shipments to Joliet and to Chicago: The former gave, metallic iron 63.56%, phos. .052%; the latter gave metallic iron 63.35%, phos. .055%.

At present, May 1, they are limited in hoisting to No. 4 shaft. They are "rising up" in No. 2 and will have that in readiness to aid production by and by. Also are sinking a new shaft 300 ft. west of the east line and 150 ft. north of the quartzite foot wall, on surface. As the foot wall dips 63° to north and the shaft is vertical, the distance down to the point of intersection will be 300 ft.

No. 2 is the east shaft and is about midway between No. 4 and the new shaft, and when they are all in readiness the ore will be gotten out rapidly.

The Anvil mine, which joins the Palms on the east, is worked up to the line on the dike. The ore is wide and of good quality, so that there is all probability of its continuing on the dike through the Palms land.

The mine is now controlled by the Messrs. Colby, *et al.*, the same parties who own the Colby, Aurora, etc., mines.

Chas. L. Colby, President; Joseph L. Colby, Treas., Milwaukee; Alton L. Dickerman, Manager; Capt. J. P. Christopher, Supt., Bessemer, Mich.

Product—1887, 1,600 tons; 1888, 23,184 tons; 1889, 35,434 tons; total, 60,218 tons.

The corporate title is the Palms Iron Mining Co.

#### THE ANVIL MINING CO.

holds the quarter section next east of the Palms, being the N. E.  $\frac{1}{4}$ , Sec. 14, T. 47, 46. While the Anvil is, undoubtedly, a valuable mining property, it so happens that just now there is, perhaps, not above 25,000 tons of ore in sight. Still they expect to mine 75,000 tons, and probably will do so. The reason is that the ore has all been obtained at the west side of the property, and the ore is limited by the underlying dike, the west line and the rock that terminates it in other directions. These bounds of the ore were determined some time ago; and, for several years, the deposit has been undergoing depletion. It is now nearly exhausted, but still comprises all the ore that is known to a certainty. There is, however, every reasonable assurance that ore exists in large quantity in the east part of the property.

They are sinking a new shaft at 800 feet west from the east line, and, south of it, have built an engine and boiler house. The shaft is now, May 1, 230 feet deep, and, over it, they are erecting the frame work of a substantial shaft house.

They soon expect to reach the ore found in the Eureka, just east of the line. The shaft is now in the formation that was found over the ore at the Eureka. No. 2 shaft is at the west end, where they are mining ore. From there to No. 3, it is 550 feet; and to No. 4, the new shaft, 1,300 feet. No. 3 is 330 feet down to the dike, but there is no ore at that point, so far.

The shafts are connected by a drift, on the dike, 330 feet down from surface, and they are cutting a cross drift north, on the dike, which will be continued until ore is encountered, if possible. The same will be done at No. 4, and, if ore occurs, the two will be connected by a drift in the ore. Judging from the position of the ore at the Eureka, with reference to the quartzite, it is expected to find it at about 150 or 200 feet north of this foot wall. They look confidently to the finding of ore at No. 4 shaft.

The present officers are:

G. E. Tarbell, President; F. J. Kipp, Vice President; R. Nunnemacher, Secretary and Treasurer; D. A. Bennett, Superintendent.

General office, Milwaukee; mine office, Bessemer.

The ore shipments have been as follows: 1887, 10,076 tons; 1888, 24,677 tons; 1889, 44,054 tons.

Amount received from sale of the ore in 1889 was.....	\$205,841 74
Expenditures: cost of mining, shipping, etc.....	174,718 20
Profit .....	\$31,123 54

#### THE EUREKA IRON MINING CO.

is the corporate title of the company that was formerly known as the East Anvil, and, later, as the Dangler. The mine joins the Anvil on the east, where the efforts, applied through several years, to find ore, have recently been crowned with success. The mine is in the side hill, which descends from the Anvil boundary, easterly for half a mile to the Black river. The description is the W.  $\frac{1}{2}$ , N. W.  $\frac{1}{4}$ , Sec. 13, 47, 46. At the time I was last at the mine, about the first of April, the situation was as follows:

No 1 shaft is on the quartzite foot wall, sunk vertically until the quartzite is reached when it descends with the dip of the rock.

It is 400 feet east of the west line, and the surface descends, in that distance, 100 feet. The shaft is 300 feet deep: 140 feet to the dike, 45 feet through it, and the rest of the distance under the dike, through the same kind of rock as occurs above the ore "capping."

From above the dike, they drifted north 140 feet and found the ore 43 feet wide. They have drifted west 317', nearly to the line, all the way in ore.

No. 2 shaft is 217 feet east from the north end of the crosscut. The ore is reached in this shaft at 40 feet below surface, and continues to 65 feet, where the dike is reached—25 feet thickness of ore. The shaft continues in the dike until the level of the drift, coming from No. 1 shaft, is reached, where they have drifted each way, east and west, through the dike into ore again. In all, the drifting, east and west, is 600 feet; ore all the way. No. 2 shaft comes down onto the dike on the apex of a fold, anticlinal, in the formation. Each way the dike descends, to east and to west. The surface at No. 2 is about 130 feet below the top of the hill at the west, while the Gogebic shaft, which is about 600 feet east from No. 2, is 230 feet below. Still down by the river, 300 feet further east, is another shaft on the Gogebic mine property, in which the dike was found at 140 feet below the surface, showing that here the dike dips rapidly to the east. From No. 2 shaft, it dips west; but, further on, it runs pretty flat across the Anvil property. It is probable that the Eureka has, ore the width of the property, 1,320 feet.

The analysis of the ore gives, I am told, 62 per cent iron; .070, phos. They are putting up shaft houses over each of the shafts, and will soon be

in good shape for producing ore. They have an engine house and a suitable plant of machinery.

It will be observed that, as far as known, the ore is all above the dike, and, unless more of it than now appears is found, a few years will exhaust it.

W. H. Whiteside, who is a miner of much skill and experience, superintends the work.

F. T. Ives, Secretary and Treasurer, Cleveland, Ohio; Jas. Corrigan, General Manager.

#### THE EAST DANGLER

is just across the river in the W.  $\frac{1}{2}$ , N. E.  $\frac{1}{4}$ , Sec. 13. Parties of Ironwood, Mich., have the option.

Capt. Peter Conley is in charge of the work.

They are sinking, but are much troubled with an excess of water.

#### THE GOGEBIC

has been referred to in speaking of the Eureka. They have sunk three shafts and are down on the dike, but have not found ore yet.

Capt. Harry Pearce is in charge of the work.

#### AT THE RHINELANDER, MIKADO

and other properties east from the river towards Wakefield, exploring is in progress or soon will be commenced. There are a good many properties in this portion of the range from Black river to Wakefield, all of which have been somewhat explored and a few of them a good deal. It is a good ore formation, ferruginous schists and slaty jasper, etc., but at none of them has ore enough been found to give assurance of a mine. In previous Reports I have described all these explorations and I find nothing new that I think will be of interest. The finding of a good workable deposit of ore in this locality would be a matter of much interest and value.

I think that some important work is being done.

#### THE CROWN POINT

mine has been purchased by the Brotherton Co. The mines join. The Brotherton being on the northeast margin of Sunday lake, the land extending into the lake so that the water covers about half of the west 40. The description is the N.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec. 9, 47, 45. The Crown Point being the S. W.  $\frac{1}{4}$  of same section, all of which, save a narrow strip on the north side, is under water. Ore was found at the Crown Point as described in my last Report, and as it is of the same character as that in the Brotherton mine and the line of the continuation of the Brotherton, and Sunday Lake mine ore deposits, and as the Brotherton ore, going west continues under the water, it seems quite probable that ore will be found beneath the lake on both properties.

#### THE BROTHERTON MINE

holds its own very well indeed. It is a good mine, affording a fair amount, annually, of excellent ore. The general features of the mine remain almost

unvaried from one year to another. The same formation exists at other explorations west of Sunday lake, but they do not find the ore that, fortunately, occurs at the Brotherton. The company has been investigating the problem of pumping the lake dry. They have ore under it possibly all the way across it, but it is scarcely safe to attempt to mine it with the water over them. It is expected that the output in 1890 will exceed that of any previous year. The maximum depth is 400 ft. and the width of ore 50 ft. The length of working is 1,500 ft. from the lake to line on east.

The officers are Joseph Sellwood, President, Duluth, Minn.; Edward Niedecken, Sec'y, Milwaukee, Wis.; M. J. Luther, Treas., Milwaukee, Wis.

Product, annually, has been as follows:

Year.	Tons.	Year.	Tons.
1886.....	8,880	1888.....	40,639
1887.....	21,721	1889.....	76,590
Total.....			147,830

#### THE SUNDAY LAKE MINE

joins the Brotherton on the east; the dividing line crosses the ore. Pending litigation between the fee owners and the lessees, the mine is idle, no work having been done since February, 1889. I find nothing special to add to previous descriptions given.

*Table of Production.*

Year.	Tons.	Year.	Tons.
1886.....	14,270	1888.....	
1887.....	18,138	1889.....	3,240
Total.....			35,648

Daniel McVichie, Supt., Wakefield, Mich.

#### THE IRON CHIEF,

which is close to the former on the east, and which was given up a few years ago as, apparently, of no value, is again undergoing examination. This time they are on the east side of the property, and have a shaft down 120 feet, and have a crosscut north from the shaft forty feet.

Superintendent, D. McVichie; John Anderson, Captain, Wakefield, Mich.

#### THE SPARTA,

or Chicago, is still worked; Capt. John McLeod is superintending the work. It lies just north of the Crown Point. The prospect seems to be becoming more favorable as the work progresses. Exploring work is in

progress at other points, west of the lake, and northwest and southwest of it. I look for valuable results to grow out of this work.

East of the Iron Chief, the most valuable results have been achieved; work at

#### THE COMET,

formerly the Eclipse, which is the S.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , Sec. 11, 45, 47, has developed a mine. Every preparation is now in progress for pursuing active mining work. The lease has been purchased by the Penokee and Gogebic Development Co., and the Eclipse will constitute one of the series of this company's mines.

They have sunk to a depth of 165 feet and drifted a length, east and west, of 300 feet. The ore is twelve or fourteen feet wide. In pursuing the opening work, they have raised 1,500 tons of ore, which is now in stock. They are putting in suitable machinery for mining work, and the M. L. S. & W. R. R. Co. is extending the Brotherton spur to the location.

There will be two four-foot drums, two eighty-horse power boilers. They are locating the machinery on the foot wall, 250 feet south of the ore.

The ore is of best quality, like the Brotherton.

#### THE PITTSBURGH

is the 80 north of the Eclipse, to wit: the N.  $\frac{1}{2}$ , S. W.  $\frac{1}{4}$ , Sec. 11, 45, 47. Capt. M. L. Tallon, who has charge of it, is working a few men, employed in sinking a shaft, which is now 65 feet in depth, 8'x12' inside timbers. The plan is to go on down with the shaft until they find the ore in its underlay, north from the comet, which, it is estimated, will be at about 350 feet in depth.

#### THE COMMERCIAL

is the W.  $\frac{1}{2}$ , S. E.  $\frac{1}{4}$ , Sec 11, 45, 47, thus making it join both the Comet and Pittsburgh. I think the holders of this lease are delaying further work just at present, awaiting results at the Comet and Pittsburgh, so that when they start in again, they can pursue a course of more certainty. Mr. Dan Kloeckner, of Hancock, Mich., and other prominent men in the copper region and at Negaunee, are interested in the property.

#### THE WASHBURN

and other gold mining explorations at Wakefield, have collapsed utterly.

TABLE of Mine Products, 1889, and specific tax thereon as reported to the Auditor General, State of Michigan, by the Commissioner of Mineral Statistics.

Names of Mines and Companies.	Tons of Ore.	Specific Tax.
American Iron Co.	20,032	\$200 32
Aragon Mining Co.	1,748	17 48
Aurora Iron Mining Co.	216,061	2,160 61
Ashland Iron Mining Co.	256,830	2,568 30
Anvil Mining Co.	44,054	440 54
Armenia Mining Co.	47,775	477 75
Beaufort Iron Co.	16,505	165 05
Braestead Mines	155,342	1,553 42
Buffalo Mining Co.	51,000	510 00
	5,538	55 38
Brotherton Iron Mining Co.	76,590	765 90
Champion Iron Co.	215,090	2,150 90
Cleveland Iron Mining Co.	274,048	2,740 48
Colby Mine.	188,019	1,880 19
Chapin Mining Co.	518,990	5,189 90
Cambria Mining Co.	72,780	727 80
Dexter Consolidated Mining Co.	4,269	42 69
Detroit Iron Mining Co.	10,114	101 14
East New York Iron Co.	29,739	297 39
East Champion Iron Co.	2,697	26 97
Federal Land and Iron Co.	9,912	99 12
Grand Rapids Iron Co.	20,058	200 58
Hamilton Ore Co.	8,369	83 69
Hartford Mining Co.	566	5 66
Humboldt Iron Co.	15,856	158 56
Imperial Iron Mining Co. (Wetmore Mine)	19,679	196 79
Iron Star Mining Co.	38,451	384 51
Ironton Iron Mining Co.	9,449	94 49
Iron Cliff Co.	233,189	2,331 89
Iron River Co. (Florence Iron River Co.)	179,238	1,792 38
Jackson Iron Co.	128,892	1,288 92
Lake Superior Iron Co.	288,784	2,887 84
Lumbermen's Mining Co.	116,300	1,163 00
Lucy Mining Co.	32,982	329 82
Lillie Mining Co.	33,916	339 16
Marquette Ore Co.	65,096	650 96
Michigamme Co.	56,999	569 99
Metropolitan Iron and Land Co. (Norrie)	771,230	7,712 30
Mastodon Iron Co.	63,086	630 86
Milwaukee Iron Mining Co.	52,728	527 28
Monitor Iron Mining Co.	21,620	216 20
Millie Mining Co.	18,916	189 16
Mount Hope Mining Co.	66,799	667 99
Negaunee Mining Co.	78,318	783 18
North Champion Iron Co.	7,757	77 57
New York Iron Mine	1,293	12 93
Newport and Lake Superior Land Co.	34,946	349 46
Paint River Iron Co.	32,161	321 61
Perkins Mine	12,302	123 02
Penn Iron Mining Co.	256,773	2,567 73
Pittsburgh and Lake Angeline Iron Co.	229,070	2,290 70
Palms Iron Mining Co.	35,434	354 34
Queen Mining Co.	66,122	661 22
Ruby Iron Mining Co.	9,472	94 72
Riverside Iron Co.	3,573	35 73
Republic Reduction Co.	22,102	221 02
Republic Iron Co.	287,391	2,873 91
Samson Iron Co.	2,797	27 97
South Buffalo Mining Co.	69,360	693 60
Sunday Lake Mine	3,240	32 40
Shafer Iron Co.	11,166	111 66
South Mastodon Iron Co.	4,006	40 06
Sheridan Iron Co.	1,102	11 02
Volunteer Iron Co.	60,157	601 57
Wheat Mining Co.	7,997	79 97

Table of Mine Products, 1889.—Continued.

Names of Mines and Companies.	Tons of Ore.	Specific Tax.
West Republic Mining Co.	1,510	\$15 10
Walpole Mine	9,614	96 14
Webster Iron Co.	448	4 48
York Iron Co.	151,828	1,518 28
York Mining Co.	13,032	130 32
Youngstown Mining Co. (Florence, Iron River Co.)	7,471	74 71
Totals	5,329,828	\$58,298 28

Products of Copper Mines and Specific Tax thereon, reported to the Auditor General of Michigan—1889—by Commissioner of Mineral Statistics.

Name of Company.	Product.		Specific Tax.	
	Tons.	Pounds.	Dollars.	Cents.
Atlantic Mining Co.	1,889	237	1,416	84
Allouez Mining Co.	881	816	661	06
Calumet and Hecla Mining Co.	24,334	296	18,250	61
Central Mining Co.	635	592	476	47
Copper Falls Mining Co.	434	1,136	325	93
Franklin Mining Co.	2,173	62	1,629	77
Evergreen Bluff Mining Co.	14	773	10	79
Lac La Belle Mining Co.	1	1,728	1	37
Huron Copper Co.	1,109	1,473	839	30
Kearsarge Mining Co.	959	849	719	57
Oscola Consolidated Mining Co.	2,367	127	1,700	29
Quincy Mining Co.	3,202	1,686	2,402	13
Ridge Copper Co.	12	1,013	9	37
Tamarack Mining Co.	5,302	1,451	3,977	04
Mass Mining Co.	26	1,742	20	15
Peninsula Copper Mining Co.	365	507	276	19
Totals	43,613	468	32,709	88

Product of Coal Mines and Specific Tax thereon, as reported by Commissioner of Mineral Statistics to the Auditor General of the State of Michigan, 1889.

	Tons of Coal.	Specific Tax.
R. H. Emerson & Co.	17,282	\$86 41
Eureka Coal Co.	100	50
Corunna Coal Co.	15,000	75 00
Bennett Sewer Pipe Co.	5,000	25 00
H. J. Stark	30	15
Star Coal Co.	325	1 62
Standard Mining Co.	9,888	49 44
Grand Ledge Coal Co.	360	1 80
Poole Mining Co.	10,120	50 60
Totals	58,105	\$290 52

Total number of tons of iron ore produced in Michigan in 1889, 5,829,828 long tons. Aggregate, including production of previous years, 43,824,957 long tons.

Total production of refined copper in Michigan in 1889, 43,613 tons, 468 lbs. Aggregate, inclusive of that of previous years, 613,596 tons, 369 lbs.

The usual tables of products of iron ore and copper, covering all the years since mining was begun in this State, which have heretofore accompanied the annual Reports of the Commissioner, are omitted from this volume. I do not deem it necessary that these tables should be re-printed every year. In the description given of every mine, is found a table of the mine's yearly production and its aggregate yield also. The tables of production in the former Reports can be referred to to ascertain the output of idle or abandoned mines.

The same may be said of the plates of the copper mines, which are contained in previous volumes. I made the additions to these maps bringing them down to the end of the year 1889, but they show so little change from those in the previous Reports that I omitted them from this. Reference to the maps in Report for 1888, will suffice for all purposes taken with the descriptions herein given.

### PIG IRON.

*Statistics of Production of Pig Iron in Michigan Blast Furnaces, 1889 and several previous years.*

Name of Company.	1886.	1887.	1888.	1889.
Eureka Iron and Steel Works, Wyandott.....	11,668½	12,484	10,765	15,568
Gaylor Iron Company, Detroit.....	8,095	6,760	8,858	6,455
Detroit Iron Furnace Company, Detroit.....	6,741	15,272	17,466	15,842
Union Iron Company, Detroit.....	6,000	8,753	8,782	11,826
Peninsular Iron Company, Detroit.....	5,263	9,207	9,303	9,515
Bangor Furnace Company, Bangor.....	12,941	8,361	7,686	.....
Elk Rapids Iron Company, Elk Rapids.....	17,434½	14,888	15,726	20,181
Spring Lake Iron Company, Fruitport.....	17,768	18,381	14,811	20,376
Jackson Iron Company, Fayette.....	10,581	13,325½	14,706	12,049
Vulcan Iron Company, Newberry.....	17,360	11,854	16,580	16,609
Deer Lake Iron Company, Ishpening.....	10,898½	10,165½	8,717	10,168
Iron Cliff Company, Negaunee, Pioneer.....	11,079	18,787	28,235	24,678
Antrim Iron Company, Mancelona.....	9,414	16,240	18,158	22,958
Pine Lake Iron Company, Ironton.....	5,070	10,342	12,320	12,520
Martel Furnace Company, St. Ignace.....	7,666	10,880	9,552	.....
Gogebic Furnace Company, Iron River.....	.....	3,700	.....	.....
Total.....	148,952	.....	187,665	198,745

### ADDITIONAL MINE ACCIDENTS.

The following information was not obtained until too late to have it appear in its proper place with the summaries of the other Inspector's Reports:

#### IRON COUNTY—ELISHA MORGAN, *Inspector.*

List of killed and seriously injured in mines in year 1889:

Dominic Codell, in Dunn Mine, by fall of rock, May 22, 1889; two men injured, but not killed, at Iron River Mine.

#### GOGEBIC COUNTY—J. PARKE CHANNING, *Inspector.*

Total number killed in mines in Gogebic, Mich., from Sept. 1, 1888, to Sept. 1, 1889, 24.

#### *Classification of Fatal Accidents.*

Nationality.		Nature of Accident.	
English.....	4	Fell down shaft.....	7
Swedes.....	7	Fall of ground.....	8
Finlanders.....	3	Explosions.....	3
Italians.....	3	Fell off timbers.....	2
Irish.....	3	Simple falls.....	2
Austrian.....	3	Riding in skip.....	1
Canadian.....	1	Blown down from cave.....	1
Total.....	24	Total.....	24

Occupation.		Mine.	
Miners.....	14	Colby.....	6
Trammers.....	7	Palms.....	4
Timbermen.....	2	Ashland.....	3
Shift Boss.....	1	Norrie.....	2
	—	Pabst.....	2
Total.....	24	Mount Hope (Iron King).....	2
		Anvil.....	2
		Aurora.....	1
		Ironton.....	1
		Explorations.....	1
		Total.....	24

#### ERRATA.

Page 87, Josiah Hull should read Josiah Hall.

Page 93, All were Bessemer hematites, should read *non-Bessemer*.

Pages 108 and 109, McKibbon Bros. should read McKinnon Bros.

Page 98, James Hoskins should read James Haskins.

Page 104, Frank Corbis should read Frank Carbis.

Page 106, N. B. Hulst should read N. P. Hulst.

Page 134, James McMiller should read James McMillen.

Page 152, Thomas Waters should read Thomas Walters.

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