STATE OF MICHIGAN

MINES AND MINERAL STATISTICS

BY

JAMES RUSSEL

COMMISSIONER OF MINERAL STATISTICS.

BY AUTHORITY

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Letter of Transmittal.

STATE OF MICHIGAN
OFFICE OF THE
COMMISSIONER OF MINERAL STATISTICS,
Marquette, Mich., Sept. 1, 1901.

HON. AARON T. BLISS,
Governor of the State of Michigan:

SIR:—In fulfillment of the duties of my office I have the honor to submit herewith the following report upon the mines and mineral interests of the State.

Respectfully, your obedient servant,

JAMES RUSSELL,
Commissioner of Mineral Statistics.

INTRODUCTORY.

Compared with my first report as Commissioner of Mineral Statistics, that herewith submitted may appear somewhat lacking in comprehensiveness of treatment of the great industries with which it deals. But the exhaustive nature of the former, and the extent to which it went into detail, together with the fact that my term of office as commissioner expired soon after it had been given to the public, has constrained me to make this supplemental to that, rather than to attempt what, under the conditions, could be nothing more than covering again ground that was very fully gone over in the report issued early in the current year.

This report has been, therefore, confined to bringing up to date the account of what has been done at the developed mines, and giving the facts regarding properties in progress of development, and in relation to such exploratory operations as have been undertaken in the mining districts of the state in the interim.

I deem it due to myself to explain in this connection that my tenure of office as Commissioner was trenched on under an arrangement made presumably for a political purpose, with a corresponding-effect on the salary received by me from the state. My term fell short of the prescribed two years in consequence, notwithstanding which I have published two reports, one the most elaborate in detail and exhaustive in treatment yet issued (it being a volume of 490 pages), preparation of the matter for which, with the printing and distribution, would not be more than fairly met by the entire amount drawn by me from the state in salary.

The state can be congratulated on the increasing interest being taken in the development of its magnificent mineral resources. Each year sees an enhancement of the volume of capital invested in mining ventures and the facilities for conducting them more economically and profitably, as also an increase in their

productiveness. It can be said of the mining industries of Michigan that never before were they more ably managed or prosperous than they now are; and never before was money being invested in them more freely, or more confidently as to the safety of the investment. This speaks more eloquently than spoken or written words can of the ability with which these industries have been and are being operated, as well as of the great richness of the mineral deposits of the state, and the established certainty that their extent is such as to make conjecture regarding the day when they shall be worked out so purely speculative as to be a waste of time. It is not too much to say that the iron mines of Michigan, which lie entirely in the upper peninsula, were never before so well prepared to produce ore in any quantity that market requirements may render advisable. Of our copper mining industry it can truthfully be said that it has yet to reach its full power as a wealth-producer, while the coal mining interest, which has its field in the lower peninsula, is but in the infancy of its development, with a most promising future before it.

The present year has been one of great activity in all three of these industries, and there is nothing in the present aspect of business throughout the country, or the conditions prevailing in the world of trade and finance, giving augury of a cessation of the prosperity they are now enjoying. Wages are good and employment abundant in the mining districts of the state, and the year has brought to them no labor disturbances deserving the name. In every community depending on a mining enterprise for its existence labor finds plenty to do and at good wages; the men are contented, and the policy of the employers appears to have in view keeping them satisfied by according them fair treatment and making their welfare a study. It should be regarded as cause for pride by every citizen of Michigan that with such vast mining interests as have been created within its borders it is free from the labor disagreements and the lawlessness accompanying them which so unpleasantly mark the history of mining districts in other states of the union where work of this kind is extensively carried on.

The minor mineral industries of the state are in a flourishing way, and while they are hardly important enough to be regarded as a distinctive feature of the wealth-creating factors of the commonwealth, they are doing their share to add to its prosperity and are furnishing profitable occupation for a very considerable proportion of its people.

In my first report I dwelt at some length on the necessity for having proper precaution taken to ensure useful work from the incumbent of the office of Commissioner of Mineral Statistics, and also the unwisdom of having provision made for printing and distributing but 1,000 copies of his annual report. I printed the required 1,000 copies of my first report and the edition was quickly exhausted, without at all meeting the demand. Requests for copies are constantly coming to this office from all parts of the country and it is a source of keen regret to me that they must be denied. I still adhere to the belief that if the state did not undertake to supply the information embodied in these reports private enterprise would take it in hand and do it thoroughly and acceptably. But if the state is to persist in having charge of this work it should first provide for having it done honestly and efficiently and then make sure that the purpose of having such a report issued annually is not defeated by the faulty economy of holding down the number of copies printed to the wholly inadequate amount of 1,000. If the report is what it should be not less than 5,000 copies of it should be printed for general distribution, and if it is riot a publication commensurate with the greatness of the interests of which it treats it had better not be published at all.

I have nothing to recant of what was set forth on these points in the introductory to my first report. What was therein stated and suggested was aimed at an abuse arising from neglect and indifference on the part of the administrative and legislative branches of the state government, but it apparently fell on unheeding ears, and I do not feel called on to elaborate on the subject here.

The task of gathering the information for this report and preparing it for the printer was entrusted largely to the Assistant Commissioner, Horace J. Stevens, of Houghton, whose work on my first report went far toward making it so valuable for the purposes of consultation and reference that the demand for it appears to be growing rather than diminishing. Mr. Stevens has come to be a recognized authority on statistics relating to the iron and copper mines of Michigan, and I take very great pleasure in acknowledging the assistance he has rendered me, without which I should have found the work of the office an exceedingly onerous burden.

I desire to say, in closing, that I am under very great obligation to the mine managers and officials with whom my duties brought me in contact while I filled the office of Commissioner of Mineral Statistics for assistance rendered and courtesies extended. I have invariably found them ready to aid with information and suggestion, and willing to do all in their power to make the work of the Commissioner useful to the state and as pleasant to him and his assistant as its nature made possible.

JAMES RUSSELL,
Commissioner.

IRON.

The march of events has been a rapid one within the past few months in the Lake Superior iron district. The process of consolidation which was begun some years ago, and which reached an acute stage in 1899 and 1900, has finally arrived at a point where the greater number of the best mines of all five ranges have been consolidated in the hands of the United States Steel Corporation, a concern of such gigantic resources and such hitherto unheard-of capitalization that it is truly the colossus among the corporations of the world. A few of the independent mines remain in active operation, and these may be divided into two classes—the small properties, of comparatively trifling or doubtful value, practically all of which can be secured by the United States Steel Corporation, whenever desired, by the payment of the fair prices, and a second class comprising a very few mining companies of the first rank, such as the Cleveland-Cliffs, Lake Angeline and several others. In the case of the large mines which yet remain outside of the all-embracing grasp of the United States Steel Corporation, it is eminently a case of survival of the fittest. The mines that remain independent producers on a considerable scale are without exception properties that in addition to possessing large and valuable ore bodies have been managed with great skill and prudence. The shortsighted concerns are out of business, and what were once their mines are now in the hands of the "trust." The far-seeing people who were not satisfied to remain in a rut, but planned and acted for the future, are the ones who remain in the business, and in their case they have little to fear from the gigantic corporation that so effectually dominates the iron and steel industry of this country.

The advent of the great steel corporation into a field where it is obvious that there will remain room for only the sturdiest or smallest of independent competitors has naturally been regarded with feelings of consternation by the great majority of operators outside of the fold. It is realized, however, that the development of such a colossus is merely the natural outcome of the trend of industrial evolution, and that nothing will be gained by grumbling or endeavoring to resist the logic of events. The sentiments with which the United States Steel Corporation are regarded by those interested in the Lake Superior mining industry are somewhat mixed, according to whether the company has hurt or helped the individual, but the general opinion is that only time can demonstrate whether the organization of the company inures to the benefit or detriment of the district as a whole. It is obvious that there are certain advantages, and disadvantages as well, inherent in such a combination of the major part of the great iron mines of the Lake district. Among the advantages, which are no slight ones, labor should be insured steadier employment than would be possible under the old plan of many independent owners. The dominance of the United States Steel Corporation in the industrial world should also give a greater stability to the iron trade in all its branches, and it is undeniable that the iron industry in the past has been a somewhat erratic one, periods of famine alternating with those of plenty. From the nature of things it is impossible that the demand for iron and its products can remain at any constant ratio with population or wealth, but the acute phases of depression and "booms" may be greatly modified by having the industry effectually dominated by a single management.

The most obvious disadvantage of this combination of the leading mines in the hands of a single corporation is the elimination of the scores of independent companies engaged in the business of mining iron ore, and the appalling discouragements fronting the men of small means who desire to engage in the iron mining industry. There is still a limited field for the independent operator unbacked by millions, but it is a circumscribed one. A few men of ability as financiers and miners can find some return for their knowledge and capital in mining the silicious ores used as sweeteners for the fine-grained Mesaba ores, and in operating small mines, becoming the gleaners, so to speak, of the iron mining field. The few remaining independent corporations having large mines, experience and capital at their command, can remain active producers upon a considerable scale, but, given the aggressive policy which can alone assure success to the United States Steel Corporation, it is certain that the number of large independent producers will become smaller, rather than increase, owing to the occasional absorption of such properties by their great competitor. The attraction of gravitation, which rules in the mining as well as in the physical world, will work to the aggrandizement of the greater at the expense of the lesser bodies.

By the process of natural selection the United States Steel Corporation has gathered in its employ many—perhaps a majority—of the best mining men of the five Lake Superior iron ranges. They are experienced men, who have earned their advancement by hard and effective work in practically every case. For the reason that the management of the mines has been left in thoroughly experienced hands, the mining industry is moving along without friction, and the thorough systematization of the business should result in considerable economies—and in this connection it may be stated that the saving of so apparently insignificant a sum as a single cent upon the cost of producing each ton of iron ore would result in a gross saving of nearly $200,000 per annum, on the present total production of iron ore by Lake Superior mines.

The men at the head of the mines of the United States Steel Corporation are receiving handsome salaries—the largest ever paid in the iron mining industry—but that the salaries are fully earned must be patent to all competent judges. A saving of a few cents per ton in costs not only pays the big salaries, but leaves a handsome profit as well, and cheap men would be very dear at the head of such great enterprises as are now being conducted by the United States Steel Corporation.

A disadvantage of consolidation that will present itself to all thoughtful minds is the making of "one man towns" of the various cities and villages where iron is mined. This disadvantage is evidently one which could and may occur. There is, however, a broadening effect about the conduct of large enterprises which makes for a wider grasp of sociological matters on the part of those in power. It must be said for the United States Steel Corporation that in the few months of its existence it has furnished steady employment at high wages to armies of men in the various mining centers of Michigan and Minnesota, and that evidences of dissatisfaction on the part of employees are few and far between. That this state of affairs may continue permanently is greatly to be wished.

The Lake Superior iron district comprises no less than seven distinct fields, five of which are in the United States and two in Canada. Of the Canadian fields, it may be said that they are in their infancy. The Michipicoten range, lying about 75 miles north of Sault Ste. Marie, at the eastern outlet of Lake Superior, made its first shipments in 1900, sending about 62,500 tons to market, and will do much better this year. The Atikokan range, which is perhaps of greater promise than the Michipicoten, lies in Algoma, north of the Vermilion range of Minnesota, and while some promising prospects have been located, is not yet a producer. The bane of the Atikokan is the prevalence of titanic acid in the ores, which in this respect greatly resemble some of the westernmost ore deposits of Minnesota, which are highly titaniferous.

The five Lake ranges in the United States are the Marquette range, wholly in Michigan; the Menominee range, mainly in Michigan, but with an overlap into Wisconsin; the Gogebic, mainly in Michigan, but with a number of important mines west of the Montreal river, the boundary line of Michigan and Wisconsin; and the Vermilion and Mesaba ranges, lying west and north of Lake Superior, both of which are located wholly within the boundaries of the state of Minnesota.

An official report dealing wholly with the mines of Michigan cannot be expected to give detailed descriptions of mines lying in other commonwealths, but so intimately related are the five American iron ranges that the figures of production can be separated by states only to the impairment of the value of such statistics. For this reason the figures of production of all five ranges are given in detail in the appended tables, the first column showing the production for the year 1900, while the last column gives the total production of each mine to the close of the nineteenth century:

Marquette Range.	1900.	Totals.
American		112,933
Ames		6,298
Barnum		801,851
Bay State		16,637
Bessie		847
Beaufort	1,583	91,800
Blue		92,639
Boston		62,542
Buffalo		217,730
Cambria	80,432	1,298,458
Champion	113,743	3,716,450
Chester	22,585	261,185
Chicago		9,012
Cleveland-Cliffs Iron Co	881,021	9,603,768
Columbia		94,813
Curry		16,671
Detroit		140,841
Dexter		118,512
Dey		2,709
East Champion		76,002
East New York	27,987	194,230
Erie		8,136
Etna		1,091
Fitch		31,817
Foster		171,893
Gibson		16,357
Goodrich		49,754
Grand Rapids		110,736
Hartford		14,289
Hortense		30,574
Humboldt		723,961
Iron Cliffs		1,700,537
Imperial	62,321	149,762
Jackson	31,714	3,715,743
Lake Superior	709,143	9,649,452
Lillie	114,990	1,235,586
Lucy		516,159
Manganese		6,359
Marquette		152,907
Mesabi's Friend		16,043
Michigamme		880,362
Milwaukee		375,451
Mitchell		136,636
Moore	4,648	4,648
National		150,216
Negaunee	126,829	1,519,723
Negaunee Concentration Works		12,708
New York	3,327	1,123,071
New York Hematite		37,587
Norwood		5,753
Nonpareil		23,395
Pascoe		59,806
Pendill		45,993
Phenix		59,114
Pioneer		15,409
Pittsburg & Lake Angeline	389,128	5,508,945
Platt		73,844
Primrose		6,040
Prince of Wales		32,415
Princeton	75,037	373,175
Quartz		491
Queen		180,866
Queen Group	398,298	2,712,336
Republic	130,126	4,910,251
Republic Reduction Co		47,174
Richards		8,261
Richmond	51,303	86,098
Riverside		16,160
Saginaw		451,424
Salisbury		686,411
Sam Mitchell		17,780
Samson		267,805
Section 12		21,887
South Buffalo		245,412
Spurr		164,244
Star West	15,987	204,649
Taylor		32,970
Titan		90,371
Volunteer	47,578	1,152,349
Webster	20,797	34,905
West Republic		133,077
Wetmore		50,870
Wheeling		10,555
Winthrop	148,945	2,388,522
Miscellaneous		6,550
Total	3,457,522	59,592,793

Menominee Range.	1900.	Totals.
Antoine	119,940	555,074
Appleton		12,102
Aragon	404,645	2,046,213
Armenia		78,969
Beta		4,211
Breen		17,430
Brier Hill		14,981
Bristol	51,639	199,518
Calumet		38,713
Chapin	929,937	9,369,900
Columbia	97,531	708,059
Commonwealth	53,342	2,249,395
Cornell		49,302
Crystal Falls	197,770	631,437
Cuff	38,209	58,419
Cundy	141,148	364,264
Curry		416,928
Cyclops		286,093
Delphic		33,770
Dober	49,203	65,192
Dunn		1,056,946
Emmett		66,655
Fairbank		8,500
Florence	35,756	1,368,680
Great Western	98,550	563,460
Groveland		1,049
Half and Half		7,524
Hamilton		96,072
Hemlock	72,413	556,486
Hersel		955
Hiawatha	11,008	13,892

Menominee Range.	1900.	Totals.
Hilltop	6,410	9,906
Hollister		4,098
Hope		17,818
Indiana		17,871
Iron River		904,587
Keel Ridge		93,101
Lamont	31,323	227,884
Lee Peck		2,844
Lincoln	72,959	153,170
Loretto	61,219	400,202
Ludington		1,001,518
Manganate		6,844
Mansfield	90,155	481,639
Mastodon		425,708
Metropolitan		107,027
Michigan Exploring Co.		1,869
Millie	14,922	219,622
Nanaimo		127,566
Northwestern		17,206
Norway		1,291,352
Paint River	1,316	223,687
Penn Iron Mining Co.	197,606	1,815,119
Perkins		397,225
Perry		3,138
Pewabic	374,043	2,701,763
Quinnesec	25,967	321,101
Riverton	71,004	73,266
Selden		2,092
Sheridan	8,063	116,299
South Mastodon		8,203
Stephenson		39,350
Sturgeon River		18,404
Verona	5,143	5,143
Vulcan		1,668,654
Walpole		19,089
Youngstown		151,425
Total	3,261,221	34,015,979

Gogebic Range.	1900.	Totals.
Ada	25,047	33,024
Anvil		313,485
Ashland	232,961	2,612,442
Atlantic	135,955	377,369
Aurora	193,111	2,766,670
Bessemer		20,889
Blue Jacket		1,799
Brotherton	89,804	827,556
Cary	125,496	805,212
Chicago	633	1,137
Colby	32,572	1,748,673
Eureka		128,719
Federal		27,928
First National		1,997
Germania	986	332,634
Hennepin	7,728	192,656
Imperial		8,515
Iron Belt	54,664	969,503
Iron Chief		12,199
Iron Chief No. 2		551
Ironton		58,368
Jack Pot	33,893	40,753
Kakagon		71,904
Meteor	7,844	97,367
Mikado	1,090	27,599
Minnewawa		1,255
Montreal	107,524	1,366,767
New Davis	3,569	57,312
Newport	217,201	1,934,176
Nimikon		28,635
Norrie	666,389	8,962,170
Odanah		77,124
Pabst	239,242	2,167,897
Palms	139,658	1,110,680
Pence		40,566
Pike	3,434	3,434
Ruby		86,525
Section 33		253,590
Shores		55,808
Sparta		4,862
Sunday Lake	74,097	457,511
Superior		121,627
Tilden	481,909	2,821,191
Trimble		25,931
Tyler's Forks		10,683
Valley		1,878
Windsor	488	148,064
Total	2,875,295	31,216,635
Grand Total	19,059,393	171,418,984

Vermilion Range.	1900.	Totals.
Chandler	644,801	6,400,451
Minnesota	325,020	6,970,059
Pioneer	450,794	1,330,990
Savoy	175,116	261,307
Zenith	60,089	228,373
Total	1,655,820	15,191,180

Mesaba Range.	1900.	Totals.
Adams	777,346	2,353,121
Aetna		19,368
Auburn	263,692	1,677,235
Biwabik	924,868	3,020,530
Canton		713,048
Cincinnati		134,041
Clark	63,071	63,071
Cloquet		163,444
Commodore	278,416	667,068
Day		20,626
Duluth	128,587	443,803
Elba	121,707	131,818
Fayal	1,252,504	3,928,879
Franklin	168,524	1,246,577
Genoa	253,651	1,136,537
Hale	32,901	194,229
Kanawha	64,218	79,181
Lake Superior	284,023	959,447
Mahoning	911,021	2,987,134
Malta	65,346	93,961
Minnewas		15,998
Mountain Iron	1,001,324	4,774,585
Norman		421,132
Ohio	172,597	714,073
Oliver	244,876	3,132,686
Penobscot	146,641	273,845
Pillsbury	101,032	307,210
Roberts	41,965	118,426
Sauntry	68,560	121,564
Sellers	56,280	544,382
Sparta	202,144	732,165
Spruce	101,675	101,675
Stevenson	56,031	56,031
Union	8,297	8,297
Williams	18,238	44,890
Total	7,809,535	31,400,077
Miscellaneous		2,320

The following table gives the principal producers of the five American ranges for the year 1900, with their total output to the end of that year in the last column:

Mine.	Range.	State.	1900.	Totals.
Fayal	Mesaba	Minn.	1,252,504	3,928,879
Mountain Iron	Mesaba	Minn.	1,001,324	4,774,585
Chapin	Menominee	Mich.	929,937	9,369,900
Biwabik	Mesaba	Minn.	924,868	3,020,530
Mahoning	Mesaba	Minn.	911,021	2,987,134
Cleveland-Cliffs	Marquette	Mich.	881,021	9,603,768
Norrie (and Pabst)	Gogebic	Mich.	905,631	11,130,067
Lake Superior	Marquette	Mich.	709,143	9,649,452
Adams	Mesaba	Minn.	777,346	2,353,151
Chandler	Vermilion	Minn.	644,801	6,400,451

In addition to the ten mines named in the preceding table, each of which shipped upwards of a half million tons in 1900, there were eleven other mines that shipped between a quarter and a half million tons each, of which the Lake Angeline and Regent, of the Marquette range, the Aragon of the Menominee range and the Tilden of the Gogebic range produced upwards of 400,000 tons each; while the Pewabic of the Menominee range, the Minnesota and Pioneer of the Vermilion range and the Auburn, Commodore, Genoa and Lake Superior of the Mesaba range each produced in excess of a quarter million tons.

In the list of the ten leading mines of the five ranges the Mesaba has one-half of the total number, leading with first and second places, while the Marquette range has two, and the Gogebic, Menominee and Vermilion ranges are each represented by a single mine. The immense ore deposits of the Mesaba, and the ease with which many of the mines are operated by steam shovels are responsible for the wonderful showing made by the newest of the five American iron ranges of the Lake Superior district.

The products of the five ranges and the total iron ore production of the Lake district to the close of the nineteenth century are as follows:

Range.	Total Product in Tons.
Marquette	59,592,793
Menominee	34,015,979
Mesaba	31,400,077
Gogebic	31,216,635
Vermilion	15,191,180
Total	171,418,984

The total ore production of the five ranges in 1900 was 19,059,393 gross tons, as against 18,251,804 gross tons in the preceding year.

The growth of the Lake Superior iron ore industry is eloquently shown by the following table, which gives the total production of every fifth year from 1855. The first ore wag mined in the latter forties, but the production was slight and amounted to but a few thousand tons in all, until the completion of the first ship canal at Sault Ste. Marie, in 1855:

Year.	Product in Gross Tons.
1855	1,449
1860	114,401
1865	186,208
1870	830,940
1875	891,257
1880	1,885,724
1885	2,466,642
1890	9,003,725
1895	10,429,037
1900	19,059,393

The writer of this report was quite severely censured by a number of the leading trade publications of the United States, for predicting, in 1890, that the output of Lake Superior ore in the year 1900 would approximate twenty million gross tons. The actual production was less than five per cent under twenty million tons. The expansion of the industry has been a marvelous one, arid the business, as a whole, has been a flourishing and profitable one, despite the too numerous periods of depression, and the many instances where failures have been scored.

In the light of the first year of the new century the dolorous predictions so numerously recorded during the past quarter century have a humorous appearance, though they were by no means intended as jokes when made. The first great scare was given the mine operators in 1877, when the Menominee range begun shipping. At that time the total annual production of Lake Superior ore was less than a million tons, or not as much as is now mined in one year by a number of single properties. Previous to the year named the Marquette range was the only developed field of the Lake district, though even then ore was known to exist on the Gogebic range, at that time a wilderness, and was surmised to also exist in the almost impenetrable forests north of Duluth, then a scrubby town with a past, but apparently minus a future, inhabited by some fifteen hundred people too dispirited to leave the place.

The dolorous prophecies regarding the evil effects on the trade certain to result from the opening of the Menominee range mines were not substantiated by developments, and it was found that there was ample demand for the product from the mines of both ranges. Despite the experience of the past, the same grim predictions of immediate and overwhelming disaster were once more voiced, by the same prophets, seven years later, when twins were born to the iron district in the shape of two new ranges, the Gogebic and the Vermilion. The new ranges throve wonderfully, but strange to say the old ranges also prospered, but this did not deter the prophets of evil from again raising their voices in lamentations when the Mesaba made its first shipment in 1892. The development of the Mesaba was contemporaneous with the panic period beginning in 1893, and taking into consideration the vast ore resources of that range, and the ease with which the ore was won by steam shovels, there was certainly greater cause for apprehension than ever before. The outcome, however, has shown that there is ample room for all of the ranges, and without the Mesaba it would have been a matter of difficulty to have met the requirements of the furnaces in 1899 and 1900. A sufficient quantity of ore could doubtless have been raised, but a considerable proportion would necessarily have been of low grade, but for the great ore resources of the Mesaba, and had the furnaces been compelled to use a considerable proportion of low-grade ore, the conquering of foreign markets, which has been so rapid a process for the past three years, would have been difficult, if not impossible.

A feature of the Lake Superior ore situation that has excited the apprehension of close students of the iron and steel trades for several years past is the depletion of the available reserves of bessemer ore. The production of high-grade bessemer ores has been almost stationary for several years, and at the present writing it cannot be seen where any great accessions to the present known measures are to be secured. The larger mining companies are constantly exploring their mineral lands, and new ore bodies of high grade are frequently found, but these new ore measures can, at most, but make good the depletions caused by extensive mining operations. The time is coming, and it will come much more rapidly than is now anticipated by the majority of mining men and ironmasters, when the Lake district will furnish a large share of its production in low-grade ores, of which there are enormous deposits.

The 1900 ore production was handled between mines and shipping ports by the following named railroads. The appended table gives only rail shipments to lake ports for transportation by water to lower lake ports. About 450,000 tons were shipped all-rail to various furnaces, of which 224,185 tons, or approximately one half, were handled by the Peninsula, division of the Chicago & Northwestern railway between the mines of the Cleveland-Cliffs company and the furnace of that corporation at Gladstone.

Railroad.	Shipping Port.	Gross Tons.
C. & N. W.	Escanaba	3,436,734
C. & N. W.	Ashland	1,746,390
Duluth & Iron Range	Two Harbors	4,043,175
D., M. & N.	Duluth	3,888,986
Eastern R'y of Minn.	Superior	1,522,898
L. S. & I.	Marquette	1,509,796
D., S. S. & A.	Marquette	1,151,698
Wisconsin Central	Ashland	887,297
"Soo Line"	Gladstone	418,452
Total		18,605,426

In the following chapters the iron mines of the Marquette, Menominee and Gogebic ranges are treated in detail.

MARQUETTE IRON RANGE.

The mines of the Marquette range shipped 3,457,522 tons of ore in 1900, a falling off from the preceding year, when the output was 3,757,010 tons. The 1900 production was, however, the largest ever made with the exception of the 1899 output, and the annual product of the range has never exceeded three million tons, until the past three years. In 1900, as compared with 1899, the Cambria, Champion, Cleveland-Cliffs, Jackson, Lillie, Lucy, Negaunee, Lake Angeline, Republic and Winthrop mines showed decreased production, while the Imperial, Lake Superior, Princeton, Regent group, Richmond, Star West and Volunteer mines gained on their 1899 outputs.

The mines of the range are reviewed in detail, in their approximate order from east to west.

REGENT IRON COMPANY.

This group of mines consists of five properties, now intimately connected, these being the Queen, Prince of Wales, Buffalo, South Buffalo and Blue. The Buffalo is the eldest of the group, having been opened in 1886, the development of the others following rapidly, while the Blue is the youngest, having made its first shipment in 1893. The product is almost exclusively a non-bessemer, though a little ore of bessemer grade is found in the Blue. To make up for the low grade of the. ore, the mineral bodies are extensive. The mines, although the eldest is but fifteen years of age, have experienced many vicissitudes, and have been operated by a variety of owners. The mines came under control of the Oliver company two years ago, and in the merger of 1901 passed to the United States Steel Corporation, but are still operated under the name of the Regent Iron company, with W. H. Johnston, of the Lake Superior mine, as district superintendent. The ore product for 1900 was 398,298 tons, a gain over the 1899 product, which was 342,978 tons. The largest output was in 1891, when 479,509 tons were mined.

The Blue mine, which was originally unaffiliated with the Queen group, was connected in April, 1901, with the Prince of Wales, which is about a quarter of a mile distant, by underground drifts, thus allowing the working of both properties to better advantage, and with a much greater degree of safety so far as the Blue is concerned. It was planned at the opening of navigation to effect a very heavy output from the Regent group this season, but the ice blockade, followed by the other marine troubles, and in turn succeeded by the big strike of the Amalgamated Association, the duration of which is uncertain at the present writing, will unquestionably result in curtailing the production that had been planned, though to what extent it is impossible to say at the present time.

NEGAUNEE.

The history of the Negaunee mine for more than a year past has been one of vicissitudes, emergencies and changes. One trouble has been quickly followed by another, and it is possible that the end of the tribulations of the management is not yet in sight, but it is safe to state that a good start has been secured in the direction of placing the mine on a firmer footing than it has enjoyed for many years.

The Negaunee mine contains large ore bodies, but is afflicted with an overburden that would tax the patience of Job, and which has put some of the best mining men of the district to nearly their wits' ends in the endeavor to control the errant forces of nature. The mine was originally opened by Captain Samuel Mitchell, and that gentleman, who managed the property until some eighteen months ago, has been criticised rather unjustly for the misfortunes that have befallen the mine since that time, while Captain James Piper, the superintendent of the mine at present, has also been criticised unfairly, because of the many mishaps that have befallen the mine since he took charge. The truth of the matter is that both Captain Mitchell and Captain Piper are thoroughly competent mining men, who have been placed in a situation of exceptional difficulty. Both of them have done things which they would not do over again, acting by the light of knowledge of the problem since secured by experience, but criticisms of their management of the mine are much easier to make than it would be for the critics to better their work.

The mine has a thin rock-capping above the ore, which, in turn, has a heavy strata of sand superimposed, this sand being 250 feet in depth in the center of the bowl-shaped depression lying above the mine. This sand allows water to seep through readily, and as the basin is of immense area, the quantity of water collected in the trough is very great. Add to this preliminary menace the sinking caused by the removal of the ore below the rock-capping, and the tendency of the water to percolate through wherever the rock is slightly broken by displacement, and the problem assumes considerable proportions.

The first shaft of the Negaunee mine was sunk through this sand, and is one of the costliest ever put down in the Lake iron district. The present troubles of the mine begun with the spring thaws of 1900, when the mine started to cave. Although this trouble had been guarded against as effectually as possibly by the use of exceptionally heavy timbering, and the leaving of pillars of unusual strength to protect the shaft, the weight above was too great, and the shaft was squeezed together, but the solid construction served its purpose in delaying the loss of the shaft so that ample warning of the coming trouble was given, and there was no loss of life. The property damage was heavy, but the management decided that the mine must be reopened at once, and a new shaft was started. This was put down, through the sand, in much better time and at far less cost than the original shaft. The inflow of water was very heavy,

averaging probably 3,000 gallons per minute for nearly or quite a year, after the first trouble in April, 1900. In June, 1901, the new shaft was completed, and pronounced a fine piece of work by mining men. The inflow of water diminished until it was only half the former average, and it was concluded that the immense basin overlying the mine had finally been drained, and that thereafter the mine need figure only on the surface drainage, having dried the immense reservoir from which at laast a billion and a half gallons had been drained into the mine and thence forked to surface in the preceding year—an amount about double the original capacity of Lake Angeline, before it was drained by the combined efforts of three mining companies, eight years before. A 1,500-gallon Prescott pump was put in place to handle the normal water flow and arrangements were made to resume hoisting on a large scale. After mature consideration it was decided that the caving system was the best plan to use in winning the ore.

The mine had hardly resumed active production upon a large scale before another accident occurred, not so serious as some that had preceded it, but sufficient to greatly hamper operations and put a temporary stopper on the large production just started. A considerable area of ground caved in suddenly, though not unexpectedly, as such a contingency had been feared. Unfortunately the cave was of greater dimensions than anticipated, and extended to such a distance that a portion of the ground under the main engine house went down. All hands were put to work on instant notice, and the machinery was all removed in safety to temporary blocks on safe ground, and none too soon, as a further cave completed the work of ruining the building. A new engine house is being constructed on ground that should not cave, and hoisting will soon be resumed on the former large scale. At present about 600 tons is being raised daily, under many disadvantages.

Underground the mine is looking well, and it is not likely that there will be an immediate repetition of the several bad accidents that have kept the management of the mine on the griddle for the past fifteen months. From the nature of the deposit and its capping there is and always will be more or less danger from water, sand and caves, but these conditions cannot be avoided, and with the operation of the mine on the caving plan, if the system works as well as it promises, the Negaunee should escape in future the succession of costly troubles that have so quickly followed each other for the past fifteen months. The mine, however, will never be an easy one to manage, and will require a good head and plenty of grit to handle. These requisites seem to be possessed by Captain Piper, and it is to be hoped that his troubles, and those of the mine, are nearly over.

BARASA.

There is little to be added regarding the Barasa since my last report. The mine is now showing good ore bodies of considerable extent, and promises to become a considerable producer. The quest of ore and making of the mine have taken years of effort and about all the money that could conveniently be furnished by its owners, who are not millionaires. Their faith in the property is being justified by the outcome. The property was optioned to the Oliver company in April, 1901.

NEGAUNEE MINERAL LANDS.

Surrounding Negaunee there are thousands of acres of valuable mineral lands. These have not received the attention they should in the past, mainly because of the course taken by the largest owners of such lands, who preferred to rest on their oars rather than take the steps necessary to develop mines. An attempt was made, some five years ago, to prod some of these owners into activity, by the authorities of the city of Negaunee, who jumped the assessed values of mineral lands to several times the figures formerly used in levying taxes. This led to considerable litigation, but at least gave the matter a thorough airing in court. Certain options passed into the hands of the Cleveland-Cliffs company, which is a stirring concern, and whose entrance into the industrial affairs of any town is a benefit to that community. Attempts to develop mineral bodies on these lands led to further litigation, the end of which has not yet been reached. For the sake of the future welfare of Negaunee it is to be hoped that the Cleveland-Cliffs company will secure peaceable possession of the lands it desires, and open mines on them. A forty-acre tract containing a million tons of ore will pasture several cows, after the timber is cut, but the mining of the ore is worth more to the town than the milk from the cows.

Early in the spring of 1901 there was a period of excitement in mineral lands such as Negaunee has never known before. In 1900 George Maas, who is a practical diamond drill operator, secured options on a considerable number of tracts of land in the eastern and northern part of the city of Negaunee, some of these being small, while others were of considerable area. A great deal of boring was done on these tracts, and the cores were drawn in every case by Mr. Maas personally, and the results of his explorations kept to himself. There were various opinions as to whether Mr. Maas was finding ore or not, but these were set at rest in March, 1901, when the Cleveland-Cliffs company took over Mr. Maas' options, and in addition thereto bought considerable tracts of contiguous land. The Oliver company speedily took a hand in the game, and for a couple of weeks real estate deals were numerous, and at boom figures. The Cleveland-Cliffs company bought sundry parcels of land at figures aggregating nearly $400,000, the largest purchase being that of the Barabe farm, consisting of sixty-six acres, for which $127,133 was paid. The highest price paid per acre was for one-half acre owned by David Lloyd, bought by the Oliver company, for which the consideration was $8,500. The question of titles figured prominently in some of the deals, several of which were hung up because of the inability of the putative owners to furnish deeds satisfactory to the intending purchasers. In addition to the lands bought outright, other tracts have been

optioned, and presumably will be bought in fee or operated under royalty if the mineral developments are as extensive as now promises to be the case.

It is understood that Mr. Maas received a bonus of $300,000 for the lands held under option by him, in addition to which a small royalty will be paid him on the ore mined in the future.

The drill cores and records secured by Mr. Maas have shown the existence of an immense body of ore, or perhaps of several large bodies, in the district east of the Hartford and north of the Negaunee mine. That the ore lies at great depth is certain, and accounts for its having never been found in past explorations. At the present time both the Cleveland-Cliffs and Oliver companies are doing a great deal of boring with diamond drills, nearly a dozen drills being employed in this territory. As soon as sufficient data is accumulated, shafts will be sunk and extensive mines opened. That the mines will be large is evidenced by the prices paid for the lands and the extensive drilling operations begun immediately after the transfers. The developments in this field are of great promise to the city in which the mines will be opened.

JACKSON.

The old Jackson mine, in the eastern part of Negaunee, the pioneer among Lake Superior iron mines and for many years one of the largest producers and most profitable iron mines of the world, is apparently a thing of the past. There are large deposits of low grade ores on the lands of the company, but the fancy ores for which the mine was long famed are mined out. The time will come, and that sooner than generally anticipated, when the low grade ores will have a good market, but for the present the Jackson is among the has-beens.

LILLIE AND CAMBRIA.

These mines, in the Teal Lake district, are twins, and have long been operated together. Their ore and conditions are much the same. The properties are worked by the Republic Iron & Steel company, under the superintendence of Alex. Maitland, and are apparently good for about the average production of the past for many years to come.

HARTFORD.

The Hartford is an example of an old mine made new, and of a small producer that bids fair to become a large one. It was opened in the latter eighties by Benj. Neely, Sr., of Negaunee, and never became a heavy shipper, its known ore bodies being small. An option was taken by the Oliver company early in 1900, and as a result of deep drill borings the property was bought and preparations begun for the opening on a large mine at considerable depth. The Oliver company has. since added to its landed holdings tracts adjoining the Hartford to the east, along the shore of Teal Lake. A three-compartment shaft, 5 x 16 feet inside of timbers, is now being sunk, and is capable of handling a large tonnage, when the deep ore measures are developed. Heavy machinery has been installed and there is every indication that the Hartford, in another year, will take place among the important mines of the Marquette range.

LUCY AND EAST JACKSON.

Options were taken on the Lucy and East Jackson mines during the winter of 1900-01, but were dropped by the holders. The East Jackson has never been more than an exploration, but the Lucy is credited with a considerable ore production. In view of the demand for ore, present and prospective, and the paucity of ore measures of proven value, it is probable that the Lucy will be reopened and worked again at some future time.

VOLUNTEER.

This property was worked under a short-term lease by the Cleveland-Cliffs company, but at the expiration of the lease, on June 30, 1900, the property was abandoned by the lessee.

CHESTER.

The old Rolling Mill mine, in the southern part of Negaunee, was bought of Captain Samuel Mitchell by Mr. Joseph Sellwood in 1900, and work was resumed under charge of Captain Alfred Newcombe last year. The mine has been rechristened and is now known as the Chester. The mine made an output of 22,585 tons in 1900, and was being worked, upon a larger scale this season until closed down in July. Cargo analyses of the shipments of 1900 gave an average of 48.215 metallic iron and .78 phosphorus in the grade known as "Chester non-bessemer," while the grade called "Chester Silicious" averaged 38.72 iron and .028 phos., the latter ore being an excellent "sweetener" for use with Mesaba non-bessemers just above the line in phosphorus. The mine is accredited with a total output of 261,185 tons. It is thought that a considerable body of good ore may be developed at considerable depth.

MOORE.

This property, originally known as the Gribben, was operated for several seasons by the Consolidated company of Ishpeming, as a producer of silicious ore for use in Mesaba mixtures. It was bought by the American Steel & Wire company in 1900 and with the merger of that company has become the property of the United States Steel Corporation. There is an immense deposit of ore of an excellent grade of this class, and the ore body is so placed that it can be largely mined at the minimum cost of production—in fact until several hundred thousand tons of ore have been removed the cost of stripping and mining will compare very favorably with the cost of producing ore from the best steam shovel mines of the Mesaba. The Moore shipped only 4,648 tons last year. A promising hematite vein is

located on the same tract as the Moore, and will probably be developed at some time in the future.

RICHARDS.

This property, lying just south of the Moore, is idle at present. It furnishes an ore much like that of the Moore, but is slightly higher in iron, silica and phosphorus.

RICHMOND.

This property, under the management of Senator Alex. Maitland, is located in the silicious district of the Cascade district, south of Negaunee, and was worked strongly in 1900, shipping a total of 51,303 tons last season, the total output of the mine to the end of last year being 86,098 tons.

PRIMROSE.

This silicious ore producer in the Cascade district is under option to George Maas, of Negaunee. It is credited with shipments of 6,040 tons in 1896, and produces an ore similar to that of the Moore and Richmond.

PLATT.

This property is held under option by Messrs. Fred Braastad of Ishpeming and Chas. L. Sporley, of Negaunee. A considerable deposit of ore of non-bessemer grade has recently been located, and it is hoped that bessemer ore may be found. The mine is credited with a total output of 73,844 tons, the first of which was shipped in 1892 and the last in 1896.

STAR WEST.

This property is in the Cascade district and was originally known as the Wheat. It has mined and shipped 204,649 tons, the last active season being in 1900, when only 15,987 tons were shipped. At present the mine is idle.

PRINCETON.

Some distance south of the main mineral belt of the Marquette range there is an outlying district, usually called the Swanzy district, from the name of the first mine opened there. The mine changed hands in 1898 and was rechristened the Princeton, since which time it has been wrought quite actively. The production for 1900 was 75,037 tons, much the largest in the mine's history, and the total production to the close of 1900 has been 373,175 tons. Mr. C. G. Mason is superintendent.

STEGMILLER.

The Stegmiller mine, formerly the Brotherton, in the same district as the Princeton, and a near neighbor of that property, has never been a producer. Mr. C. G. Mason is superintendent.

CLEVELAND-CLIFFS.

The Cleveland-Cliffs company is now much the largest of the independent mining companies of the Lake Superior district. It is one of the oldest and also one of the most progressive corporations engaged in the iron mining industry, and is expanding steadily. It is a combination of the Cleveland Iron Mining company and of the Iron Cliffs Iron Ore Mining & Smelting company. Wm. G. Mather of Cleveland is president and M. M. Duncan is agent, with the eastern offices at Cleveland, and the local offices at Ishpeming. Andrew Yungbluth is auditor of the company; J. E. Jopling mining engineer; W. E. McKee master mechanic, and Austin Farrell superintendent of the furnace at Gladstone.

In addition to the mines at Ishpeming, which include the Cleveland, Cleveland Lake, Cliff Shaft, Salisbury, Foster and Tilden, the company has recently made extensive investments in mineral lands in Negaunee, reference to which has already been made in the section devoted to Negaunee mines. The company also operates the Michigamme, Imperial and Webster mines in the Michigamme district, and has recently acquired the Ashland mine, at Ironwood, regarding which further particulars will be found in the chapter devoted to Gogebic range mines. In addition to its ownership of mines, which is extensive and is being increased steadily by the acquisition of properties of merit, the Cleveland-Cliffs company has a furnace at Gladstone and is building another at Marquette. It is a half owner of the Lake Superior & Ishpeming railroad, owns the Munising railway and is building the Marquette & Southeastern, a line which will connect the two roads previously named. The company also owns a large fleet of modern ore carriers.

The management of the Cleveland-Cliffs company must be given credit for possessing the best foresight and most comprehensive understanding of the iron ore and iron trades of any independent mining company in the Lake Superior district. This may be said without detracting from the other independent companies, which have confined themselves to the mining and marketing of iron ore. It became apparent to the management of the Cleveland-Cliffs company some years ago that a fundamental change was taking place in the conditions governing the iron mining business, and that they who hesitated were lost. Being an independent company, without the strong eastern furnace connections which have been of such great aid to companies such as the Lake Angeline, it was evident to the astute management that but two courses were open, one of which was stagnation, with extinction at the end of a decade or so. While the other path, which was chosen, was that of expansion. The first step taken in the direction of growth was the building of steel vessels of large capacity for the transportation of ore from Marquette and Escanaba to the receiving ports on Lake Erie. The second step was to abandon the old Pioneer furnace, at Negaunee, which had outlived its usefulness. The old furnace was making money at the time it was abandoned, but it was evident

to those who forecasted the future that the time would soon come when it could not be operated at a profit. A new furnace was built at Gladstone, on Lake Michigan, and this was, and remains, the largest and best charcoal furnace in the United States, but will yield the palm of superiority to the new furnace now building at Marquette, by the same company. The plan of campaign for the new furnace at Gladstone was carefully prepared, and the smallest details worked out. Large tracts of cheap limber lands easily accessible from the new location were secured; modern kilns were erected, and a complete plant installed for the saving of wood alcohol and grey acetate of lime, valuable by-products of charcoal-making that were lost at the old kilns.

The third step taken by the company was the construction of the Lake Superior & Ishpeming railway, connecting the mines with the port of Marquette and rendering the mines independent of the railroads at this end. This road is a model in grades, ballasting and rolling stock, with an excellent ore pier at North Marquette.

The plan of campaign thought out some years ago has been modified to slight extent by circumstances as they have arisen, but in its main features has never been changed, although it has been added to from year to year. The keynote of the Cleveland-Cliffs company's policy is growth, betterment and an incessant striving to keep to the front with the best methods, men and machinery. The wisdom of this policy is now more apparent than it was when adopted, and it is palpable that so long as the corporation maintains its present standard, it has nothing to fear from competition, not even from the United States Steel Corporation, that behemoth among trusts which has swallowed so many of the great Lake Superior mines, and which is certain to swallow many of those that yet remain among the independents.

The Cleveland-Cliffs company is still expanding. Its plans are necessarily unfolded only a little at a time, as it is never good policy for a big corporation to tell more than it is certain of, but it can safely be said that the Cleveland-Cliffs company will do more to develop the industries of Marquette and adjoining counties than any other concern, not excepting even the great U. S. S. C., which in this state is concerned solely with the development and working of mines. Unless the Cleveland-Cliffs company is bought out by the United States corporation—and if so, the price will be a big one—the former company will eventually become one of the largest employers of labor in the state, and will build up a chain of connected industries that will stand as a monument to the genius and foresight of Messrs. Wm. G. Mather and the able men associated with him in the management of the Cleveland-Cliffs company.

The grand prospects before the company are the more pleasing because of the hearty, human interest taken by the management of the company in the well-being of every employee. This is not assumed, but is genuine and spontaneous, and is evidenced in many different ways. The C-C button is worn by employees with pride, and there is a solidarity in the ranks of labor, from the president down to the day laborer, that is refreshing and full of promise.

At the Ishpeming mines of the company there have been few changes in the past year. The company does not make history rapidly by sudden promotions and abrupt dismissals. The men who get to the top have to work their way up, and being carefully tested on each round of the ladder, they rarely lose their grip. The output of ore by the Cleveland-Cliffs mines for 1900 was 881,021 tons, in addition to 62,321 tons shipped from the Imperial.

LAKE SUPERIOR.

This mine, or, rather, group of mines, is one of the oldest, largest and best in the Lake district. It is now the property of the Oliver company, and Mr. W. H. Johnston, who has been connected with the mine for the past thirty years or more, and who has worked his way by merit from the bottom of the ladder, is not only superintendent of the Lake Superior croup, but is district superintendent for the Oliver company of all of the United States mines on the Marquette range. Although the Lake Superior, then known as the Burt, began shipments in the fifties, it is by no means a played-out property, and its production for 1900, amounting to 709,143 gross tons, was the largest in its history, and about double the output of 1892, which was the largest ever made by the mine to that time. The Lake Superior has produced a total of 9,649,452 gross tons of ore, an output exceeded only by the Cleveland-Cliffs and Norrie group of mines, though the Chapin, of the Menominee range, is a close competitor for the honor of third place. The output of the current year will bring the gross product of the Lake Superior well above the ten-million-ton-mark—an amount greater than the total production of all Lake Superior mines in the first quarter century of mining and nearly equal to the total production of the district up to a date so recent as the centennial year of 1876.

There have been few changes of importance in the past year at the Lake Superior. The men who have attained command by dint of years of experience and faithful work have been retained in their places—a compliment to the ability of the employees, and a tribute to the sagacity of the new owners, for it is sometimes true that a new broom sweeps clean, and occasionally the cleaning is carried on so drastically that good men are displaced, merely because they are old men at the work.

The Excelsior furnace remains idle, and there is apparently little prospect of the furnace going in blast again in the near future.

The company continues its policy of exploration, a policy that has been the greatest factor in maintaining the mine among the great producers. Few companies have been exploring longer or more thoroughly than the Lake Superior, and the records of drill borings and other exploratory work are kept in the most methodical

manner. As a consequence of this work, a shortage of ore in any direction is met with the development of reserves remaining untouched. The mine, however, is growing away from its old boundaries, and the ore reserves in the original, or "Hard Ore" property, are being gradually depleted. When the most complete exploratory work has rendered it certain that no new ore bodies can be reached to advantage from the old openings, the pillars will be sliced down and an immense amount of ore taken from the worked-out shafts. This, however, is a matter that is not of the immediate future, though the time can be quite plainly foreseen. "A" shaft has already been abandoned, but there are years of activity ahead of some of the other pits.

The original Lake Superior Hematite mine is about worked out, but continuations of the ore lenses have been found immediately to the eastward, and this part of the property is known as the "Lake" shafts, as they develop ore bodies underlying what was originally the bed of Lake Angeline. The portion of the old lake bed controlled by the Lake Superior is much smaller than that secured by the Cleveland-Cliffs company, which got the lion's share of the ore underlying that bed of water, but the Lake Superior has the advantage of not being compelled to cope with the indomitable bed of mud that overlies the Cleveland's Lake shafts, and which has given so much trouble to that company.

The Section Sixteen mine is holding its own well and continuations of the ore bodies are being developed, the southern lenses showing much the best in quantity and quality.

The Section Twenty-One mine, in the Winthrop district, is the largest producer of the Lake Superior group, but its ore is not of such high grade as is produced from the Hard Ore and Section Sixteen mines.

The hard ores of the Lake Superior are all crushed before sending to market, and no iron mine in the Lake district is securing better results. The very satisfactory practice secured at the Lake Superior in ore crushing is ascribable to the excellent crushers, which are of the Gates centrifugal type, and to the skill with which they are handled.

PITTSBURG & LAKE ANGELINE.

There is no other iron mining town that has a trio of such great mines as Ishpeming possesses in the Cleveland-Cliffs, Lake Superior and Lake Angeline properties. There are few better managed mines, and no iron mining town where so many men are employed so steadily and at such a high average of wages. The Lake Angeline has long been noted as one of the largest and richest mines of the Lake district, and its period of greatest prosperity has been contemporaneous with the term of office of Captain Thos. Walters, who remains as superintendent, while Mr. Alfred Kidder of Marquette, who has been agent of the mine since its infancy retains that position. The original ore bodies of the mine have been largely worked out, but by dint of steady and well-directed efforts, new ore measures have been opened to replace the production of the shafts depleted. The East End Angeline continues the large producer of the mine the original or western end, where mining on the caving plan was first introduced by Captain Walters, having been nearly cleaned out. The ore production for 1900 was 389,128 tons, a falling off from the output of the preceding year. The mine has shipped a total of 5,508,945 tons.

The Lake Angeline company is operating the old Mitchell mine, adjoining the Winthrop, which was bought two years ago. The old property has been reopened, new shafts sunk and the mine brought into better condition than ever before in a long and somewhat checkered career. It is now in thoroughly competent hands, and promises to prove a large and profitable producer of non-bessemer ore for many years to come.

The Lake Angeline company is also exploring property on the Menominee range, and manifests no disposition to go out of business when the ore in its original mine is worked out. The company is an enterprising one and has done its full share in building up and maintaining the industrial position of the Marquette range.

WINTHROP.

This is one of the oldest mines of the Marquette range, being located three miles southwest of Ishpeming, and has seen its full shares of change and tribulation, having been operated by a number of different companies and firms. It is now a possession of the United States corporation, having come into the hands of that concern via the National Steel route, though the property is still operated under the name of the Winthrop Iron company, in compliance with the policy of the Oliver company, the mining branch of the Carnegie portion of the U. S. S. C. The production of the Winthrop for 1900 amounted to 148,945 tons, a falling off from the preceding year, when the output reached 171,318 tons. The decrease is not due to paucity of ore, but to the difficulty experienced in marketing the product, the ore being of low grade. The times haw already arrived, however, when the furnacemen must make extensive use of the lower grade ores, and it is probable that the Winthrop will wax, rather than wane, in the future, especially as it is now owned by the concern that consumes the major portion of the ore mined from Lake Superior mines. No. 3 pit remains the principal producer, though there is a good showing in No. 5. The mine is worked as an open cut, and ore is mined cheaply, though in places there is a 15-foot overburden, expensive to remove. The product is all put through crushers before shipping, two big Gates centrifugals doing the work.

NEW YORK.

This property shipped 6,642 tons of ore in 1899 and 3,327 tons in 1900. The ore was secured by scramming and picking over old rock dumps, by Mr. Richard Quayle of Ishpeming. The mine itself, which was once one of

the great mines of the district, is worked out, having owned but forty acres of land in all, and has been idle for the past seventeen years.

EAST NEW YORK.

This property was opened in 1888 by local capital, and closed in 1892, when the conditions in the iron trade began to foreshadow the collapse that came in the following year. The property was reopened in 1900, under a new management, practically the same as that of the Buffalo Furnace company, Captain Frank Platto being in charge. The mine shipped 27,987 tons in 1900, and stands credited with a total output of 194,230 tons.

DEXTER.

This is a manganiferous ore producer that has had many ups and downs—especially the latter. The ore is of high grade, but has not been found in sufficient quantity to allow a profit to any of the several companies that have worked or tested the mine. It was taken under option by the Oliver people in the spring of 1900, but abandoned a few months later, after which it was optioned by the Manila Iron company, but was also dropped by them.

HUMBOLDT.

This mine, once a property of considerable importance, has produced approximately 750,000 tons of ore, and has been idle for the past ten years.

SAMSON.

Despite any quantity of favorable talk and newspaper comment, in which early resumption was forecasted, this mine remains idle. It has shipped 267,805 tons of ore, practically all of which was mined nearly twenty years ago.

AMERICAN.

The American is another mine west of Ishpeming about which there has been talk of resumption, but which remains idle. It was formerly known as the Sterling, was last worked in 1892 and has produced 112,933 tons of ore all told. The trouble with the American, as with most of the other mines in its district, seems to be that the ore, though of fair grade, is lacking in quantity.

BESSIE.

This mine, north of Humboldt, possesses a considerable body of low-grade ore, and is at present in the hands of the Oliver company. Given a brisk demand at fair prices for the grade of ore found at this property, it can be made a large producer at low cost.

FOXDALE.

This is a "North Range" mine in the Humboldt district that has never gotten its name among the list of shippers, but which has cost its owners a great deal of money, from first to last. The mine was unfortunate in being opened by local capital in an unpropitious time. Great sacrifices were made, but without substantial reward, by the men who had faith in the mine. The property was sold in June, 1901, to the Bird Iron company, which has been operating in the Crystal Falls district of the Menominee range. New and better machinery has been installed, the shaft is being deepened, new stopes opened and the property actively pushed. It is a shipper this season, and gives promise of developing into a, good mine.

CHAMPION.

The Champion and Republic mines are still, as for several decades past, the only mines of the first magnitude on the Marquette range, outside of the Ishpeming-Negaunee district. The Champion has been a fine property, paying good wages and excellent dividends. Within the past ten years it has experienced something more than its share of reverses, but it can be truthfully said, at the present time, that the prospects of the mine are better than they have been for many years, this being due to careful exploitation of the ore bodies in the western end of the mine; the opening of a large new mine on the north, and the finding of an ore body of very great promise to the eastward. The Champion mine is the sole support of a village of 2,500 people, many of whom own their homes and have their money invested there, consequently the welfare of the mine means a great deal more than satisfactory dividends to a limited number of shareholders.

The properties of the Champion company have been steadily worked for the past year, and the ore production of 1900 amounted to 113,743 tons, a falling off of nearly one hundred thousand tons from the preceding year. The ore deposit north of the Champion mine proper, which was fully described in the last report, has been developed into a mine capable of supplying a large amount of ore, though from the nature of the product, which is not of high grade, it does not meet with a market as readily as the fancy ore furnished from the old mine.

In June, 1901, a deposit of magnetic ore, similar to that of the Republic mine, was found a short distance east of the C. & N. W. railway station, at no great depth from surface. This find was made, not by accident, but early in the systematic exploration of a tract of land lying east of the mine, owned by the Champion company. Diamond drill operations have been conducted and more or less ore found, but as the formation is such that the ore occurs in irregular lenses, the drill cannot tell the extent of value of the ore bodies as well as could be desired, hence a permanent shaft will be sunk and the mineral bodies opened in such manner that ore can be mined as soon as a mine is developed. The magnetic ore found near the railroad station is in most respects similar to that of the Republic mine, assaying upwards of 70 per cent metallic iron, and is a strictly fancy ore, of

great value. Should there prove to be large deposits of ore of this grade, a new mine of fully as great value as the old Champion will be developed within the next two or three years.

Those who have grown to regard the Champion as a decadent property should revise their opinions. The mine has been handled with great skill and the conduct of its finances has been equally good. The working out of the eastern end of the mine, which was first opened, has been offset by the greater development to the west. The problem of selling the hard ore, which breaks in large masses, has been satisfactorily solved by the crushing plant, which was one of the first installed at a Lake mine, and which is now one of the most efficient. The Champion is the deepest iron mine in the Lake district, if not in the world, its No. 5 shaft having reached the depth of thirty levels, averaging sixty feet each, giving a total depth of 1,800 feet. Its spiral shaft, an engineering marvel, was fully described in the preceding volume. The company has managed to maintain dividends as well as wages, and in view of the large acreage owned in the mineral belt, and taking into consideration the aggressive and capable management, further important developments may be confidently anticipated.

REPUBLIC.

The Republic mine shipped 130,126 tons of ore last year, a slight reduction from the tonnage of 1899, the gross output to the close of the century being 4,910,251 tons. The mine has suffered in the past eighteen months from fire to a considerable extent, both on surface and underground, the subterranean fires being the less serious, owing to the solidity of the ore and walls, which render it necessary to use but a limited amount of timbering. The principal improvement at the mine during the present year is the installation of a fine new compressor, of Allis make, costing nearly $50,000 set up. This is probably the best compressor in use at present in the iron districts, and is an excellent piece of machinery. The old compressor plant is still standing, and will remain for use as an auxiliary, in case of accident. David T. Morgan remains as agent at the mine, and Peter W. Pascoe continues as mining captain.

RIVERSIDE.

The Riverside mine, in the Republic district, was taken under option by the Oliver company in the spring of 1900, and a large amount of work was done there in the following eight months. All work was suspended on Jan. 31, 1901, and the buildings dismantled, machinery removed and everything of value taken from the mine. This was a disappointment, as it was hoped, both by the Oliver company and the people of Republic, that a large mine might be opened.

KLOMAN, ERIE AND MAGNETIC.

The Kloman, Erie, Magnetic and several smaller explorations, scarcely worthy the name of mines, remain idle, as for many years past. It does not stand to reason that the Republic is the only mine in this district, especially when it has proven itself such a large and rich property, and at some time in the future, whether near or remote, there will be other profitable mines worked in the Republic field. It is more than probable that there is a southerly continuation of ore measures running from the Republic district to a junction with the Menominee range. There is a heavy drift overburden above the rock ledge, however, and the country is a difficult one to explore. In time the ore will be located and mines opened. There was never a time in the past history of the Lake iron regions when there was such persistent demand for new ore bodies of high grade or large extent, and the secrets of nature will eventually be wrested from her grasp. Mr. E. F. Bradt of Iron Mountain secured options on the Erie and adjoining properties in July, 1901, and will explore for ore.

PASCOE.

Mr. Jas. T. Pascoe, of Humboldt, is exploring on lands north of Humboldt, and has found a promising showing of ore.

MICHIGAMME.

This property has been owned by the Cleveland-Cliffs company since 1896, and its production is given with that of the corporation, instead of separately, as formerly. The mine is working steadily and securing a fair product. The ore bodies are not of great size, and the ore is considerably mixed, but by using care a good grade is secured, the new crushers assisting greatly in this work. The crushing plant, which was fully described last year, has some of the heaviest crushers of the jaw-opening type ever cast, and is well housed and successful in operation.

SPURR AND STEWARD.

The Spurr and Steward mines, west of the Michigamme, and opened on a continuation of the same ore lenses as the latter named mine, are still idle, as they have been for many years.

IMPERIAL.

The 1900 output of the Imperial mine was 62,321 tons, the largest yet secured. The Imperial is a consolidation of the old Webster and Wetmore mines, and is capable of getting out a much larger tonnage than has ever yet been taken, if the market can be found for the ore, as the ore bodies are extensive, though the product is of low grade, like that of the other Baraga county mines. James Matthews has succeeded John Peters as mining captain.

BEAUFORT.

The Beaufort mine is operated by the Bristol Mining company under lease from the owners, with G. W. Woodworth as superintendent. The ore is of low grade, being lean in iron and high in phosphorus, but the vein is an extensive one. It was idle during the past winter, but is again working a fair force.

TITAN.

The Titan immediately adjoins the Beaufort, and has a continuation of the same ore body, the adjoining pits of the two mines having been broken together in mining the ore. The mine is idle and has not been worked since 1887.

NORWOOD.

The Norwood lies immediately northeast of the Beaufort and carries the extension of the Beaufort vein. It has never been a producer and is now idle, though showing a considerable body of ore.

OHIO.

Some exploring has been done on this property adjoining the Beaufort and an ore body supposed to be the Beaufort has been located.

TAYLOR.

This is the westernmost mine of the Marquette range, and is located in Baraga county a few miles east of L'Anse. It was taken under option by the Oliver company in the spring of 1900, but was not re-opened.

MENOMINEE IRON RANGE.

The Menominee is the second of the Lake Superior ranges in age, having shipped its first ore in 1877. It is located almost wholly in the state of Michigan, having only two mines in the Wisconsin end of the district. It has the longest rail haul from mines to shipping port of any of the Michigan ranges, but as an offset, its ports of Escanaba and Gladstone, from which all the ore goes, are the nearest to the lower lake ports to which the ore is consigned. Its output for 1900 amounted to 3,261,221 gross tons, a falling off of about 40,000 tons from 1899, when the output of 3,301,052 tons was much the greatest in the history of the range. Its product for 1900 was secured from 27 shipping mines, and this number will probably be exceeded this season. Detailed figures of ore production for 1900 will be found in the pages of statistics at the beginning of the iron section of this report.

ANTOINE ORE COMPANY.

The ore product of the Antoine for 1900 was 119,940 tons, the largest in the history of the company. Oglebay, Norton & Co., of Cleveland, are the operators of the property.

APPLETON.

The Appleton lies in the Loretto district, just east of the mine of that name. It was taken under option by the Bristol Iron company in 1900, and was pumped out, after which an examination was made and the property abandoned. It has produced 12,102 gross tons in all.

ARAGON.

This large and interesting mine was described at some length in the last volume of Michigan Mines and Mineral Statistics. It is a good mine, well equipped, and has been excellently managed. The total output to the close of the century was 2,046,213 tons, of which 404,645 tons, much the greatest output in the history of the mine, was secured in 1900. The property was bought, in May, 1901, by the United States Steel Corporation, $2,500,000 being paid for the lease and equipment, the ore in stock being bought in addition at a price mutually agreed upon. The property is a growing one, and will in the future become an even greater producer than it has been in the past. Its 1900 output placed the Aragon ahead of the Pewabic and second only to the great Chapin among the mines of the Menominee range.

ARMENIA.

This mine, located in the Crystal Falls district, was opened in 1899, but has never been a large producer, and has not shipped since 1895 until the season of 1901. No ore has been hoisted since 1890 until this season, the small shipments of 1895 having been made from the stockpile on surface. The property was once known as the Smith, and was opened and operated for two years by Ferdinand Schlesinger. The mine is now operated by Corrigan, McKinney & Co., who have very extensive interests on the Menominee range, especially in the Crystal Falls district, and is practically a new mine, there having been no buildings or machinery on the ground when the present owners took hold, while the "mine" consisted of a few old openings that were a detriment rather than an advantage, the shaft having caved in several years ago. The ore is of low grade, very soft and exceedingly wet, making its removal a matter of some difficulty and requiring considerable ability to handle it to advantage. The new shaft is in solid ground, 260 feet in depth, and the property is being well opened and admirably handled.

BALTIC.

This is a newly-opened mine in the Iron River district. The property was explored in 1900 and a good plant of machinery installed for sinking and hoisting in the spring of 1901. A new engine house 25 x 70 feet has been built to receive this machinery. A considerable stockpile of shipping ore was accumulated before the spur was laid from the main line of the C. & N. W. railway, and the

Baltic, which gives evidence of the possession of a large ore body of fair non-bessemer grade will probably become one of the largest mines of the Iron River district in time. It is operated by Pickands, Mather & Co.

BREEN.

The Breen, adjoining the Emmet, at Waucedah, is still idle. It produced 17,340 tons of silicious ore, and was closed in 1880.

BIRD.

This is a new mine, in the Crystal Falls district, and was first known as the Voos, when opened in 1900. Assays of ore from this property give it exceptional value for this district, where the product is almost invariably non-bessemer, ore from the Bird having assayed as high as 66 per cent iron and .022 phosphorus, giving a rich and desirable bessemer grade. The property was leased to Gr. E. Voos and associates, and was by them optioned to Oglebay, Norton & Co., who refused to pay the considerable sum demanded for the lease, for which reason the option was forfeited. The lease was disposed of in December, 1900, to the Crerar-Clinch interests, and the Bird Iron company was formed to operate the mine. George B. Penwell is president and M. S. Saunders secretary of the Bird company, with Captain Arthur Buzzo as superintendent. The fee of the land on which the Bird mine is located is owned by the County of Houghton, and a minimum royalty of $2,000 per annum is exacted. The Bird company has recently secured control of the Foxdale mine, in Marquette county.

BRISTOL.

The Bristol mine, in the Crystal Falls district, was originally known as the Claire. It was opened in 1892 and worked only two seasons. In 1899 it was reopened under the new name by Oglebay, Norton & Co. Its 1900 product was 51,639 tons, a reduction from the 1899 output, and the gross production of the mine to the close of 1900 has been 199,518 tons. The mine was practically idle from the fall of 1900 until the spring of 1901, when work was resumed. This company operates the Beaufort mine, in Baraga county, and has been doing some test-pitting east of the Beaufort this season.

CHAPIN.

The Chapin is the giant of the Menominee range and one of the greatest iron mines ever opened. Notwithstanding its mineral riches, the history of the mine has not been without reverses, as well as seasons of prosperity. The present excellent physical and financial condition of the property may be largely ascribed to Mr. James MacNaughton, for many years superintendent, who left the Chapin on July 1, 1901, to take the more important position of superintendent of the Calumet & Hecla, which is among copper mines more than the Chapin is among the mines of iron, and which is the largest dividend-payer of any mine, and employs five to seven thousand men.

If the Chapin has lost the services of a good man it is fortunate in having secured an excellent miner and executive to take the vacant place. Mr. Otto C. Davidson succeeds Mr. MacNaughton as district superintendent of the mines of the United States Steel Corporation for the Menominee range, leaving the Commonwealth Iron company, of which he has been superintendent for some years, to take the more responsible position noted. Mr. Davidson's work, especially at the Aragon, has been regarded most favorably by all competent critics, and he is not only respected for his ability as a mining man, but is heartily liked by the workmen under his charge and by all who come in contact with him. One pleasing instance of his ability as a mine manager should be stated, that being the large number of bright young men who have graduated from the Commonwealth company's employ, during Mr. Davidson's management, to positions of greater responsibility at mines of the various iron ranges, and fields much farther removed.

The gross output of the Chapin reaches the grand total of 9,369,900 tons, to the close of 1900, and the product of last year was 929,937 tons, which, with the exception of a slightly larger output in 1899, was the largest ever secured from the mine.

The Chapin is installing two powerful new pumps in "B" shaft, the larger of which has a capacity of 1,200 gallons per minute. Both pumps are of Prescott make, and with the big Allis-Riedler and the other large pumps owned by the mine, will give the Chapin the most powerful pumping plant possessed by any Lake iron mine. This is required by the exceptionally heavy flow of water under normal conditions, the limestone formation being favorable to the percolation of water. The shafts of the Chapin are of exceptional depth, and the mine must drain an immense territory, under the most favorable conditions, while at times mining work taps great underground reservoirs, or water-courses, which tax the capacity of the equipment to its fullest. An instance of the sort referred to was given early in February, 1901, when a "vug" was tapped in the Hamilton shaft, speedily increasing the inflow of water from the normal figure of 500 gallons to more than 2,000 gallons. The disabling of the pump through an accident to a valve required the use of bailers, which are run down the shaft on the skip-ways, in the emergencies which are of almost annual occurrence at this mine. The shaft was unwatered in a much shorter time and at much less cost than would have been anticipated by anyone not acquainted with the expeditious manner in which the Chapin people meet emergencies of this sort.

"D" shaft is being abandoned, owing to the exigencies of mining, but a new shaft is being sunk a short distance to the south, to replace the shaft thus lost.

The big Allis-Riedler pump, which has been frequently described, and is an object of great interest to mining

men, is to be protected by a steel shell. The pump chamber, on the sixteenth level of the Hamilton shaft of the Chapin, was excavated in solid rock, but as it is in the limestone the walls have cracked in places, and to protect the pump, which is vital to the operation of the mine, from the damage which might be caused by the fall of even a small amount of rock from the roof, a steel chamber 34 feet wide by 60 feet in length and 22 feet in height has been designed.

The power to operate the Chapin mine has been mainly secured, since the mine was first opened from the Quinnesec falls, several miles distant, where a big air compressing plant reduces the air to high pressure, the compressed air being sent to the mine in a big steel pipe. In June, 1901, the compressor plant was badly damaged by an explosion of great severity, in which several men were badly injured, it being remarkable that they were not killed outright. The exact cause of the explosion is uncertainable, but it is the theory of the management that it was caused by a mixture of compressed air and over-heated lubricating oil. The building in which the hydraulic plant is housed is of stone, and beyond considerable damage to the roof was little injured. The plant is being repaired and rebuilt on a larger scale.

CHICAGOAN.

This property is located about midway between the Crystal Falls and Iron River districts of the Menominee range, and has been under option to the Oliver company for nearly two years until June 1, 1901, when work was suspended, the Oliver people having become convinced, as the result of very thorough exploratory work, that the conditions did not justify attempting to make the mine a producer.

COLUMBIA.

The Columbia is one of the oldest and best mines of Crystal Falls, and has been a producer to greater or less extent for every year since 1885. The 1900 production was 97,531 tons, as compared with 126,290 tons in the preceding year, the 1899 output having been the greatest ever secured from the mine. The property changed hands in the spring of 1901, being sold by the Huron Iron company to the Oliver company. The mine has a 160-acre tract, the greater part of which is underlaid by ore, and has been merely scratched as yet. The new operators are going at the work systematically and with a will. Buildings and machinery are being repaired or replaced, and in the mine itself every effort is being made to open the property upon a considerable scale. The shaft is being sunk one level and new stopes opened. The work planned by the new owners is so extensive that it is not likely the Columbia will appear prominently on the lists of shippers for 1901, but will be in condition to make a good output next year, if circumstances are favorable to the mining of a considerable tonnage.

COMMONWEALTH.

This mine is across the state line, in Wisconsin, and has produced in all 2,245,395 tons of ore, of which amount only 53,342 tons were shipped in 1900. The mine is pretty well worked out, and barring the development of new ore bodies as yet unknown, is almost a property of the past.

CORNELL.

This property, lying in the Iron Mountain district, is controlled by the Bristol Mining company, and possesses large deposits of silicious ore, of good quality for that grade, but for which there is only a limited market, and that at prices that preclude the operation of any mines of this class except those having exceptional facilities for cheap mining.

CRYSTAL FALLS.

This is one of the best mines of the district of the same name, and has produced 631,437 tons of ore in all, of which the 1900 output, amounting to 197,770, was much the largest tonnage secured in any year. It is operated by the Crystal Falls Iron Mining company, which is controlled by Corrigan, McKinney & Co., of Cleveland. Captain S. C. Bennett, who has been in charge of the Menominee range interests of this firm, was succeeded at the beginning of the present year by Captain William J. Richards, who was previously employed at the Fayal mine of the Minnesota company and later by Corrigan, McKinney & Co. at several of their Mesaba range properties. The mine continues to look well and show good ore bodies, the showing being best at the bottom, which is a most encouraging sign. The ore is dryer than is common in this district and both vein and walls are of more solid nature than elsewhere in the vicinity, thus enabling the working of the mine with the minimum amount of timbering.

CUFF.

This is a new property, which made its first shipment in 1899, and marketed 38,209 tons in 1900. The product is a silicious ore of excellent grade, running as high as 42 per cent in metallic iron, and has an exceptionally low average in phosphorus, rendering it a very desirable “sweetener” for ores deficient in silica and too high in phosphorus for making bessemer pig.

CUNDY.

This is one of the growing properties of the range, and shipped 141,148 tons of ore last year. Its first shipment was made in 1896 and it has produced a total of 364,264 tons. It is operated by the Cundy Iron company, composed of shareholders very closely affiliated with the Illinois Steel company, now part of the U. S. S. G. The ore is of fair grade and the deposit is a very large one. At this writing, Aug. 17, 1901, it is expected that the mine will suspend operations in the near future.

DESSAU.

This company, composed of New York capitalists, shipped a sample cargo of ore in the fall of 1900, which averaged 41 per cent metallic iron and .033 phosphorus. The property is one of the numerous high-silica propositions in the Iron Mountain district, the product of which is at present marketed with some difficulty, as the demand is far less than the supply, which is very large.

DOBER.

The Dober lies about a mile south of the village of Iron River, and has produced 65,192 tons of ore since its first shipment in 1898, the output for 1900 being 49,203 gross tons. The opening of the mine was expensive, it being thought prudent to divert the course of Iron river for more than 2,000 feet in order to enable the working of the mine with safety, as the ore body outcropped in the bed of the river and the fatality of 1893 at the Mansfield mine gave warning of what might happen to a mine worked under a river in a greedy and careless way. The property is operated by the Oliver company and gives promise of becoming a very large producer in time.

DUNN.

The Dunn, located in the Crystal Falls district, was once the greatest mine in that vicinity, but was robbed and suffered to fall in. It is being reopened by Corrigan, McKinney & Co.

EMMETT.

The Emmett, now owned by the U. S. S. C., is located at Waucedah, at the eastern end of the Menominee range. It was one of the first mines opened on the range, but never achieved prominence, having produced only 66,665 tons all told. Its ore is a silicious bessemer, carrying above 40 per cent in iron. The deposit is a considerable one, and will be available whenever additional ore of this class may be needed.

FLORENCE.

The Florence mine, located in the village of Florence, Wisconsin, is one of the oldest mines of the range, and has produced 1,368,680 tons of ore, of which 35,756 tons were shipped in 1900. The mine reached its apogee in 1890, when the output was 218,570 tons, the output of that year being the second largest secured from any Menominee range mine. The product is a low-grade non-bessemer, for which the demand is limited.

FOREST.

This is a new mine, in the neighborhood of Lac Fumee, Iron Mountain district, and is being opened by the Oliver company. A shaft has been sunk more than 200 feet and crosscuts are now being driven. There is a suspicion that the property contains a large body of ore underlying Lac Fumee, and should this theory prove correct, it will be necessary to drain the lake to develop and operate the mine in safety.

GLADSTONE.

An exploration by this name, in the neighborhood of the old Indiana mine, has struck a good quality of ore, apparently of bessemer grade, though rather low in units of iron, the value of which can only be determined by more extensive development.

GIBSON.

This property is located in the Amasa district, which is north of the main mineral belt of the Menominee range, and still further south of the Marquette range, hence is included in the former, though it is probable that in time, when the heavy drift is overcome, there will be found a connecting link extending from the Republic outlier of the Marquette range to the Amasa district of the Menominee, thus connecting the two ranges by a sort of Siamese-twin bond. The mine is in the hands of the Oliver company and gives considerable promise of making a good property, though the ore is of non-bessemer grade.

GREAT WESTERN.

This is one of the more important mines of the Crystal Falls district and has produced in all 563,460 tons of ore, of which the 1900 production of 98,550 tons was the largest secured in any year. It is operated by the Great Western Iron Mining company, a Corrigan-McKinney company organized in the fall of 1900. The ore deposit is of great extent and of fair grade for the Crystal Falls district, where phosphorus is usually found to a great extent in all ores, the Great Western ore running above 61 per cent in iron. A new shaft is now sinking, through quicksand, this having been started on the footwall side to obviate drawing, which is a common trouble in this district. The new shaft, when bottomed, will be given an excellent equipment, and will eventually become the principal artery of the mine.

GROVELAND.

The Groveland mine is located at the western end of the Felch Mountain or Metropolitan district, an outlying spur of the Menominee range paralleling the main mineral formation some miles to the north. The mine was opened in 1891 and worked but one season. A process of concentrating the mixed ore produced from property was tried, with indifferent success. So discouraging was the prospect that the lease was thrown up and the rails were removed from the branch track built to the mine by the St. Paul railway. The Felch Mountain district never produced a successful mine, the Metropolitan, which shipped 107,027 tons in all, being the largest producer opened in that district, and the Metropolitan was practically closed down for keeps in 1884, though small shipments were made in 1886 and the two following years. The Felch Mountain range has had a rather poor

reputation with mining men, but this did not deter Messrs. Corrigan, McKinney & Co., who are experienced and successful operators on several ranges, from securing an option on the Groveland in the spring of 1901. The ore is a fine blue hematite, of bessemer grade, but is badly mixed with greenstone. The new operators begun work by sorting over the old rock-dump, which is a combination of stockpile and rock burrow, and having secured the relaying of the rails on the spur to the mine, shipped a thousand or more tons of hand-picked ore, averaging a good grade, though not quite as closely freed from the gangue of greenstone as might be desired. A boiler, hoist and pumps are being put in place at this writing, in July, and the mine will be unwatered. When the water is forked out the property will be thoroughly examined, and if the showing is as good as is hoped, the mine will be developed on a liberal scale.

HEMLOCK.

The Hemlock is located in the Amasa district and has been a steady producer, with the exception of the years 1894 and 1895, since its first shipment in 1891, two years after the discovery. It is owned and operated by Pickands, Mather & Co., of Cleveland, and has shipped a total of 556,486 tons of ore, of which the 1900 production amounted to 72,413 tons. The product is a medium grade non-bessemer, and 1901 shipments are broken to furnace size by a Gates centrifugal crusher having a crushing capacity equal to that of the crushers at the Lake Superior mine, Ishpeming.

HIAWATHA.

This is a small producer in the Iron River district, which shipped single cargoes in each of the years 1893 and 1895, and produced 11,008 tons in 1900. It has a single shaft about 150 feet in depth and ore of non-bessemer grade, found in small and somewhat irregular lenses.

HILLTOP.

This is a new property in the Crystal Falls district, opened by the American Mining company. It shipped 3,496 tons in 1899 and 6,410 tons in 1900. The ore is of low grade, but is apparently of considerable extent. Like a number of similar mines of this caliber, the Hilltop is dependant largely upon the whims of furnace men, who are very finical when it comes to buying the low grade ores, of which the supply is usually much larger than the demand. The time will come, however, and within a few years, when ores of this grade will be in steady demand at living prices, and when that time comes the Crystal Falls district, with its many millions of tons of low grade ore, will be a busy mining camp, and the mining industry in this field will be carried on steadily, instead of by the intermittent jerks that are so wearing on the nerves of labor and trade dependant upon the operation of the mines.

HOLLISTER.

This is a small property in the Crystal Falls district, opened in 1890, and which shipped one cargo in that and each of the two succeeding years, making a total product of only 4,098 tons. It was held under option by Oglebay, Norton & Co. until the fall of 1900, when the option was surrendered, and was taken in the following spring by the Oliver Mining company, which is now exploring the property.

HOPE.

The Hope was opened in 1892 and shipped 15,543 tons that season, but sent out only a single cargo next year and then dropped off the list of producers. The mine was optioned in the spring of 1901 by the Oliver company, and is now being developed by them.

ISABELLA.

Now a part of the Riverton mine, having been consolidated with the old Iron River mine under the new name.

JAMES.

The Manila Iron company dropped the explorations on the James tract, near Iron River, reference to which was made in the last report, but the work of continuing the explorations was taken up by the owner and friends, and a considerable body of low-grade ore has been cut by diamond drill, and opened by a shaft.

KEEL RIDGE.

Is owned by the Pewabic company and operated in a limited way by the Antoine Ore company for a high-silica ore, under a royalty of five cents per ton.

KIMBALL.

This property is located in the immediate neighborhood of the village of Crystal Falls. The shaft was unwatered in May and examination made of the underground openings, which were found to make a good showing of ore. A shallow shaft sunk near the engine house has also been bottomed in ore, of which there is apparently a large amount. The Kimball was first opened in 1888.

LAMONT.

The Lament mine, formerly known as the Monitor, located in the Crystal Falls district, has produced 227,884 tons of ore, of which 31,323 tons were shipped in 1900, the production being a little less than half that of the previous year. It is worked by Corrigan, McKinney & Co., of Cleveland. The main shaft came together to such an extent in the simmer of 1900 that work was abandoned and the mine allowed to fill. A new shaft was immediately started, but work was suspended Dec. 1 until April, 1901, when the property was unwatered and

sinking resumed in the new shaft. The mine has one shaft, the old Paint River shaft, at present, but this is not advantageously situated for hoisting, though of great assistance in the work of sinking the new shaft, as it permits the breaking of an uprise to meet the new shaft. The Lament possesses large ore measures, and while it cannot accomplish much as a producer this season, will have its new shaft in operation in 1902, and can get out a large tonnage then, if a satisfactory market can be found for the product.

LEE PECK.

This small mine was opened in 1892, in the Crystal Falls district, as the Cherry Valley, and shipped 2,844 tons that season. It was reopened in 1900 by Corrigan, McKinney & Co., but did not give much promise, and work was suspended in the fall of that year.

LINCOLN.

This is also in the Crystal Falls district and operated by Corrigan, McKinney & Co. It has produced 153,170 tons of ore in all, and the 1900 output was 72,959 tons. The mine carries the extension of the Great Western ore bodies and is operated in connection with that property, though under lease to the Lincoln Iron Mining company.

LORETTO.

The Loretto mine is located in the village of the same name, five miles east of Norway, and is owned by the Loretto Iron company, of Chicago, the stock of which is held mainly by the people interested in the granite quarry at Amberg, Wis. Captain Henry Truscott is superintendent, and the mine has produced 400,202 tons since opened in 1893, the 1900 output of 61,219 tons being about the average rate of production maintained for the past three years. The ore is bessemer grade, though running under 60 units in iron, and the mine is opened beneath the beds of the Sturgeon and Pine rivers, near their junction.

The Loretto is a well managed mine, and a number of extensive improvements have been made in the past year, these including a new and powerful hoisting plant, a new power plant housing two boilers of 200 horse power each; new machine shop 24x54 feet in size and new smithy 24x50 on the ground, both of which are well equipped with tools, forges, etc.; new office building and warehouse, and about twenty new houses for employees, the latter being substantial structures. The mine has two parallel ore bodies, of which the northern is the richer and the southern the larger. A portion of the product from the southern vein is non-bessemer.

LOTTA.

The Lotta mine, owned by the Lotta Mining company, is located on Section 33, Town 44, Range 31, in the Michigamme Mountain outlier of the Crystal Falls district. A small vein of bessemer ore has been located and is developed by a shallow shaft. The district is a new one, and the developments will be awaited with interest.

MANILA.

The Manila Iron company was organized some eighteen months ago as an adjunct to the Minnesota Iron company, which was in turn controlled by the Federal Steel company, the purpose in life of the Manila company being to develop mineral lands secured on the Menominee and Marquette ranges. The work was in charge of Mr. E. F. Bradt, who had offices in Iron Mountain, and was attacked with zeal and discretion, but the financial shuffle which resulted in the formation of the United States corporation swallowed the Federal Steel company, which in turn carried the Minnesota Iron company, and that action naturally eliminated the Manila, which was the Minnesota's offspring. It is quite probable that the Manila Iron company is still in legal existence, but for all practical purposes it is as dead as the mummy of the oldest Pharaoh, at present, though corporate exigencies may at some future time require that the breath of life be again blown into its nostrils. Mr. Bradt has resigned his position and is engaged in explorations in the Republic district of the Marquette range, while the Menominee range holdings of the Manila company are under the Oliver management.

MANSFIELD.

This is the most easterly mine of the Crystal Falls district, and one of the best, as it produces a good grade of bessemer ore. The mine shipped 90,155 tons in 1900, that being the largest product ever secured. The total output of the mine to the close of last year was 481,639 gross tons.

The Mansfield was opened in 1890 and was ruined in 1893 by the Michigamme river breaking through the roof, the accident incidentally costing the lives of twenty-eight miners. In 1896 the wrecked mine was secured by Chicago capitalists, who organized the De Soto Iron company to take over the property. The course of the river was changed for some 1,200 feet, and the mine reopened. The mine was sold, in January, 1901, to the Oliver company, and Captain S. C. Bennett placed in charge. A new shaft had been started by the De Soto company before the sale. A considerable amount of development work is under way. The new shaft was planned to be one of the largest and deepest in the iron districts when completed, being 6x16 feet in size inside of timbers, with three compartments, and was to have been sunk to a depth of at least one thousand feet. At present the new shaft is not sinking, attention being given to the old shaft, which has been retimbered and placed in as good condition as possible. The company is working at a disadvantage because of the necessity of sinking on the hanging-wall side, due to the foot-wall side being in the possession of other owners.

MANSFIELD DISTRICT.

A considerable amount of exploring, mostly done in a desultory manner, has been performed in the Mansfield district, and some great stories of big finds of bessemer ore have been set afloat from time to time, but as yet the developments do not keep pace with the tales. It is probable that a number of good mines will be developed eventually in the Mansfield portion of the Crystal Falls district, and explorations in that neighborhood are rendered exceptionally attractive because of the presence of high-grade ore, not found further to the west.

McGREGOR.

This silicious -ore producer of the Iron Mountain district was closed down in July, 1900, and remains idle.

MASTODON.

A little exploring was done on the property of this old mine in the fall of 1900, and a fair ore body was cut.

MICHIGAN.

The Michigan mine, located in the Amasa district, was discovered ten years ago and developed by local capital, but never became a shipper. Possession was secured by the Oliver company in 1900, and Capt. James P. Edwards, formerly of the Chicagoan mine, was put in charge as mining captain at the beginning of 1901, succeeding Capt. Isaac Williams. The property bids fair to become a mine of some importance.

MILLER.

This is a new mine, adjoining the Dober, in the Iron River district, and is also under control of the Oliver company, and is practically a part of the Dober.

MONONGAHELA.

The Monongahela is an undeveloped property lying just west of the Columbia, in the Crystal Falls district. Considerable work was done by Oglebay, Norton & Co., under the supervision of Frank Scadden, in 1900, but work was suspended in the fall of that year. The property was secured in March, 1901, by the Pittsburg & Lake Angeline company, of Ishpeming, and is being developed by that company.

NANAIMO.

The Nanaimo mine was one of the first opened in the Iron River district, but has never scored a success. It was last worked, in a small way, in 1891, and has produced 127,566 tons of ore in all. It is owned by McKinnon Bros., and was optioned in April, 1901, to Mr. F. H. Abbott of Crystal Falls, who is endeavoring to interest capital in the mine, it being contended by the friends of the property that its past failures have been due more to lack of capital and ability on the part of those managing it than to any deficiency in ore or other untoward conditions.

PAINT RIVER.

This mine was opened in 1882 and closed in 1892. It adjoins the Lamont and is practically a portion of that mine. It has produced 223,687 tons of ore, of which 1,316 tons were shipped last season, this being the first credit given the mine since 1892.

PENN.

The Penn Iron Mining company owns the East, Central and West Vulcan, and the Curry, Brier Hill, Norway and Cyclops mines, in the city of Norway. The 1900 output of 197,606 tons was the smallest made by the company since 1896, but the total output of the seven mines of the Penn company reaches the great aggregate of 5,493,127 tons. There is little that is new regarding these mines, which are being managed with prudence and with no small degree of success, considering the rather unfavorable conditions of mining broken ore deposits and securing a product of only medium grade. The old Cyclops shaft was unwatered in the fall of 1900, and a fire in March, 1901, did considerable damage to the Curry shaft. A large compressor was installed at the West Vulcan in the fall of 1900, and a big Worthington pump was installed in the East Vulcan in the winter following. The company is working steadily, and its tonnage for 1901 will probably show a gain over last season.

PEWABIC.

The Pewabic has ranked second to the Chapin among the ore producers of the Menominee range for some years, until 1900, when it was passed by the Aragon. Its total tonnage, however, is greater than that of the Aragon. The Pewabic shipped 374,043 tons of ore in 1900 and has produced 2,701,763 tons in all, since it was opened in 1890. The ore bodies are large, and the considerable reduction in product noted in 1900 was not due to the inability of the mine to produce as much as in the preceding year, when the shipments reached high-water mark with an output of 530,129 tons.

The Pewabic has large ore bodies, one of which produces the well-known "Pewabic" fancy bessemer. The largest body of ore, however, is of the high-silica bessemer variety, the "Genoa" grade being one of the best of this class of ores, running up to 44 per cent metallic iron and as low as .007 in phosphorus.

QUINNESEC.

The Quinnesec was one of the first mines opened on the Menominee range, and is located in the town of the same name, midway between Iron Mountain and Norway. Although one of the largest of the early producers of the range, the Quinnesec failed to make

good the promise of its younger days, and was abandoned in 1888, after a lingering career of continued debility extending over the four or five preceding years. One small cargo of ore was secured from the old rock-dumps in 1895, but the mine itself remained idle until 1899, when it was taken in hand by Corrigan, McKinney & Co. and 11,050 tons of ore shipped. The output for 1900 was 25,967 tons, and the production for the current year will be larger.

A mixed vein affording a high-grade bessemer ore has recently been encountered, and is now being developed. It is hoped that this ore body will grow cleaner as it is more extensively opened. So encouraging is the present prospect before the old mine that the lessees are building new engine houses and will install new machinery, and in other ways expend considerable sums on the property. A strong force is now being worked, and the ancient village of Quinnesec, for years about as lively as a well con ducted cemetery, is again an active and prosperous mining town, supported by the Quinnesec and Cundy mines. The Quinnesec is connected with the Northwestern and St. Paul railways, the tracks of the latter having been recently laid to the mine, on a Sunday, in order to avoid the legal complications which are of such frequent occurrence when one railroad attempts to take away business from another.

RIVERTON.

This is the old Iron River mine under a new name, and which, under both names, has produced 976,853 tons of ore, and is the most important mine of the Iron River district. The Isabella mine is also worked in connection with the Riverton. The ore measures underlie the original bed of Iron river, but the course of the stream has been deflected for some distance, to afford the mine and miners immunity from accident through flooding of the workings, an accident highly probable to occur in a formation such as exists on the greater part of the Menominee range, unless the necessary precautions are taken to guard against the water coming in.

The Riverton is operated by the Oliver Mining company, and shipped 71,004 tons last season. No. 3 shaft has been deepened and greatly improved, and now contains double skip-ways, with a third compartment for ladders and pipes. A fine new changing-house has also been built and numerous smaller improvements effected, all of which, by their permanence, indicate that the Oliver company has much faith in the future of the mine and is preparing to win the ore at the lowest cost through the use of the best methods and machinery.

ROBERTS ORE CO.

This company was organized in April, 1901, to take over the holdings of mineral lands owned by Messrs. R. C. Flannigan and C. T. Roberts. The Hilltop, sold to the American Mining company, was one of the properties controlled by Messrs. Flannigan and Roberts, but they still retain a number of undeveloped mines in the Crystal Falls and Iron River districts.

SHERIDAN.

This property, sometimes known as the Stegmiller, was opened by Escanaba people in 1889, and has since been a small but fairly constant producer, achieving good products in 1892 and 1899, the 1900 output being only 8,063 tons. The mine is under the control of Pickands, Mather & Co.

TOBIN.

The Tobin, in the Crystal Falls district, is one of the numerous crop of properties that sprang up just before the panic of 1893, to be withered in that frosty period. A shaft was sunk to the depth of 100 feet in the winter of 1891-92, but the property never shipped, though a fair showing of ore was made. The property was acquired in 1900 by Corrigan, McKinney & Co., and a little work done that fall, but the shaft was allowed to fill during the winter, and was not unwatered until May, 1901, when the work of developing a mine was begun in earnest. The present showing is encouraging.

VERONA.

The Verona Iron Mining company, of Amasa, Mich., was incorporated under the Michigan laws with a capital stock of $500,000 in February, 1901. Its shareholders are the Piekands, Mather & Co. people, with Chas. H. Munger general manager and C. E. Lawrence superintendent. A mine is being opened on what is known as the Murphy tract at Stambaugh, in the Iron River district, this property having been thoroughly explored by the Menorninee Exploration company, a corporation controlled by the same firm, and also under the management of Mr. Lawrence. An option has also been taken by the Verona company on the Young tract, near the new Baltic mine, in the Iron River district, on which a mine will probably be easily opened, as the ore of the Baltic pitches under the Young tract.

At the Verona mine, in the Norway district, a production of 5,143 tons of ore was secured in 1900. Work was begun here in the previous season, and the mine is being systematically developed.

WEST LUDINGTON.

The West Ludington is located a short distance west of the Ludington end of the Chapin mine, and is owned by the Cundy Iron company, with Capt. J. G. Cundy as superintendent. The shaft has now reached a depth of nearly 500 feet, and will be dropped eventually to a depth of 1,000 feet. Crosscutting is in progress and an ore body of good grade and size is being developed.

GOGEBIC RANGE.

The Menominee and Gogebic ranges both overlap the boundaries of the Wolverine State, and have mines in the adjoining Badger commonwealth, but whereas the Menominee range has but two mines on the Wisconsin end, the Gogebic has sixteen mines in the latter state, these being the Atlantic, Bessemer, Gary, Germania, Iron Belt, Kakagon, Montreal, Nimikon, Odanah, Pence, Section 33, Shores, Superior, Trimble, Tyler's Forks and Windsor. The Wisconsin mines, however, produced but 425,113 tons in 1900, out of the total product of 2,875,295 tons secured from the entire range, and their gross product to the close of 1900 was only 4,706,306 tons, out of the total of 31,216,635 tons shipped by the district, leaving 26,510,329 tons as the output of the Michigan mines of the range.

In 1900 there were but six producing mines in the Wisconsin end of the range, and as the outputs of two of these were less than a thousand tons each there remained but four active mines of real importance, the 1900 production of the six active mines having been as follows:

Atlantic	135,955
Cary	125,496
Germania	986
Iron Belt	54,664
Montreal	107,524
Windsor	488
Total	425,113

The 1900 production of 425,113 tons from Wisconsin mines of this range showed a gain over the 1899 output, which was but 353,548 tons. The Shores, which produced 11,819 tons in 1899 was not a shipper in 1900. The Atlantic, which produced but 19,964 tons in 1899 shipped 135,955 tons in the following year, while the Cary practically doubled its production in 1900, and the Iron Belt cut its production in half. The Montreal showed a falling off of about 30 per cent in 1900, compared with the figures of the preceding year. The Odanah, now called the Ottawa, is working this season, with Geo. H. Abeel as manager.

The figures of production of all of the Gogebic range mines in both states, for 1900, and their totals for all years, will be found in the preliminary pages of the section of this report devoted to iron.

The Hayes Bros., of California, who opened and reopened the Ashland mine, recently sold to the Cleveland-Cliffs company, are developing the Minnewawa property, in Wisconsin. This tract lies immediately west of the Ashland, but across the Montreal river, which is the boundary line between the states. A vertical shaft is being sunk, but this may be deflected after the ore bodies are reached. The very thorough explorations conducted by the Hayes Bros, on the Ashland property have given them a valuable insight into the iron formations of the Ironwood district, and their expectation of developing a good mine on the Minnewawa property seems warranted.

ASHLAND.

The history of the Ashland mine reads like a romance, and were the plain facts of the mine's past and present to be set forth under the garb of fiction, the story would be condemned by the critics as too improbable. The Ashland lies just east of the Montreal river and was first opened by J. O. and E. A. Hayes, the owners of the fee. The property was secured on lease by the Penokee & Gogebic Development company, and worked until 1898, when the mine was abandoned as worked out. The Hayes brothers, who had removed to San Jose, California, thus had the property thrown back on their hands, a thoroughly discredited mine, which had been abandoned by a strong corporation as worthless, owing to the complete exhaustion of its ore bodies.

The mother of the Messrs. Hayes is gifted with peculiar powers, according to the belief of her sons and of many other sober persons who have had evidence of her occult abilities. The Hayes brothers, who are shrewd and successful business men, have implicit confidence in their mother's prognostications, and in justice to her and to them it should be said that her advice has proven uniformly good, even when apparently unwarranted by existing conditions. Madam Hayes, from her home in California, turned her spiritual eyes upon the Ashland mine, more than two thousand miles distant. The underground openings were minutely described by her, and she also indicated the existence of large ore bodies remaining untouched, and located them with such exactitude that anyone acquainted with the mine would know just where to drift or crosscut to reach them, if they existed. As soon as the snows melted in the spring of 1899 the Messrs. Hayes were on the ground, and begun actual mining work in June of that year. The mine was freed from water and temporary shafthouses rigged, the old ones having been allowed to fall into the pits when the ground caved.

It was known when the Hayes brothers resumed work at the Ashland that they were acting under the supposedly inspired instructions of their mother, and there was no little snickering on the part of the incredulous, who were in the great majority. This did not bother the Messrs. Hayes, and from the first it was evident that they were not merely exploring for ore, but were arranging to reopen the mine upon a large scale, their plans having been perfected before the first hammer was struck on a drill, or the first gallon of water forked from the mine. Smiling incredulity was changed to mild surprise when the first ore body indicated by Madam Hayes was actually opened by the miners, but as strike after strike was recorded and the Ashland was changed from an abandoned scram into a big mine with millions of tons of ore in sight, within a few months, the scoffers became mum. In every case the ore was found where the mother of the owners had told them to seek it. This is a strange tale to be given the public for fact, and strangest of all to appear in an official report upon mines, prepared and published for one of the greatest mining states of

the union, but the facts are known to hundreds of people and can be readily verified by the sceptical.

When the Ashland reverted to the owners of the fee in the spring of 1899 it was in very bad shape physically. The surface improvements were mostly in ruins and the shafts had fallen in. The property was in exceedingly bad shape for mining, yet in the first twelvemonth Hayes Bros, mined and brought to surface something like 150,000 tons of high grade ore, although it was the opinion of the preceding operators that there did not remain as much as a thousand tons of ore in the entire mine. The work of exploration was kept parallel with that of development and large ore bodies were cut by the diamond drill at great depths. The resuscitation of the mine was almost a resurrection, and in the spring of 1901 the mine was sold by Hayes Bros, to the Cleveland-Cliffs company at a figure not made public, but generally thought to be about four millions of dollars.

The new owners of the Ashland are among the largest and most aggressive of the independent mining companies still operating in the Lake iron district. Mr. Hugh F. Ellard, for some years with the Aragon mine, at Norway, Mich., was selected as superintendent of the Ashland, and with him came Capt. Gustaf Anderson, from the same mine, to take charge of underground work. Will W. Smith is clerk and Wm. Tolan is master mechanic.

The output of the mine for 1900 was 232,961 tons. The largest production was in 1890 when 435,949 tons were raised and shipped, and the mine is accredited with a total production of 2,612,442 gross tons, standing fourth among the producers of the Gogebic range in gross output. Present indications are that the mine will ship as much ore this year as last, and perhaps a little more, unless the present strike of the Amalgamated association should interfere too greatly with the iron business.

Since the Ashland was taken by the Cleveland-Cliffs company considerable repairs have been made to a number of the mine buildings and the policy of betterment and expansion begun by the Messrs. Hayes has been continued upon a large scale. At the present time shafts 3, 4, 6 and 8 are in commission. The old shaft house at No. 8 has been torn down, the shaft itself having come together. No. 6 shaft, which is a little east of the middle of the property and has a great deal of ore tributary to it, is in pretty bad condition, being considerably drawn, with the surface also in bad shape, hence it has been decided to replace it, and a diamond drill is now working near the shaft in the caved ground. A hole is being drilled from surface, at right angles to the formation, and similar holes will be sent from the second, fourth and ninth levels. The cross section thus obtained will give a profile that will determine the location of the new shaft, which will be in the footwall slates, behind the present No. 6 shaft at a probable distance of about 150 feet. It is quite possible that the old electric light building, now idle, will have to be demolished to allow room for the new shaft house, though the latter structure may be located a little farther south. The new shaft will be made modern in every way and fitted with the latest appliances for the economical handling of a large tonnage, as this is one of the best portions of the mine. The Ashland has a single power plant, consisting of a boiler house and an engine house, both located near No. 6 shaft. Two new tubular boilers are being installed, and will generate 300 horse power, sufficient for the operation of the mine until considerably further developed, when additional boilers can be set as needed.

No. 4, the next active shaft west of No. 6, descends vertically for three lifts, after which it follows the incline of the ore body to the northward. Eventually the three upper levels of this shaft, now opened vertically, will be replaced by an uprise driven to surface from the third level at the same angle as the lower levels of the shaft. This work, however, will riot be undertaken this season, as there are several more pressing matters requiring previous attention.

At the present time the Ashland is producing at a greater rate than at any previous time, with the exception of the years 1889 to 1891, inclusive, but no sinking is being done. So much ore has been shown in the upper levels that it is deemed unwise to attempt sinking until most of the ore now in sight has been removed, as the mine is operated on the caving plan, and the opening of shafts too far ahead of production would be work that would very likely have to be done over again. The diamond drill, however, has told the story of immense ore reserves extending far below the present or the deepest preceding workings. There are some places in the mine where the caving system of winning the ore is not in use, but the caving plan is used wherever practicable, and will eventually be employed throughout the mine.

It is a remarkable fact that there are a number of chambers in the Ashland mine that are now being mined out for the third time. This seems like reading the fable of the purse of Fortunatus, which filled itself automatically whenever gold was taken from it. The chambers in question were originally opened and stoped out in the early days of the mine, when there was ore in sight everywhere. Years later, when the mine was supposed to be upon its last legs, these old chambers were carefully scrammed, with the result that thousands of tons of high-grade ore were secured, after which they were abandoned as absolutely worthless. Between that time and the present day the ground above the chambers caved, filling them with broken rock. On examining the old chambers it was found that a number of them were filled with excellent ore, brought down with the ground from above. This ore comes out already mined and broken to satisfactory size as a rule, and the incident affords another chapter in the most remarkable history possessed by any Lake Superior iron mine.

At the present time mining is being done in both No. 6 and No. 7 shafts within 30 feet of surface, and the ore is of the very best grade. Naturally there has been a little trouble from sand working down in the ore taken from so

near surface, but a large number of mills were started in No. 7, from sub-level to sub-level, and the ore drawn through them was so carefully selected that the greater part went into the high-grade product.

The Ashland mines only two grades of ore, both of which are of bessemer variety, the grades being "Ashland," guaranteed above 60 units of iron and .035 in phosphorus, and "Taylor," guaranteed 59.8 per cent iron and .050 phosphorus. The ore has been running better this season than ever before In the history of the mine, the majority of the cargo analyses running 62 per cent iron or better, and many of them crowding 63 per cent. For the entire month of July every ton of ore hoisted was shipped in the "Ashland" grade, not a single skip of second-grade ore coming to surface, and at the present writing, early in August, the mine is still producing only the best grade. The management scarcely dares to hope for a permanent continuance of this favorable condition, but its existence for five successive weeks speaks eloquently for the mine and its management. The Ashland's ore is very wet, like that of most of the mines of the Ironwood district, the percentage of moisture ranging from 9 to as high as 12% per cent, but this is more than offset by the super-excellent quality of the ore.

There are no long trams in the mine, and it is not probable that a haulage system will ever be installed—at least not until human labor grows dearer and power haulage cheaper.

The mine is now making about 550 gallons of water per minute, and the installation of a new pump is being considered.

OLIVER IRON MINING COMPANY.

The Oliver Iron Mining company is the greatest producer of iron ore in the world. The Oliver company was originally the mining branch of the Carnegie Steel Company, Limited, and was under the management of Henry W. Oliver, of Pittsburg. Upon the absorption of the Carnegie company by the United States Steel Corporation, early in 1901, the Oliver company also passed under control of the United States Steel Corporation. Other mining interests also came under the control of the Steel Corporation, but these have not in all cases been completely assimilated with the Oliver company, as in the instance of the American Mining company, the mining branch of the American Steel & Wire company, which is now a component part of the Steel Corporation, but is still operated independently of the Oliver company, Joseph Sellwood, of Duluth, remaining as general manager. The Oliver company, however, stands head and shoulders above all competitors in the Lake Superior district, and has extensive interests on all five ranges. As the largest individual interests of the Oliver company in this state are on the Gogebic range, and Ironwood was until recently the Lake Superior headquarters of the company, it has been thought best to make detailed reference to the Oliver company at this point, although frequent references to the operations of the company will be found in the sections devoted to the Marquette and Menominee iron ranges.

Until this year the Oliver company had its general offices in Pittsburg, and its principal Lake Superior office at Ironwood, in charge of Thos. F. Cole, with another supervisory office at Milwaukee, in charge of Dr. Nelson P. Hulst. Early in 1901 there was a revision of the directorate and general plan of management of the company, as a result of which Mr. Cole was made president and the main offices transferred to Duluth, with sales offices retained in Pittsburg, the local offices on the different ranges remaining unchanged. The officers of the Oliver Iron Mining company are as follows: Thos. F. Cole, president and general manager; Dr. N. P. Hulst, vice president; C. D. Eraser, secretary; D. G. Kerr, treasurer; W. M. Jeffery, auditor. The main office is in the Exchange building, Duluth, where Mr. Cole has his office, and where Mr. Jeffery and the accounting staff have recently removed from Pittsburg. Dr. Hulst's office remains in Milwaukee, and the secretary and treasurer continue in the Carnegie building, at Pittsburg, Mr. Kerr, the treasurer, being also in charge of the ore sales business of the company.

In addition to the general staff, there are district staffs on the various ranges, the district superintendents being W. J. Olcott for the Mesaba, O. C. Davidson for the Menominee, W. H. Johnston for the Marquette range, and J. H. McLean for the Gogebic. The local staff of the Oliver company for the Gogebic range is as follows: J. H. McLean, district superintendent; Frank Drake, chief engineer; Laurence P. Stevens, cashier; Wm. A. Cole, master mechanic. Mr. Drake, who has his headquarters in Ironwood, has been made chief engineer for the Oliver company, and will shortly remove his offices to Duluth, with the other general officials, whence he can best direct the extensive engineering operations of a corporation working mines in three states, on five separate ranges, and employing an army of men. In order to preserve the geographical continuity of the mine descriptions of the range, the properties of the Oliver company will be described separately, in order of their occurrence on the range, from east to west, the Ironwood, or Norrie group, following:

NORRIE.

The Norrie group, operated by the Oliver company, consists of the Norrie, East Norrie, Pabst and Aurora. The Norrie and East Norrie have always been worked as one mine, and since first opened the Pabst has been closely connected with the Norries, and operated under the same general management, though the accounting and shipments have been kept separate.

The Norrie produced 666,389 tons of ore in 1900, a slight falling off from the figures of the previous year. The mine has shipped a total of 8,962,170 tons of ore since it was first opened in 1885, and taking into

consideration its total production, which is exceeded only by the Cleveland-Cliffs and Lake Superior at Ishpeming, and the Chapin at Iron Mountain, all of which are older mines; the high average value and uniformity of its product, and its immense undeveloped ore reserves, the Norrie is perhaps entitled to rank as the greatest iron mine of the entire Lake Superior district John Luxmore is mining captain at the Norrie and North Norrie and D. E. Sutherland holds the same position at the East Norrie.

Surface improvements in the past year include a new machine shop, of brick and iron, 70 x 90 feet in size, and a new warehouse adjoining, 26 x 100 size, and also of brick and iron, both located south of No. 3 East Norrie shaft. The old machine shop and electric haulage plant were destroyed by fire in October, 1900. T he new haulage plant was placed in commission of July 15, 1901, and at this writing, after two weeks of operation, is working perfectly. The plan and plant were described at length in my last report, and the new plant is a duplicate of that burned, the underground system remaining unchanged.

A new shaft, of four compartments, has been started in the foot-wall, opposite No. 3 shaft. This shaft is 6x23 feet in size, inside measurements, and is now down more than 200 feet. From the collar of the shaft to the rock ledge the shaft is solidly timbered in the usual manner, but from the ledge down is "timbered" with steel, affording a decided novelty in this district, though a little experimenting with steel timbering has been done at the Pioneer mine, on the Vermilion range, in Minnesota. The wall-plates are made of 30-pound rail, with I beams for dividers, reinforced with angle-bars riveted in the corners. The use of steel makes a symmetrical and pleasing shaft, and one of great strength withal. The use of steel for staying and framing shafts and other mine openings has been suggested as a possibility for many years, just as the use of steel shaft houses and headgears was suggested for a decade or more before the first one was built. Steel shaft houses are now used almost exclusively in the Lake copper district, and will come into more general use in the iron regions, though the conditions of mining vary so materially in the two districts that steel is not always as well adapted to the requirements of iron mines as it is to the needs of the copper producers, the shafts of the latter being permanent, and intended for use during the life of the mine, which may be scores of years, while, from the nature of things, the shafts of the iron mines are frequently of a merely temporary or tentative nature. In the case of such a shaft as the new one being sunk at the Norrie, permanence is assured, and the best possible material and equipment is certain to be the cheapest in the end. If the iron mines can displace timber with steel they will not only find a new use for their own product, but will also relieve themselves of the growing burden of securing necessary supplies of heavy mining timber. As the upper peninsula becomes more fully developed the supply of timber suitable for mining work is growing smaller, and costlier. This increasing cost and increasing difficulty in securing near-by timber supplies is certain to continue, and the prospect of securing relief from the burden through the general use of steel is sufficient to insure the earnest attention of all progressive men in the iron regions, for whom the new shaft of the Norrie will possess deep interest.

The general plan of mining followed at the Norrie group remains the same as for some years past. The caving system is used wherever it can be applied to advantage, and is departed from only as unusual conditions render such a departure necessary. The mine is now opened on the twelfth level at the East Norrie and "B" shaft at the East Nome is now sunk to the eleventh level. The electric haulage system is working on the ninth level at the East Norrie, and will be extended to the Aurora, a connection having been broken between the mines. The water from the East Norrie is now syphoned to the Aurora, whence it is forked out. Drifts being necessarily driven with a slight upward slant from the shafts, in order to afford drainage, the connection between the two mines was reached at a point higher than the shafts, but the syphon takes care of the water easily. An auxiliary pump is kept in the East Norrie to handle the water in case the syphon fails to work, but so far has not been called on.

The Norrie is working a large force at the present writing, and this will be continued unless unfavorable developments in the east should require a curtailment. The mine, including the Pabst, will probably ship about 900,000 tons of ore this season.

AURORA.

The Aurora was opened in 1885, and ranks third in tonnage produced, being preceded only by the Norrie and Tilden mines. It has shipped in all 2,766,670 gross tons, of which the 1900 product amounted to 193,111 tons. The mine is controlled by the Oliver company, and is practically a part of the Norrie, having been recently connected with the East Norrie. The electric haulage system of the East Norrie is also to be extended to the Aurora, and the East Norrie water is now syphoned into the Aurora, whence it is forked to surface by a powerful pump, installed to handle the water from both mines. This pump, which is a triple-expansion Frescott, was set in the fifteenth level of the Aurora in the fall of 1900, and has a vertical lift of 925 feet. It is of capacity to raise 1,000 gallons per minute from a vertical depth of 1,000 feet. The mine is opened on the fourteenth and fifteenth levels and will probably get out about 250,000 tons this season. The system of hoisting will be changed to the combination cage and skip which has given such excellent results at the Tilden and elsewhere, and which will obviate extra handling of the ore on surface. Wm. Thomas continues at the property as mining captain.

PABST.

This property lies immediately east of the Aurora, and has been to all practical intents and purposes a part of the Norrie mine for many years, but having been

separated from the Norrie by the Aurora, has always been considered a separate mine. Inasmuch as the Aurora has been acquired by the Oliver company and is now connected with the East Norrie, the Norrie, East Norrie, Aurora and Pabst are now practically one mine, and, considered as such, form incomparably the greatest iron mine of the world. The Pabst is credited with a total output of 2,167,897 tons, of which 239,242 tons were mined last year. The entire Norrie group, now practically one mine, and operated by a single company, produced 1,098,742 gross tons of ore in 1900, and to the close of the century these properties have aggregated an output of 13,896,737 tons, an amount more than four million tons in excess of the total output of any other Lake Superior mine.

John Tregembo remains as captain at the Pabst, and there have been no changes of great importance underground or on surface within the past year. The ore above the ninth level is pretty thoroughly cleaned out, and the ninth level is now being opened. The production of the Pabst for the current year will be about the same as last year.

NEWPORT.

The Newport mine was opened in 1886, and has shipped a total of 1,934,176 tons of ore, reaching high water mark in 1899, when the output was 263,711 tons, the 1900 production falling off to 217,201 tons. The mine is operated by the Newport Mining company, of which Ferdinand Schlesinger is president; F. E. Woodbury, vice president; Fred E. Magdeburg, secretary, all with offices at 22 University Building, Milwaukee, Wis. J. R. Thompson is general manager, with offices at the mine, Ironwood, Mich. Thomas Oliver is mining captain, L. C. Brewer clerk and Robert Shand master mechanic.

The mine is at present employing a few less than 400 men, and is producing quite largely. A new warehouse 30 x 50 feet and a new carpenter shop, 20 x 45 feet on the ground, both of wood, have been built in the past year, the latter structure replacing the shop burned last year.

The present Newport mine consists of the original Newport, on the east, and the mine called the Bonnie when first opened. The shafts are lettered, instead of numbered, and run in order from west to east, "A" shaft being at the extreme west, next to the east line of the Pabst mine, while "K" shaft is at the extreme east end of the Bonnie portion of the mine. At the present writing, early in August, 1901, only the two end shafts are being sunk. "A" shaft at the west is being dropped to the eleventh level, a plat having been cut for the tenth level, though no drifting has yet been done on the tenth, and the lowest mining is on the ninth level. Recent developments at this end of the mine are of considerable promise, the Newport having apparently gotten some of the deeper ore bodies of the Pabst. The Newport end of the mine has been looking poorly for several years, and the discovery is of much promise for the future of the mine. Last year's production was mainly from the Bonnie end of the mine, but this season's mining is not so preponderatingly to the east as was the case last year.

"K" shaft at the extreme east, or Bonnie end of the mine, is also being sunk, and at present writing is sinking for the fourteenth level, mining being in progress on the twelfth level, while on the thirteenth level a drift has been started east, which is to traverse the entire length of the mine and eventually unite all of the deeper workings at this depth.

NEW DAVIS.

The New Davis mine was originally opened in 1887, as the First National, in which year one cargo of 1,997 tons was shipped. In 1890 it was reopened as the Davis, and a few years ago became the New Davis, being reopened by Ironwood parties, with Dr. J. H. Moore as president and manager of the company. The mine has produced only 59,310 tons all told, but has considerable ore in sight and could be made to give a large tonnage if the market warranted. Just preceding the opening of the season of 1901 the mine was taken over by the Wisconsin Manganese Ore company, of Milwaukee, which is now operating the mine under the general supervision of Mr. Geo. H. Abeel, with H. Whiting as mining captain. The mine was working nearly one hundred men in the earlier part of the season, but the force was nearly cut in half in July, and on Aug. 1 the property had about fifty men on its payrolls. The mine could probably furnish fifty to seventy-five thousand tons this season if the market warranted, but at present the demand is rather slack.

The mine has opened considerable bodies of ore, and is now producing a manganiferous ore that is extremely variable in its make-up, running as low as 6 per cent and as high as 25 per cent in manganese. The percentage of manganese is sufficient in even the lowest grade to render the ore desirable, while the better grade is exceptionally rich for the Lake Superior district. The ore, however, would be more desirable did it not fluctuate so greatly in the percentage of manganese carried, as it is difficult to guarantee entire cargoes carrying high percentages of manganese, and such ores are in good demand.

GENEVA AND ROYAL.

The Blue Jacket mine, which shipped 1,799 tons of ore in 1887 and then dropped out of sight has been renamed the Royal by the Oliver company, and, in connection with an adjoining tract, called the Geneva, is being explored by that company, with James Stanlake in immediate charge as mining captain. The Geneva and Royal have forty acres each, and lie immediately east of the New Davis, comprising the south half of Section 18-47-46. A shaft is being sunk on each of the properties, and lean ore has been found at the Royal. The shafts will

probably be sunk to the depth of about 500 feet each before any drifting or crosscutting is attempted, unless ore coming into the shaft at lesser depth should render it advisable to follow such a find. In view of the known geological conditions prevailing on the other side of the Newport hill, the developments shown by these shafts at considerable depth will be of deep interest. Taking into consideration the pitch of the successive strata of iron ore, held in the dikes of the Ironwood district, it is possible that the same ore measures, or a modification of them may extend some distance under and beyond the Newport hill, although such an extension must naturally be looked for at great depth, and it will prove costly work to locate the ore bodies. Fortunately the Oliver company possesses the means and the disposition to follow a promising quest as far as may be desired, and the developments at great depth, in the Royal and Geneva, will possess deep interest and be of positive value, whether they may prove favorable or the reverse.

JACK POT.

The Jack Pot lies between the Ironwood and the Bessemer groups of mines. In time there will be a continuous chain of mines from the Iron Belt district, west of Hurley, Wisconsin, to the Anvil, in the eastern end of the Bessemer district. A little exploring was done on what is now the Jack Pot tract about 1886, but the work was too desultory to accomplish any results, and it was not until 1892 that any important ore body was located, in which year 3,944 tons were shipped. A single cargo of 1,651 tons was shipped in 1893, but the panic of that year, which closed down even such magnificent mines as the Norrie, put the Jack Pot out of commission, and it was impossible to find anyone with sufficient capital and faith to take hold of a forty-acre tract in a new and little-known district, where but a trifling amount of ore had been produced. A small shipment of 1,265 tons was made in 1897, after which the mine remained idle until 1900, when work was resumed with vigor and discretion, a product of 33,893 tons being secured.

The Jack Pot is in the hands of Jones & Laughlins, Limited, of Pittsburg, a well-known iron manufacturing corporation, which has very close affiliations with the Lake Angeline company, of Ishpeming. Capt. W. J. Sincock, for many years at the Lake Angeline mine, is in charge as superintendent, with the officials of the Lake Angeline mine, is in charge as superintendent, with the officials of the Lake Angeline company acting in an advisory capacity, and the mine is developing in a very satisfactory manner. The ore is of high grade and the measures are increasing as depth is attained. It is working steadily and with a full force, and bids fair to become one of the important mines of the range when more fully developed.

COLBY.

The fee of the Colby mine is owned by a company consisting mainly of residents of the copper district and Detroit, but has been operated by a variety of corporations and firms since its opening, in 1884. The Colby was the first producing mine of the Gogebic range, and was also the pioneer steam-shovel iron mining proposition. It was a very large producer almost from the start, for several years, but in 1891 the eastern end of the property was set aside as a separate mine, and is now known as the Tilden, after which the Colby product fell off to the scattering class. It was last actively worked by Corrigan, McKinney & Co., who took it in 1896 and succeeded in getting out 152,875 tons in 1898, but the 1899 product fell to 103,239 tons, and in 1900 the output was only 32,572 tons, bringing the mine's total product up to 1,748,673 tons, a portion of which was taken from that part of the mine now operated as the Tilden. The lease has been thrown up by Corrigan, McKinney & Co. and the owners are now looking for a new lessee.

TILDEN.

The Tilden was originally the eastern end of the Colby, and was worked to some extent prior to 1891, in which year it was set off under the name it now bears, but the mine as it exists at present dates almost entirely from the time of cutting loose from the parent mine, ten years ago. The property was quite fully described in the last report on Michigan mines. The mine has produced a total of 2,821,191 tons, ranking second only to the Norrie among Gogebic mines. The 1900 output was 481,909 tons, a falling off of about four per cent from the high water mark, reached in the preceding year. W. H. Knight, who has proven himself an excellent mining captain, remains in that position. The mine is working about 625 men and from present indications will effect about the same production as last year. The mine is now one level deeper than a year ago, and the ore bodies remain large and satisfactory. No. 10, the new shaft begun in 1899, is the easternmost shaft of the property, although the old west shaft of the Palms, which was sunk partly on the Tilden's territory, is now in possession of the Tilden, and controls a long stretch of ground at the eastern end of the mine, between No. 10 shaft and the western boundary of the Palms.

No. 7 shaft house, burned in April, 1901, has been rebuilt upon a more substantial plan than formerly, and the shaft is now equipped with self-dumping skips in place of cages. The western end of the mine has been opened during the past eighteen months and manganiferous ore averaging about 1.75 per cent of manganese in cargo lots is being taken therefrom in considerable quantities.

The Tilden is operated by the Oliver company and is one of the best mines controlled by that company.

WEST COLBY.

The West Colby was originally opened as the Valley mine, by Hermann Nunnemacher and associates, of Milwaukee, in the early days of the Gogebic, and shipped a single cargo of 1,878 tons in 1886, after which

nothing was done at the property until eighteen months ago, when it was taken in hand by mining men of Ironwood and Ashland. In the spring of 1901 the West Colby Mining company was organized to take over the property, which was bought for $28,000 cash, $22,000 stock in the new company and a royalty of 10 cents per ton on all ore produced after the first hundred thousand tons. The new company is practically the same as the Ashland Iron & Steel company, which operates the Ashland furnace. The ore is of good quality and apparently of considerable extent.

PALMS.

The fee of this property is owned by Detroit parties, and the mine is operated by the Dunn Iron Mining company, of which Ferdinand Schlesinger, of Milwaukee, is president, with J. R. Thompson, of Ironwood, as superintendent, and William Rowe mining captain. The mine was opened in 1887 and has been a producer to greater or less extent every year since its opening, having achieved a total output of 1,110,680 gross tons, of which 139,658 tons were gotten out in 1900.

The ore averages about 55 per cent iron and .065 phosphorus, being a low-grade bessemer, which is not in as good demand at present as might be wished. The mine itself is not looking as well as it has in the past, but is by no means played out. At present there are about 65,000 tons of ore in stock, raised since the close of navigation in 1900, and the mine was entirely closed down July 19, 1901. If the ore on hand can be disposed of, the mine will be reopened this season, otherwise it will remain idle until a sale of the product is effected.

ANVIL.

The Anvil mine, lying next east of the Palms, was opened in 1888 and worked intermittently until 1896, in which year it closed, although several cargoes of ore were shipped from stock in 1898. It is now operated by the Newport Mining company, J. R. Thompson superintendent and Wm. Rowe mining captain. The mine has two shafts and produces an ore of about the same grade as the Palms. About 100 men are now working and a fair production will be secured this season if no reduction is made in the present force, as there is a considerable body of ore, which is being quite cheaply mined, and the mine is looking well at present. The total production of ore to the close of 1900 has amounted to 313,485 tons.

EUREKA.

This property lies east of the Anvil, which it adjoins, and was opened in 1890 and made its last shipment in 1896. It has produced a total of 128,719 tons of ore, and remains idle.

ADA.

The old Federal and Ironton mines, in the Bessemer district, were secured in 1899 by Messrs. Corrigan, McKinney & Co., of Cleveland, and were renamed the Ada, and a production of 25,047 tons was secured in 1900. Capt. Harry Whitburn, who has charge of the Corrigan-McKinney interests in the Gogebic territory, is superintendent. A fair force is being worked and the mine is shipping this season.

RUBY.

The Ruby, better known as the Puritan mine, adjoins the old Federal and Ironton properties, is under the same management and is practically an integral portion of the Ada.

MIKADO.

The Mikado was opened in 1895 and has been worked every alternate season since then. It is at present under lease to Pickands, Mather & Co., of Cleveland, with Chas. H. Munger, of Duluth, as general superintendent. The mine possesses a single shaft 750 feet in depth. The old shaft was found in bad shape by the present operators and has been retimbered and put in good condition. The ore is a high grade bessemer, and if the mineral body is as large as is now hoped, the mine has a prosperous future ahead of it.

SUNDAY LAKE.

There is great activity in the Sunday Lake district this season, and in consequence business is good at the little town of Wakefield. The Sunday Lake mine was opened in 1886, the same year as the Brotherton, and was worked in a small way for three seasons. Work was again resumed in 1890 and has since continued each season, with the exception of 1898. The mine is now in the hands of the Sunday Lake Iron company, of which Joseph Sellwood is president and general manager. The total production of the property has been 457,511 tons, of which 74,097 tons were shipped last year, this being the largest output ever secured from the mine. Barring unforeseen contingencies the product of the present season will be about 100,000 tons. N. B. Roscorla is mining captain and John L. Zoberlein clerk. The mine has two shafts, of which No. 1, the deepest, is now down about 700 feet. About 150 men are employed at present.

BROTHERTON.

The Brotherton mine is the principal property of the Sunday Lake district, although the Sunday Lake is at present working fully as strongly, and both properties will produce about the same amount of ore this season. The Brotherton was opened in 1888 and has been a shipper every season since, although closed for a time in 1893. The mine has shipped 827,556 tons in all, of which the 1900 output amounted to 89,804 tons, the largest

production ever secured, with the exception of 1892, when the product was 130,833 tons.

The mine is owned and operated by the Brotherton Iron Mining company, with Joseph Sellwood president and general manager. N. B. Roscorla is mining captain and John L. Zoberlein clerk, the management being the same as at the Sunday Lake, the adjoining property. The best interests of both properties have been conserved by the change in ownership which placed the Sunday Lake property under the same management, and practically the same ownership, as the Brotherton. In years past there has been constant friction between the owners of these mines, over the question of pumping. Early in their career the mines were joined by a drift broken through on a lower level, and this drift proved a bond that made the mines Siamese twins. Unfortunately their inclinations were usually as opposite as their real interests were identical, and the issue of who should fork out the water was always a sore point. The mines were formerly very wet, and the pumping charges nearly or quite devoured the profits of mining, but under the present management of the mines better pumps and less water have combined to eliminate the trouble that was formerly so grievous. The Brotherton plant cares for the water, which averages about one thousand gallons per minute, entailing a heavy pumping charge for mines of considerable depth. Fortunately the ore is of superior grade, so that the expense of operating is not proving too onerous. The Brotherton has three shafts, of which No. 1, sunk at an angle of 65 degrees, is the deepest, having been sunk about 700 feet. Naturally neither the Brotherton nor Sunday Lake is anxious to go deeper until the ore is pretty well removed from the upper levels, as the pumping costs increase rapidly with depth.

A new hoisting plant was installed in September, 1900, this being one of the best on the range, consisting of a Corliss engine with 22x48 inch cylinders operating three seven-foot drums—one for each shaft of the mine.

The Brotherton is looking well at present, and bids fair to grow in importance as a producer for some years to come. About 150 men are employed and 1901 shipments should reach 100,000 tons.

PIKE.

The Pike is a new mine located on the forty-acre tract next east of the Brotherton. It is owned by Capt. Pike, of Ashland, and is in charge of Alex. Johns. There is a single shaft and the Pike apparently has a continuation of the Brotherton ore body. The ore is of excellent grade, and is being shipped to the Ashland furnace. The first production was made in 1900, when 3,434 tons were shipped.

CHICAGO.

The Chicago lies next east of the Pike, and is an exploration controlled by the Oliver company under charge of Capt. W. J. Truscott. The work is being very thoroughly done by the Oliver people, and a crosscut was sent north for a distance of 286 feet, on the fifth level, in search of a continuation of the soft blue ore found in small quantity when the mine was first opened in 1896, in which year 504 tons of high grade ore was shipped. The desired ore body was not located by the crosscut, but a twenty-foot vein of lean ore was found and opened for a length of 350 feet. This ore body lies further north than anything found in any of the adjoining properties, but it is a question whether it will prove a merchantable ore, as it is high in silica and low in iron, and of non-bessemer grade. The Chicago produced 633 tons last season, but no attempt will be made to ship this year. Explorations will be continued, in search of the high-grade ore found five years ago.

METEOR.

The Meteor is the most easterly mine of the Gogebic range, although indications of iron ore are to be found beyond. It was opened in 1890 as the Comet, and worked in a small way until 1894, but on coming into the hands of Corrigan, McKinney & Co., was given its present astronomical title, differing slightly from its former appellation, but delightfully reminiscent of its earlier cognomen. It is in charge of Capt. Harry Whitburn and is now working about 80 men. The present indications are most promising. A new ore body is being developed, the apex of which was cut on the fourth level, the vein being between two and three feet in width at that point. On the fifth level, sixty feet below, the vein had widened to seven feet, and on Aug. 1st the same vein was cut on the sixth level, but its width cannot be determined until opened. The promise of this new find lies partially in its widening out at depth, but even more in its phenomenal purity, the assays so far secured running 67 to 68 per cent metallic iron with only .035 to .038 in phosphorus. Such an ore is a strictly fancy bessemer, of the grade that always has a market at good prices, in even the worst of times, and is of exceptional purity, being equal to the best ore yet found in the Gogebic district. Should the new ore body prove to be of considerable extent, as now seems probable, it will result in greatly stimulating exploratory work in the eastern end of the Sunday Lake field.

MARENISCO EXPLORATIONS.

The Oliver company did some exploring southeast of Ramsey, on the so-called Marenisco iron range, in 1899 and 1900, but stopped the work in the latter year. Holes were bored by the diamond drill and a number of pits were sunk, but as nothing of value was found, and as the indications were not promising, the work was abandoned.

COPPER.

CLARK.

The old Clark copper mine, near Copper Harbor, Keweenaw county, was reopened in the fall of 1900 for manganese, an ore deposit of that metal being known to exist in a fissure vein crossing the formation. Considerable work was done in the winter of 1900-01, as high as 75 men being employed, under the superintendency of Samuel W. Osgood, Jr. The mining results proved disappointing, the ore being found in the form of an impure pyrolusite, and occurring in small lenticular masses. Work was suspended in the spring of 1901, and there is little prospect of a resumption of activity.

WASHINGTON.

The easternmost copper property in the Keweenaw peninsula at which any mining or exploratory work has been done of late is the Washington, lying west of Mosquito Lake, where some trenching and other exploratory work has been performed under the direction of Capt. James Chynoweth, with John Ford in immediate charge. Considerable trouble was met from water, which poured into the deeper openings at a rate greater than the capacity of the exploring pumps to handle properly, so work was mainly confined to trenching, by which process several amygdaloids carrying copper were cut, but the best of the lot was not of great promise, and the finances of the company making it apparent that either an assessment or a suspension of work was necessary, the latter course was chosen as the best, and work was stopped on March 31, 1901.

ARNOLD.

Affairs at the Arnold have not shaped themselves to the wishes of the management, and early in the spring of 1901 the Arnold mine proper was practically closed down. The property of the Arnold company includes the Arnold and Copper Falls mines, the latter having been a dividend-payer at one time. The Arnold proper is opened on an ashbed bearing considerable resemblance to the ashbed amygdaloid on which the Atlantic is developed, and is possibly a continuation of the Atlantic lode. The dip is very flat, and the percentage of copper small. During the winter some attention was devoted to clearing out the old Copper Falls tunnel, which was much injured by a bad flood several years ago. At the present writing, in July, 1901, the Arnold company is employing less than 50 men, of whom about a dozen are working in the Arnold mine, the balance being at the Copper Falls, where a fissure vein is being opened. It is believed by Capt. Wesley Clark, the superintendent, that this fissure is a continuation— of the celebrated Owl Creek vein, from which the Copper Falls took the metal that paid its dividends many years ago. The production of refined copper secured by the Arnold company in the calendar year 1900 was 856,-000 pounds.

ASHBED, HUMBOLDT AND MEADOW.

These three properties have some shallow openings on the Arnold ashbed lode, but have not been worked for a year or more, and were never producers. The poor showing made at the Arnold mine proper is naturally a black eye for the Ashbed, Humboldt and Meadow, which as yet have nothing to show in the way of copper-bearing lodes other than the extension of the ashbed. As each possesses a considerable area, it is possible that further explorations, when undertaken, may reveal something of value in the way of amygdaloids or fissure veins, the Keweenaw county district being especially prolific in cupriferous fissures, the three mines named being located near the same district as that in which the celebrated fissures of the Cliff, Central and Phoenix were exploited to the dividend-paying stage. Apparently about the only show these mines possess of ever becoming active producers is through consolidation with the Arnold, and a reorganization of the Arnold company to give adequate funds for working on a large scale.

PHOENIX.

Keweenaw county has sadly fallen from the eminence it once attained in the production of copper, but there are at least two bright spots in the county at present, these being the Mohawk and Phoenix. The Phoenix was treated on at considerable length in my last report, since the issue of which the mine has been steadily developed, with gratifying results. The property of the Phoenix Consolidated company comprises three old mines, the Phoenix, St. Clair and Garden City, and embraces an estate of 2,505 acres.

The Phoenix is mining exclusively in fissures, which cross the stratified formation at approximately right angles. The work of reopening the old shafts, which were all sunk in the day when rule of thumb was used, has been attended by the usual troubles consequent upon crooked shafts and tortuous drifts, with rotted timbers and considerable debris blocking the bottoms of the shafts. This work has been undertaken with admirable patience and persistence, with results that are now favorably apparent. The kinks have been taken out of the shafts, new and substantial timbering set in place and improved methods of mining and hoisting adopted at all points. There was considerable salvage from the old Phoenix machinery plant, in the way of boilers, hoists, etc.

In the St. Clair shaft mining work has been continued steadily, the results proving highly encouraging, as considerable heavy copper has been secured, as well as a large quantity of stamp rock, the latter being stocked until such time as a mill is erected. The West Vein, or Robbins shaft, which was found in very bad condition, has been put in good working order, and is now

producing mass and barrel copper, as well as excellent stamp rock, from four drifts. An old hoist was found at the Crocker shaft of the Phoenix and was repaired in the shops. A two-ton skip has replaced the inefficient and uncertain bucket of earlier days, and the Robbins is growing to look like a mine.

In the way of new development work planned for the immediate future the breaking of the incline, on the slide at the St. Clair, through to surface, is the most important feature. The plan of opening pursued originally at the St. Clair shaft was a random one, and the result is that the rock must be twice trammed and twice hoisted, thus practically doubling the cost of raising. The extension of the incline through to surface seems the most feasible plan of providing for a single haul, and will be attended to.

Since October, 1900, the Phoenix has been a steady producer of copper to the extent of 13 to 20 tons per month, the product being exclusively in the form of mass and barrel work. The production of refined copper for 1900 was 88,206 pounds, secured in the last three months of the year, and will be much larger for the current year. The production of heavy copper has been sufficient to practically pay the expenses of operating and developing the mine, and has even left a small profit at times. This, in connection with the large amount of rich stamp rock stocked on surface and remaining underground for future stoping, renders a mill highly desirable. A survey was begun in June for a new mill, the topography of the Phoenix territory and the question of water supply being given careful consideration. The Eagle river flows through the Phoenix territory, and as this stream affords a considerable body of water in even the dryest periods, and also has a considerable fall in a few miles, it will be possible to secure all the water needed for a mill without pumping, and possibly to secure water power sufficient to run the entire mill.

A tunnel is being driven south from the St. Clair shaft on the fourth level, to prove the territory in that direction. On July 10, 1901, this tunnel had reached a distance of 1,725 feet, or practically one-third mile, south of the greenstone, passing through a number of beds of trap and amygdaloid, but not having as yet encountered a conglomerate.

The physical condition, income from production and prospects of the Phoenix are most gratifying to shareholders, and give promise of the development of a profitable mine in the near future.

MOHAWK.

Among the score or more of new and reopened mines of the Lake copper district, there is none giving greater promise of making a rich mine than the Mohawk. The Mohawk Mining company was organized in November, 1898, and took over the lands of the Fulton Mining company, on which a little mining had been attempted, but as the Mohawk was opened on an entirely different lode from any previously prospected, the mine is an absolutely new one.

The Mohawk mine is a duality in unity, in that it has two separate mines in one, both connected and workable from the same openings, yet as distinct mines and producing as different products as though opened many miles apart. The Mohawk was originally opened on the northern extension of the Kearsarge amygdaloid. This lode now rivals the Pewabic lode of the Quincy and Franklin mines for first place among the profitable amygdaloids of the district, though the Baltic lode is being developed at a rate that indicates possible pre-eminence in production within the next three or four years. The Kearsarge amygdaloid is now mined by the Osceola Consolidated company at the Kearsarge and South Kearsarge mines; by the Centennial company and by the Wolverine company, as well as at the Mohawk, and as the same lode underlies the Calumet & Hecla lands, it is probable that it will eventually be developed on that property as well.

Previous to the opening of the Mohawk mine explorations had been conducted on the Fulton property, as the tract now owned by the Mohawk was called, for the Kearsarge lode, but insufficient allowance was made for the deflection of the strike of the formation to the eastward, and the early pits were sunk too far to the west. The first discovery of the lode was made about 1896, when a wood-road was cut, this showing bright copper in a promising amygdaloid. Development work was undertaken in 1898, when the snow left, with results highly satisfactory from the start, and as it soon became apparent that a large mine would be opened, a corporation was organized and took over the lands. The stock was placed on the market at $7.50 per share, and unlike most of the new mines, has commanded a premium of nearly 100 per cent over subscription price even during the lowest ebb in coppers, in the spring and summer of 1900.

A large amount of work has been done at the Mohawk, and the mine is well opened. Early in 1900 a fissure vein was cut near No. 1 shaft. The fissure, where first opened, was only about six inches wide, but the weight and metallic luster of the contents making it evident that the mineral was an ore of some weighty metal, samples of the rock were sent to Dr. Geo. A. Koenig of the Michigan College of Mines, for assay, and were found by him to be an entirely new ore of copper, which he named "mohawkite" in honor of the mine where it was discovered. This seam of mohawkite has been followed for some distance, both laterally and in depth, and the vein has widened to a full three feet on the third level. As the fissure vein crosses the Kearsarge amygdaloid at nearly a right angle the opening of a mine on the fissure gives a separate mine, yet one which is connected with the original mine opened on the amygdaloid yielding native copper, while the mohawkite supplies an ore of copper which is inferior only to chalcocite (copper glance) in the percentage of metallic copper contained. As depth has been attained in the fissure vein the

composition of the mohawkite has been found to vary somewhat from the original assays. The original samples carried about 62 per cent of copper, 7 per cent of nickel, 28 per cent of arsenic and 2 per cent of cobalt, with traces of iron. Its chemical composition is much the same as that of domeykite and whitneyite, found in the Shelden & Columbian tract, at Houghton, except that mohawkite carries nickel as well as copper in the form of a compound arsenide. As depth has been attained in the fissure, the mohawkite has shown an unmistakable tendency toward the elimination of the nickel, which is now found in smaller quantities, while silver is also discovered with the copper, and antimony, so frequently associated with arsenic, is also found in small proportions. Some of the ore in the mohawkite fissure is so radically different from that first assayed that it has been termed a stibio-domeykite by Dr. Koenig.

The changes in the chemical composition of the mohawkite fissure vein are of greater interest to the chemist and metallurgist than to the miner or shareholder, as the percentage of copper remains about the same regardless of fluctuations in the other metallic contents, there being a slight gain in copper to partly offset the loss in nickel. As now running, it is safe to state that the ore from the fissure will average about 65 to 66 per cent metallic copper and 28 per cent arsenic, with 20 ounces of silver to the ton, and cobalt and antimony in small quantities. Two small cargoes of mohawkite were shipped to Swansea, Wales, for reduction, during 1900, and netted about $143 per ton. As this return was materially less than the assay value of the copper alone, it was thought best by the management of the mine to arrange for smelting in the United States, and an arrangement was consequently made with M. Guggenheim's Sons, one of the oldest smelting concerns in this country, by which a special smelter is now being constructed for the reduction of the mohawkite ore. The sulphur fumes from the Montana ores are bad enough to kill vegetation for some miles around the smelters, but the arsenical fumes from mohawkite would destroy animal and human life were the arsenic allowed to pass freely into the air. The smelter is being constructed at Hackensack Meadows, New Jersey, about 20 miles from New York city, and the arsenic will be saved by passing through a series of vaulted brick deposition chambers, on the walls of which the element will crystalize, and from which it will be scraped by workmen wearing respiratory masks. A contract has been made between the smelting firm and the Mohawk company, for three years from the completion of the smelter, calling for the supply of a minimum of 100 tons of mohawkite per month. The smelter will have a daily capacity of about seven tons, allowing for a maximum production nearly double the minimum tonnage guaranteed, and as there is now about 5,000 tons of mohawkite blocked out above the third level, with an unknown quantity below that point, there will be no difficulty in furnishing the quantity of ore contracted for, and it is probable that the smelter will be run to its full capacity. Several hundred tons of the mineral is now barreled at the mine, awaiting the completion of the smelter, which should be in operation in October.

The smelters have agreed to save the copper and a reasonable percentage of the arsenic contained in the mohawkite ore. The silver can also be parted from the copper by electrolytic treatment, but the antimony and cobalt will probably pass with the waste products. Whether the nickel will be saved or not depends upon the percentage of that metal and the difficulties met with in separating it from the numerous other elements in the ore. Mohawkite is a mineral of such complex structure, and possesses such a numerous collection of valuable elements that its smelting offers a variety of problems. It is certain, however, that the copper can be saved entire, and it is probable that the ingenuity of American metallurgists may be relied on to eventually secure the last particle of value although the ultimate perfection of saving may require a considerable amount of experimental work. The value of the copper contained in the mohawkite is very nearly $200 per ton, on the average, in addition to which must be figured the values of the silver, arsenic and nickel, and possibly the cobalt as well. The contract made with M. Guggenheim's Sons will allow the Mohawk company a larger percentage of values than was secured from the shipments to Swansea, as well as saving the ocean freights.

Early in July, 1901, a second fissure vein of mohawkite was discovered, this time near No. 2 shaft, between the fifth and sixth levels. Where cut this vein was about six inches wide, and in general appearance almost identical with the original fissure, when first found. It is as yet too early to speak with certainty of the value of this second fissure, but in view of the importance assumed by the first vein, the late discovery is certainly one of much promise.

A mill is being built for the Mohawk, near the mouth of the Tobacco river, on Traverse Bay, Lake Superior. The Hebard quarry railroad was bought by the Mohawk company at the same time as the millsite, and this road has been extended to the mine. The stone foundation for the new mill is completed and steel is on the ground for a portion of the framework, which will be of steel throughout. The mill is to be of four-stamp size, but will be fitted with two stamps and the necessary washing machinery at the start, and the two additional stamps will be set in place as needed. The two stamps with which the mill is to start will have a daily capacity of about 1,000 tons. It is probable that the mill will go into commission about the middle of 1902, after which the Mohawk will speedily become one of the most profitable of the new mines of the district.

WOLVERINE.

The Wolverine mine is sometimes called "the little Calumet & Hecla" by its admirers, and is worthy of the designation. Its progress, from 1894, when it was a mine with a dubious past and an uncertain future, has

been most rapid, and in the past seven years it has emerged from obscurity to a point where it now ranks with the Calumet & Hecla, Tamarack, Quincy, Osceola and Atlantic, as one of the permanent dividend-paying properties of the Lake Superior copper district. Its steady growth as a producer is shown by the following table, giving annual production in pounds of refined copper for the past five years:

Year.	Production.
1896	2,196,791
1897	2,316,296
1898	4,588,114
1899	4,500,373
1900	4,789,829

Starting production with a single stamp at the mine, the mill and its appliances being far from modern, the Wolverine expanded in 1898 by leasing one stamp at the Allouez mill, and despite the handicap of producing its mineral from two separate mills, both small, the property has earned an enviable position both as regards production, costs and profits. The Wolverine is making copper more cheaply than any other amygdaloid mine in the district, and when its new mill is completed will probably be in a position to turn out metal at a lower cost per pound than any mine of the Lake district with the possible exception of the Calumet & Hecla.

Work on the construction of a new mill was started in the spring of 1901. The site is opposite that of the Mohawk, on Traverse Bay, Lake Superior. The rock will be hauled over the Mohawk & Traverse Bay railroad, which is completed, though negotiations are now in progress that may lead to the actual transportation being done by the rolling stock of the Hancock & Calumet railroad. The superstructure of the new mill was started July 1. B. S. Shearer, formerly master mechanic at the mine, is in charge of the work at the mill, which will require the greater part of a year to finish. The new mill will start with two stamps, which can treat about 500 tons each, daily, as against an average of about 350 tons now crushed by each of the two stamps in use, so that an increase of at least 40 per cent may be looked for in the production of the mine as soon as the new mill is placed in commission. As there will also be a reduction in milling costs, the earnings of the mine will show an increase of nearly 50 per cent, given a continuation of the market prices of copper that have prevailed for the past two years.

Underground the mine was never looking better than at present. The reserves have been added to steadily, and the starting of the new mill will find the mine with more stopes than ever before. It is probable that a third head will be added in a short time after the new mill starts, and the mine can be made to supply the rock without undue crowding. Three heads in the new mill would more than double the productive capacity of the mine.

The Wolverine is paying regular semi-annual dividends of $2 per share, in addition to which the new mill is being paid for out of the surplus, which on July 1, 1901, had reached the handsome figure of $540,141.88. The eastern offices of the company are at 11 William street, New York, with John Stanton president and John R. Stanton secretary and treasurer. At the mine, Fred Smith, who has been in charge since it was a puling infant, is still the capable head of the property, and Willard E. Smith is mining engineer, with Chas. L. Noetzel clerk and cashier.

ALLOUEZ.

At the Allouez mine there, is practically nothing new since the issue of the last report. A little good copper ground has been found in the exploring shaft on the Osceola lode, but the showing as a whole is not especially promising. The advisability of reopening the old mine on the conglomerate has been considered by the management of late, but a decision to resume mining on that lode has apparently not been reached as yet. The mine might be made to pay on a seventeen-cent copper market, as it has paid tributors in the past, but working a mine to gut it, as tributors do, and working a property to conserve it, as well-informed and honest companies do, are two very different propositions.

CENTENNIAL.

Since the publication of my last report there has been no change of great importance at the Centennial, further than that the opening of a new mine on the Kearsarge amygdaloid is progressing steadily and with satisfactory results. An assessment of five dollars per share, amounting to an even half million dollars, was levied last February, and was well received by shareholders, it being felt that the money was needed for the legitimate development of the mine. The old shafts on the Calumet conglomerate are completely abandoned, which is much the best use that can be made of them. But little work has been done of late in the shafts on the Osceola lode, which are too good to be condemned, but not good enough to make a first-rate mine. They will be of use in furnishing auxiliary supplies of stamp rock when the new mine on the Kearsarge is fully opened, and in that way will be of some little value.

The showing on the Kearsarge amygdaloid is improving slowly but steadily as depth is attained, and the future of the mine is now brighter than ever before in its long and somewhat checkered career. There have been times when greater promises were made, but there is no tooting of horns at present, which is just as well. There was newspaper talk in the late spring of 1901 that some sort of an arrangement would be made between the Centennial and Arcadian companies, by which the mill of the latter would be used by the mine of the former, but these seem to have been either premature or unfounded—probably the latter. The Centennial company owns one of the finest unimproved millsites in the entire copper district, located on the eastern shore of Torch Lake, opposite the giant mills and smelters of the Calumet & Hecla. It is to be hoped that the development of the mine will soon warrant the construction of a new and modern mill. The mill now in use is very old, and while it serves the purpose of providing a considerable

revenue toward meeting the expenses of the property, it is not of the sort that earns dividends. The production of refined copper by the Centennial mine for the year 1900 was 892,500 pounds.

The management of the company is the same as last year, with H. F. Fay president, James Chynoweth superintendent, John M. Wagner clerk and John Pentecost mining captain.

CALUMET & HECLA.

In The last report of the Michigan Bureau of Mineral Statistics, issued less than a year ago, a very full description was given of this mine and its many marvels. In the present report no attempt will be made to retrace the ground then covered, but the events of importance which have since transpired regarding this mine will be briefly touched upon.

The work of retimbering No. 2 shaft, badly burned by the fire of May, 1900, has been completed, but was a more serious job than first anticipated, the work requiring the better part of a year.

The effect of the fire was plainly evidenced by the production for 1900, which was but 77,761,382 pounds of refined copper, a falling off of 13 2-3 per cent from the output of the preceding year.

The development of a mine on the Osceola amygdaloid, paralleling the real Calumet & Hecla opened on the Calumet conglomerate, has been interrupted and begun anew twice in the past year. The mine was opened more rapidly than the machinery manufacturers were prepared to furnish equipment, and the delays of the latter have been very annoying. A large number of men were laid off in the fall of 1900, from the amygdaloid shafts, and while the force was again increased a few months later, a second reduction was required in the spring of 1901. There are about 20 miles of drifts and shafts opened on the amygdaloid, making a monstrous mine, second only to the Quincy among the amygdaloid mines of the district, and this mine should be able to turn out fifteen to twenty million pounds of refined copper annually, after once placed in commission.

In addition to the delays caused at the new shafts by the belated arrival of necessary machinery, many annoying stoppages have been caused in the construction of the new mill from the same reason. The new mill, which is to have six Leavitt heads, is being built as an annex to the southern end of the Hecla mill, at Lake Linden. This is now enclosed end good progress is being made, but it is still unsafe to set even an approximately accurate date for its going into commission, as further vexatious delays may arise, and in view of the history of the past three years, a promise for the delivery of building material or machinery on a specified date must be taken with several grains of salt. The excuses of the manufacturers are always good—and they are nearly always forthcoming, for prompt delivery is the exception, and delay the rule.

On July 1, 1901, the local management of the mine was changed, Mr. James MacNaughton succeeding S. B. Whiting and S. D. Warriner, on that date, under the title of superintendent, the position of general manager having been abolished, while three assistant superintendents were appointed to aid Mr. MacNaughton, in place of the one previous occupant of that place. Mr. MacNaughton was an employee of the Calumet & Hecla in the engineering department, in a subordinate position, when a very young man, in the middle eighties. From that place he went to Iron Mountain, where he began as engineer under C. H. Cady's superintendence of the Chapin mine. His rise was steady, and for several years he has been at the head of the Chapin, which was in 1900 the largest iron ore producer in the state. Mr. MacNaughton's management of the Chapin was brilliantly successful, and his friends feel confident that the successes achieved by him in the iron district will be repeated, upon an even larger scale, at the Calumet & Hecla.

The change in management has been seized as an apt opportunity for the making public of some harsh criticisms of the Calumet & Hecla company, its officials, policy and mine. To say that the management of the mine is beyond criticism or that no mistakes have been made, would be doing violence to the truth., for mistakes are common to even the wisest mine managements, and in the case of so prominent a mine as this, the mistakes which would be buried or overlooked in a smaller mine are apparent to all. One of the causes of criticism—which is almost as old as the mine itself—is in the alleged wasting of money for machinery that is claimed to be unnecessary, or useless. There are two points of view regarding this matter, one of which—that of the critics—is from the ground that it is the duty of the management to make as much copper for as small a cost as possible, and divide all the profits among the shareholders. The second point of view is that taken by the management of the corporation, the policy of which, despite all announcements to the contrary, is the same as it has been for a quarter of a century past. This policy is to effect a large production, at as low a cost as is consistent with good wages and the safety of men and mine. Many experiments have been made in equipment, and costly machines have been received to never turn a wheel, or to go to the boneyard after a few months' trial. This policy has cost the company vast sums, but it has also been the means of advancing the mining and machinery practice of the Calumet & Hecla, and of the district as a whole., until it is now generally conceded that in most important respects the copper mines of Michigan lead all the mines of the world. The policy of the Calumet & Hecla is not beyond criticism, but the liberal scale of wages paid by this property from the first; the noble generosity with which it has maintained hospitals, libraries and similar institutions; the many benefactions it has showered upon employees, and the manner in which it has aided in advancing mining practice in the district—all this and more are understood and appreciated by the people who have come in

contact with the company, and should protect the management from at least a portion of the criticisms recently directed at it.

TAMARACK.

The most important development of the past twelvemonth at the Tamarack has been the successful bottoming of No. 5 shaft. This work is worthy of more than parsing mention, owing to the magnitude of the task and the highly successful manner in which the work has been carried out from its inception. The Tamarack mine was originally opened by No. 1 shaft, a vertical opening cutting the Calumet conglomerate at a depth of 2,270 feet. This shaft, planned by the genius of the late John Daniell and sunk by the cash of Messrs. Clark, Bigelow and their associates, was a great success, and quickly placed the Tamarack among the big mines of the district. Shortly after the first shaft was successfully bottomed, a second was started, not far distant, to give safety and ventilation, as well as to open new ground. Both these shafts were in a corner of the Tamarack property, having been located nearest the outcrop in order to reach the lode at the least possible distance. Two additional shafts were sunk to the north and east, but 120 acres of property on which these latter shafts were located were set aside as the Tamarack Junior mine, which was consolidated with the Osceola in 1897. Two additional shafts, known as Nos. 3 and 4, were started some distance north of the original shafts, and these, known as the North Tamarack shafts, were bottomed in 1894 and 1895. No. 3 proved disappointing, and work at No. 4 was stopped after the shaft reached the conglomerate. As the mine was more fully opened, No. 3 shaft improved somewhat, and has been a large producer for some years, but its rock has never averaged anywhere near the richness of the older shafts or the workings of the Calumet & Hecla. An improvement in the percentage of copper has been noted, and the copper course is making in such direction that much good ground will eventually be opened under No. 4. The end of the mine has been and will continue a large producer, but, as before stated, is under the average of the lode.

When No. 4 was bottomed, under discouraging circumstances, it was decided that a fifth shaft should be sunk, midway between 3 and 4 at the North Tamarack, and the two original shafts. After giving careful consideration to the trend of the copper courses existing in the Calumet & Hecla, the site for the new shaft was located in a, swamp about midway between the old and new shafts, but at a point requiring a very deep opening to cut the lode. The eastern and local management of the mine has always held great hopes in this shaft striking the conglomerate rich, but, naturally, no great stress was placed on this hope in public statements, as disappointments are frequently met with in mining. The first sod for the new shaft, known as No. 5, was cut in August, 1895, and a few weeks later Capt. W. E. Parnall, superintendent of the mine, stated in a letter to the eastern office that in his opinion the shaft would cut the lode about Christmas, 1900, at a depth of approximately 4,650 feet. The conglomerate was actually reached at midnight, Dec. 20, 1900, at a depth of 4,657 feet, a most remarkable verification of Capt. Parnall's estimates.

The hopes of the Tamarack management have been made good by the developments in No. 5, the conglomerate being found rich in copper where cut. At the present writing, in July, 1901, ground is being opened both above and below the point of intersection of the shaft and lode, and there will soon be sixteen drifts ready for stoping, on four levels above and four below. The machinery plant and buildings on surface are receiving the finishing touches, and the shaft will begin regular production before the close of the year.

No. 5 shaft is now approaching 5,000 feet in depth, and will eventually exceed a mile. It is already the deepest shaft on the globe, having passed the Red Jacket vertical of the Calumet & Hecla in June, 1901. Its capacity will be very great, probably nearly equaling that of the balance of the mine. The plant is a very complete one, and has received hearty commendations from mechanical and mining experts. That No. 5 shaft 3 will add 50 per cent to the productive capacity of the mine is a reasonable prediction, and, taking into view the richness of the rock and the great capacity of the shaft, it is within the range of possibility that the operation of No. 5 will eventually double the productive capacity of the mine and place the Tamarack where the Calumet & Hecla was some ten years ago.

The eastern and local management of the mine remains unchanged.

OSCEOLA.

The Osceola Consolidated Mining company owns and operates four separate mines in the Calumet district, these being the Osceola proper, opened on the Osceola amygdaloid; the Tamarack Junior, opened on the Calumet conglomerate, and the Kearsarge and South Kearsarge mines developed on the Kearsarge amygdaloid. In the Osceola proper, the northern end adjoining the Calumet & Hecla is largely worked out, and the developments of the past few years have been toward the south, numbers 5 and 6 shafts now being the principal producers. The percentage of ingot copper obtained from the old Osceola ran very low during the latter part of 1900 but has since shown again. The mine has large reserves and it is safe to say that at the present time it is a better property than ever before in its history.

The Tamarack Junior has 120 acres, underlaid by the Calumet conglomerate, but only a portion of the conglomerate lode is rich enough to pay for working, although the proportion of well mineralized ground has proven larger than was at first thought. The Tamarack Junior is nearing an end of its productivity, although there is sufficient rock in sight to last for some years to come. It is possible that the two vertical shafts by which this mine is developed may eventually be dropped through to the Osceola amygdaloid, which underlies the

conglomerate, but this is at present a mere matter of conjecture.

The Kearsarge is a large property comprising 1,120 acres of ground, the major portion of which is underlaid by the amygdaloid taking its name from this mine. The developments of the past year at the Kearsarge have been highly satisfactory.

The South Kearsarge consists of 160 acres in the southwest corner of Section 7, 56-32, lying immediately south of the Wolverine and east of the Centennial. The mine is opened by two shafts on the Kearsarge lode and is making a good showing of copper.

The milling plant of the Osceola consists of six stamps in the old mill and three stamps in the new mill that went into commission two years ago. A third mill is now being constructed, of sufficient size to accommodate four stamps, with jigs, slime tables, etc., though it is now planned to start this mill with three heads only. The new mill is entirely enclosed and a considerable part of the machinery in place, but it can scarcely begin regular production until nearly the close of the year. The new shaft at the Kearsarge and the new mine at the South Kearsarge will then be in condition to afford considerable rock and will enable the Osceola to profitably employ its full stamping capacity.

For the calendar year 1900 the gross receipts of the Osceola company were $2,136,253.02 and the total costs were $1,559,538.34, leaving a net income of $576,714.68, out of which earnings were paid dividends number 49 and 50, amounting to $571,200. During the year the company received $188,011.89 from the sale of treasury stock, and $20,000 from the Centennial Mining company for a small triangular tract of land in the southwest corner of the South Kearsarge, which was required by the Centennial to secure the outcrop of the Kearsarge amygdaloid. Among the expenditures during 1900 was an item of $89,405.44 for the construction of the new mill and another item of $99,561.97 for the sinking and construction work at the South Kearsarge. The company had 4,000 shares of treasury stock on hand Jan 1, 1901, the proceeds from the sale of which will be used in new construction work.

During the year 1900, the rock mined amounted to 836,372 tons, while the rock stamped was 683,066 tons and the quantity of mineral obtained therefrom was 17,166,715 pounds, the stamping cost per ton amounting to 27 20-100 cents. The total number of feet of shafts sunk was 1,861 feet, and 7,156 feet of drifts were opened in the Osceola proper; 3,465 feet of drifts were driven on the Kearsarge and 502 feet in the South Kearsarge, while 758 feet of drifts were opened in the Tamarack Junior. The total number of feet of openings of all kinds at all four mines amounted to 18,552 feet. This large amount of opening work, which more than offsets the old workings exhausted, in addition to the entirely new work at the South Kearsarge, has added materially to the stoping ground held in reserve at both the Kearsarge and Osceola mines.

At the Kearsarge the new No. 3 shaft has now reached a great depth and is about to go into commission, having been equipped with an excellent hoist and combination rock and shaft house. It is the intention to eventually abandon No. 2 for hoisting purposes, although it will be kept open for ventilation and emergencies.

At the South Kearsarge a large rock house has been built at No. 1 shaft and is connected by a trestle 1,100 feet in length with No. 2. This trestle was nearly completed when struck by a heavy wind storm, and completely demolished, late last year. It has been rebuilt on a stronger plan and is not likely to go up in the air again.

A. S. Bigelow is president and W. J. Ladd secretary and treasurer of the company, with offices at 199 Washington St., Boston, Mass. Wm. E. Parnall is superintendent and William C. Watson assistant superintendent at the mine.

TECUMSEH.

The Tecumseh Copper company owns 560 acres in Sections 27, 32, 33, and 34 of 56-33, lying immediately south of the Osceola. It is capitalized at $2,500,000, having 100,000 shares, of which 45,041 shares were in the treasury for development purposes, at the close of 1900, at which time the company had on hand a cash balance of $15,726. The expenditures during, the year 1900 were $56,478.

A great deal of money has been expended on the Tecumseh in the past, with discouraging results. A number of deep shafts have been sunk and several of the copper bearing beds of the district opened to a considerable extent, but, while the formation is apparently regular and strong, the copper has been lacking. At the present time, the Osceola amygdaloid is probably the most promising of any of the cupriferous beds on the Tecumseh property, but the amount of copper shown in the shaft is very small. No. 6 shaft of the Osceola. which is only a quarter mile north of f the Tecumseh line, is one of the best in the Osceola mine, and it is possible that were the Tecumseh shaft on the Osceola amygdaloid to be sunk to an additional depth of 1,000 feet, as suggested by Capt. Chynoweth, favorable results would be secured.

It has been rumored that an assessment would be levied on the stock of this company, but the report has been denied by officials. There have also been some negotiations conducted with a view to disposing of a part of the mineral lands owned by the company, which are so located that they would be of some value to a mine opened on the east end of the property, but as yet no sale has been effected.

MAYFLOWER.

The Mayflower Mining company owns 840 acres in Sections 7 and 8, 56-32, south and east of the Kearsarge, Wolverine and South Kearsarge mines, and

located so far to the east that the Kearsarge lode does not outcrop on its land. The officers of the company are, H. F. Fay, president; W. B. Mosman, secretary and treasurer; Jas. Chynoweth, superintendent; Jas. Biscombe, mining captain. The Mayflower lies immediately north of the Old Colony and the conditions at these properties are much the same, in consequence of which the tunnel now being sent west from the Eastern sandstone is of nearly as great value to the Mayflower as to the Old Colony.

The total expenses of the Mayflower for the year 1900 were $58,630, of which amount $34,189 was for mining costs, including labor and material. The development work at the mine for the year ending Feb. 28, 1901, was 1,674 feet. Exploration on what is called the Isle Royale amygdaloid was carried 258 feet, but results were not satisfactory. The sandstone shaft near the southeast corner of Section 8 was abandoned at the shallow depth of 62 feet. The Faull shaft, which is the principal one on the property, was sunk to a depth of 380 feet, and a crosscut has been driven west from the second level of this shaft for some distance. The most encouraging feature met with at this property for some time, has recently been found at the northern end of the property near the Traprock river, where a promising amygdaloid was uncovered a few weeks ago.

OLD COLONY.

The Old Colony Mining company is a twin of the Mayflower, but is of somewhat larger area, having 1,200 acres, of which upwards of 1,000 acres are located on the mineral belt, the balance overlapping on the Eastern sandstone. A tunnel is being driven from the sandstone on the east entirely through the Old Colony tract, and at this writing, July, 1901, is about 2,300 feet in length. The officers are the same as those of the Mayflower, and the property is under the superintendency of Jas. Chynoweth, with Jas. Biscombe of the Mayflower in charge as mining captain. The tunnel passed through a somewhat broken country for the first thousand feet, when a strong and wide conglomerate was cut. It is probable that there is very little of value towards the eastward of this conglomerate, owing to the greatly disturbed condition of the strata in this section.

For the year ending Nov. 30, 1900, 610 feet of shafts were sunk; 1,203 feet of tunnel were cut; 292 feet of crosscutting opened and 452 feet of drifts driven, giving a total of nearly one-half mile of openings. The pump shaft was abandoned at a depth of 230 feet, from which 180 feet of drifting were done. The amygdaloid on which this shaft was sunk carried a small quantity of fine copper, but did not give promise of developing into a paying proposition. The tunnel shaft is located about 150 feet west of the mouth of the tunnel, and has been sunk 336 feet in the conglomerate. Occasional patches of well mineralized ground were found in this shaft, but owing to the disorganized condition of the various strata, the shaft can hardly be considered one of great promise.

Near the northern boundary of the property an amygdaloid lode has been opened by what is known as the North shaft, and some drifting and crosscutting has been done from this shaft. The copper contained in this amygdaloid is exceedingly fine.

The tunnel is now more than half way across the property and the developments to date have been mainly of a negative nature. It is to be hoped that copper bearing lodes of greater promise may be discovered on the western half of the Old Colony tract.

ONECO.

Work at the Oneco property was suspended in November, 1900, and was resumed on a small scale in July, 1901. There have been no developments of any importance since my last report.

RHODE ISLAND.

This property consists of 800 acres, all on the mineral belt and lying north of the Franklin Junior. The tract carries the Osceola, Calumet & Hecla, Allouez, Mesnard and Pewabic amygdaloids, in the order named, from east to west, in addition to which there is an unnamed amygdaloid known locally as the "west vein." The mine is opened on the Pewabic lode, which at that point is narrow and not overly rich in copper, showing much the same characteristics as in the Franklin Junior, immediately to the south. The mine has two shafts on the Pewabic lode and a third shaft on the Allouez conglomerate, which parallels the Pewabic at an approximate distance of 500 feet to the east. In the middle sixties three shallow shafts were sunk on the conglomerate, these being connected on—the first, or twelve-fathom, level. The central shaft was 140 feet in depth, bottomed in a wide but barren lode.

A narrow amygdaloid, running from five to six feet in width, has been cut 42 feet west of the Pewabic lode, in a crosscut driven from the third level of No. 1 shaft. This lode carries considerable copper and is worthy of further attention. It is intended to crosscut to the Allouez conglomerate from the fifth level of No. 2 shaft. A considerable amount of heavy copper has been hoisted in the past few weeks, and at the present time the showing at the Rhode Island is more satisfactory than it has been since the shafts were first started. The mine is equipped with a small but complete machine shop, and has a machinery plant well adapted for exploratory and development work. The company at the close of last year had on hand the sum of $82,537.78, which will be sufficient to continue work on the present scale for the balance of the year, or longer. T. Henry Mason is president and W. R. Todd secretary and treasurer of the company, with offices at 45 Broadway, New York, and Capt. Thos. Dennis is superintendent.

ARCADIAN.

The Arcadian Copper company is capitalized at $3,750,000 under the laws of New Jersey, having 150,000 shares. The board of directors consists of H. H. Rogers, Wm. Rockefeller, Wm. A. Paine, A. C. Burrage, C. D. Burrage, Sidney Chase, N. F. Leopold, H. G. Forman and Jas. B. Dill. H. H. Rogers is president, and N. F. Leopold general manager, Robt. H. Shields being superintendent at the mine.

At the present time the mining work at the Arcadian is mainly confined to "A" and "B" shafts, at the Douglass, or southern end, of the mine, and to the two St. Mary's shafts, opened on the Mesnard epidote. The copper is heavier and more frequent at the south end of the Arcadian property than in the northern shafts, and within the past two months some excellent ground has been encountered in the epidote shafts, with the result of materially increasing the production of the mine.

The Arcadian owns an immense area of ground on the mineral belt, and while its original openings have not made good the hopes entertained of them, the tract is so vast that it would be very unwise to condemn the property as valueless because of unsatisfactory developments secured on a single lode. At the St. Mary's shafts there is a considerable proportion of heavy copper, in the form of small masses and barrel work. The Mesnard epidote is a narrow lode, but at points is very rich. The Arcadian tract carries the northern extension of the Pewabic and allied amygdaloids, to which some attention will be given.

There are two shafts at the St. Mary's branch of the Arcadian, opened on the epidote, both of which are now sinking below the fourth level, with drifting and stoping on several levels of each. The hoists at these shafts are good for a quarter mile each. Two stamps are now in commission at the mill and a diamond drill is in use exploring the territory to the west of the Mesnard epidote. The property is being managed with great economy and recent developments at the epidote and at the Douglass end of the Arcadian are of considerable promise.

FRANKLIN.

The mineral property of the Franklin Mining company consists of the old Franklin mine, immediately north of the Quincy, and of the Franklin Junior, formerly known as the Peninsula and as the Albany & Boston, three miles north of the old mine. For the past fifteen years the old Franklin has been on its last legs, according to the general supposition, vet the old mine continues to turn out a large amount of copper rock and is apparently good for several years to come, though in the nature of things an end must come in time, as the deeper reaches of the Pewabic lode, on which the mine is opened, are cut off by the boundary lines of the Quincy company, which now owns the territory to the south, west and north of the Franklin.

An amygdaloid, known as the "West lode," was cut in the old Franklin some six months ago, and was found to contain a considerable amount of copper. High hopes were based on the future of the old mine, because of this discovery, but the developments on the lode to date have not been as satisfactory as was hoped when the new amygdaloid was cut. At the Franklin Junior mine, operations are still continued on the Pewabic amygdaloid, or what is generally supposed to be such, and also on, the Allouez, or Albany & Boston, conglomerate. It is known that there is a very rich chute of copper-bearing ground in this conglomerate at one point on the Junior property, though the average of the lode runs considerably below one per cent, or at least so ran in the past, when worked. The single shaft now working on the conglomerate is turning out about 250 tons of rock daily, and this amount will be increased in the near future. The Franklin does not make public its monthly production, but the figures are allowed to leak out, hence, it is impossible to say just what percentage of ingot is being secured at the present time, but it is stated by the management of the company that the conglomerate is giving very satisfactory returns.

The production of the Franklin for 1900 was 3,663,710 pounds of refined copper, showing a very large gain over the figures of the preceding year, when the new mill was in commission for less than six months. The mill is running three stamps and is giving economical and satisfactory results.

A syndicate headed by Mr. T. J. Mays of Houghton is working a reduction plant on the old Franklin sands opposite Houghton. In this plant there are four circular slime tables operated on the Emmons sludge process, also five Hodge jigs, with crushers, etc. The plant has not been in operation sufficiently long as yet to allow the forming of an accurate opinion as to its probable success, but it is certain that the old sands contain a considerable percentage of copper, and it is to be hoped that the operations will be successful.

The officers of the Franklin Mining company are F. H. Raymond, president; Daniel L. Demmon, secretary and treasurer, with offices at 19 Congress St., Boston. The local officials are Joshua D. Hosking, agent; Arnold Jaehnig, clerk; Thos. Kelly, mining captain at the old Franklin Nicholas Clymo, mining captain at the Junior; John Daniell, mining engineer, and Edward Warne, mill superintendent.

QUINCY.

This magnificent old mine, which for the past generation has been among the largest and most profitable of Michigan copper producers, has taken a new lease of life, and, at the present time, is producing an average of 1,200 tons of mineral per month, equivalent to about 20,000,000 pounds of ingot copper. The production of refined copper at the Quincy for the year 1900 was 14,116,551 pounds, a slight falling off from the output of the preceding year.

The officials of the company are T. Henry Mason, president; W. R. Todd, secretary and treasurer; W. A. O. Paul, assistant secretary and treasurer; with offices at 45 Broadway, New York. The local officials are Samuel B. Harris, agent; John L. Harris, assistant superintendent; Angus McDonald, clerk; Thos. Whittle, mining captain; Con Bedell, mill superintendent, and C. E. Brackenbury, mining engineer.

The extensive improvements begun four years ago are now completed, although in the case of a mine so large as the Quincy, there will always be something doing in the way of construction work. The improvements begun in 1897, and now completed, were planned upon a very large scale, and included betterments in every branch of the work, both underground and on surface. The new No. 7 shaft is in highly productive ground, and in every way successful. The new Mesnard shaft at the northern end of the mine is now more than 1,000 feet in depth. The upper levels of this shaft pass through lean ground, but the lower levels are decidedly better in appearance. The new stamp mill is now in full commission, the third and last stamp having been set at work on January 9, 1901. Among the other new work at the mine is a new stone blacksmith shop, 50 x 124 feet, with a wing 50 x 90 feet, fully equipped with the latest and best tools. This is one of the best shops in the district and a model in every respect. A large new warehouse was erected in 1900 at Hancock, and also a new wharf, 40 feet wide by 416 feet in length. A 60-ton Brooks locomotive and 24 rock cars of 18-tons capacity each have been added to the railroad equipment. The company is now planning the construction of new coal wharves at the millsite on Torch Lake. The building of coal sheds at this point will necessitate the payment of ten cents per ton tolls to the owners of the Torch Lake canal, but, on the other hand, will enable the Quincy company to transport all its fuel from the wharves over its own railroads.

Much interest was aroused last winter by the finding of two new amygdaloid beds to the westward of the Pewabic lode, on which the mine is opened. A crosscut driven west from the mine on the forty-fourth level intersected both of these lodes, the farthest, distant some 300 feet from the Pewabic lode, being the so-called "West Vein." Crosscuts were also driven from this lode at the thirty-sixth, thirty-ninth and fortieth levels and quite an amount of drifting was done, but the lode did not prove as rich as was indicated by its showing where first cut, and it probably will not be developed.

The fourth furnace has been built at the smelting works, and the smelter is now prepared to take care of the largely increased production of the mine.

An improvement at the mine, which will probably have a far-reaching effect, is now contemplated, this being the installation of electric haulage for underground tramming. It is probable that trolley lines will be installed to furnish power for electric locomotives, although storage batteries may possibly be used. The locomotives will probably be capable of handling four tram cars, carrying four tons of rock each. Electric traction has been used underground for some years at the Cleveland-Cliffs Lake mine in Ishpeming, with excellent results, and an electric haulage system was installed last year at the Norrie mine at Ironwood, and at the Aragon mine, on the Menominee iron range, compressed air has been used for some years to handle the tram cars. The iron mines of the Lake district have been in advance of the copper mines in this matter, the latter continuing the obsolete plan of doing all tramming by human labor.

The receipts of the Quincy company for the year 1900 amounted to $2,353,416.54 from the sales of copper and silver, in addition to which the sum of $10,113.45 was received from interest, and $11,008.79 from real estate sales in Hancock. The total operating expenses were $1,319,792.81, leaving a mining profit of $1,033,623.73. The expenditures for construction account during the year amounted to $604,870.91, giving a net income for the year of $449,875.06. The dividends paid during the year were $900,000 and the balance of cash assets in January 1, 1901, was $757,817.20. Inasmuch as the heavy expenditures for construction account are practically at an end, and the production of the mine is at present nearly 50 per cent larger than last year, with high prices ruling for the metal, the net earnings of the Quincy for the year 1901 will probably be much the largest in the history of the mine, and as the company has a substantial cash surplus, it is probable that the net earnings will be satisfactory to the most critical shareholder.

The average force employed at the Quincy for the year 1900 was 1,366 men, of which number 433 were miners, the balance being trammers, mechanics, surface laborers, mill employees and office men. The wages of the miners working on contract averaged $62 per month. The yield of mineral per fathom of ground broken was 512 pounds, and the yield of refined copper per fathom was 391 pounds. The percentage of ingot copper per fathom of rock broken is the smallest in the history of the mine, with the exception of the year 1872, when the figure was precisely the same. The highest percentage of yield in the history of the mine was in 1883, when the average yield per fathom of ground broken was 850 pounds. The average earnings of the miners during the year 1900 were the highest in the history of the mine, with the exception of the year 1873, when the monthly wages of miners on contract averaged $62.42. The total number of tons of rock mined was 650,545, of which amount 590,166 tons were hoisted and 555,723 tons were stamped. The production of mineral for the year was 13,818,830 pounds from the stamp mill and 4,772,919 pounds from the rock house, the latter being the heavy copper hoisted in the shape of mass and barrel work.

ISLE ROYALE.

This fine property, a consolidation of three old mines lying just south of the village of Houghton, became a producer in May, 1901, and the results secured in the

two months since the first head was started are highly pleasing, and a vindication of the good judgment of all who have maintained faith in this mine and its management, through good and through evil report.

The lands owned by the Isle Royale company include the Isle Royale, Grand Portage and Huron mines, which produced, collectively, nearly 50,000,000 pounds of refined copper before the mines were absorbed by the present consolidation in 1897. In addition to these old mines, the Isle Royale lands include the tracts known as the Frue and Dodge, on which some desultory exploring was done many years ago, and a large amount of land to the southward, reaching well to the north line of the Baltic mine. The Isle Royale company also has a long term option on the mineral rights underlying the Montezuma tract, the surface of which has been platted and largely sold for residence purposes by the Shelden & Douglass estate.

The work of making a big new mine out of several old ones has been done very thoroughly, the job taking much more time and money than has ever before been devoted to such a task in the district. The management has been criticised at times by impatient shareholders, or others desirous of enjoying the advantages certain to accrue to local business interests from the regular working of the mine, but the carping of the fault-finders is effectually answered by the magnificent mine and equipment secured through the lavish expenditure of time and cash. The Isle Royale end of the mine was first attacked, and this has been developed by two new shafts, which have been sunk to greater depth than the mine was previously opened. Several miles of drifts suitable for stopes have been driven, and the mine is opened much further ahead than is customary. The benefits of such a policy are plainly seen in the operation of the mill, the mine being so largely opened that it is possible to supply the three heads with an average quantity and quality of rock without straining, or robbing the reserves in a pinch.

The mill is located on the southern shore of Portage Lake, about two miles west of Houghton and a short distance east of Snowshoe Island. The lake is rather shallow in that vicinity, and the sands will fill rapidly, but to offset this the mill is located some thirty feet above the water-level and has a very long frontage, while the channel is so far out in the lake that it will not be interfered with for many years. The new mill was quite fully described in my last report, and now that it is in commission I find that the pleasing prophesies regarding its efficiency are being fully verified, although as yet the heads are stamping only about 450 tons daily, though this quantity will be increased by 10 to 15 per cent when the stamps are brought up to their full efficiency. The first head was started in May, the second in June and the third and last head begun stamping on July 1. Thanks to the heavy caissons, filled with concrete, the stamps are immovable, and the machinery has worked from the start without a single hitch of any moment. The mill is supplied with water by a big pump located on the lake shore, and gets its rock from the mine over a railroad built for the purpose, with easy grades, all favoring the loaded trains. A substantial coal wharf and merchandise wharf near the millsite permit the economical receipt and handling of fuel and supplies, while the Dollar Bay smelters are directly opposite the mill, and the mineral is taken from the stamps to the furnaces by water at trifling cost. The machinery plants at mine and mill are planned for efficient and economical work, and the manner in which they are meeting their duties is a credit to the management of the mine and designers and builders of the machinery.

The Isle Royale, in common with the other mines of the Bigelow group, follows the mistaken policy of not reporting its monthly production. It is difficult to see what good end is secured by this secretiveness, is the annual products are made public, and this hiding of the monthly returns is especially unreasonable in the case of such excellent mines as these in question. The shareholders of the Tamarack, Osceola and Isle Royale, several thousand in number, should be given the figures monthly. It may be argued that such knowledge would inure to the detriment of the mines, through the consumers getting too much information, but this argument is not a valid one. Just at present the consumer has no word to say about the price of the copper he buys—he can pay seventeen cents a pound for Lake copper, or he can go without, just as suits him best, and even were the price not fixed by powerful interests favoring the producer, the consumers could easily secure information sufficiently definite to enable them to judge very closely as to what the mines are doing.

The Isle Royale, during the first two months of milling, made very nearly one per cent ingot copper from its rock stamped, in addition to securing a larger amount of heavy copper than was generally anticipated, the total amount of copper saved at the mill and rockhouses bringing the production to better than one per cent ingot. This is a very satisfactory figure, and as the mine is opened and equipped for production upon a large and thoroughly economical scale, the profits now being earned are sufficient to pay a fine rate of interest on the present selling price of the stock. The Isle Royale company was organized in 1897 with a cash surplus of one million dollars, in addition to the ownership in fee of the lands on which its mines were opened. In 1899 the Miners' Copper company, owning extensive tracts south of the Isle Royale, was also absorbed, and as the cash surplus of the Miners' company also amounted to a million dollars, the Isle Royale has had an even two million dollars in cash available for its development, in addition to the value of its lands. At the time of the starting of the first stamp, in May, 1901, about one and a half millions had been expended. The company had a considerable deposit in the Globe National Bank, of Boston, at the time of the failure of that institution, in December, 1899, but 80 per cent of the deposit has already been paid by the receiver of the bank, and the balance will be forthcoming soon so that the Isle Royale

company will lose nothing, and, as there were plenty of other funds available at all times, will have suffered no inconvenience through the failure.

No copper property ever opened or reopened in the Lake district has begun actual production under such advantageous circumstances. No other mine has ever started its stamps with so much stoping ground opened, or with such a complete equipment for mining, crushing and stamping. At the time the first stamp was started, in May, the mine had nearly five miles of drifts opened, in addition to the old openings, which were not taken into consideration, and leaving the old Portage and Huron mines out of the matter entirely. The amount of stoping ground opened in the Isle Royale at the time its mill started was not less than two million tons. This is much higher than the estimate made by the management, but Capt. Parnall's figures are too conservative—a fault preferable to overstatements. This means that the mine had sufficient stoping ground opened when its first stamp started to supply all three heads with rock to their maximum capacity for four years, without opening another drift or sinking another foot of shaft. Of course the development of the mine will not stop with the beginning of production—in fact there is more untouched stoping ground opened in the mine now, in July, than was the case just before the mill started, as it is the policy of the mine to add to its reserves rather than to deplete them.

The operation of the Isle Royale mill has set at rest all remaining doubts as to the value of the mine. No serious fears regarding the future of the property have ever been entertained by those competent to judge of the mine's value, since the organization of the Isle Royale company, four years ago. Three things are required to make a mine in this district, the requisites being copper, money and skill. The possession of copper by the Isle Royale has never been a matter for dispute, the large production secured in the past, under unfavorable circumstances, being sufficient evidence of mineral resources. The new company furnished the largest amount of money ever devoted to the opening and equipment of a Lake Superior mine, and the ability of the management is not open to question.

The flattering results secured at the Isle Royale in its first two months of operation foreshadow greater developments than have yet taken place. With a big mill, now treating as much rock as the Quincy was stamping only a decade or so ago, the Isle Royale has merely touched one corner of its extensive mineral lands. In addition to the Isle Royale lode, on which the mine is opened, there is the parallel Portage amygdaloid, lying but 200 feet distant from the present workings, and other lodes known to carry considerable copper. The Portage mine will probably be reopened next, as it lies close to the Isle Royale tract, and the Huron, which has made nearly 18,000 tons of copper in the past, will eventually be reopened, beyond which there is an immense stretch of undeveloped territory lying between the Huron and Baltic mines. The Isle Royale will continue to grow, and the present milling facilities will be increased. The officials of the company have said nothing as yet about adding to their mill, but the management Is not of the sort that believes in standing still, and a big addition to the present mill, or a new mill located near by, will come within a few years.

A. S. Bigelow is president and W. J. Ladd secretary and treasurer of the Isle Royale Copper company, which has its principal eastern offices in the Sears Building, at 199 Washington street, Boston. Capt. W. E. Parnall, of Calumet, is superintendent, and Richard M. Edwards is in immediate charge, with the title of assistant superintendent. Edward Warmington is mining captain, H. D. Haddock clerk and A. L. Burgan mill superintendent.

ATLANTIC.

The Atlantic Mining company has a capitalization of $1,000,000, divided into 40,000 shares of the par value of $25 each. Its eastern office is at 11-13 William street, New York City, with Joseph E. Gay president and John Stanton secretary and treasurer. At the mine Frank McM. Stanton is agent, F. W. Denton assistant superintendent, A. D. Edwards clerk, Theo. Dengler mining engineer, Wm. S. Trethewey mining captain and F. G. Coggin, Jr., mill superintendent.

The production of the mine for 1900, from 410,674 tons of rock stamped, was 6,577,955 pounds of mineral, which yielded 4,930,149 pounds of ingot copper at the smelter. The product of refined copper averaged 213 pounds per fathom of ground broken, or 12 pounds per ton, equal to six-tenths of one per cent ingot. This was about midway between the average of .59 in 1898 and .614 in 1899, and shows but a trifling fluctuation in the value of the rock for the past three years. The gross value per ton of rock stamped was $1.97, and the total costs were $1.77 per ton, or, deducting construction account expenditures, the total costs of mining, milling, smelting and marketing amounted to a fraction below $1.50 per ton. Out of the profits of 1900 operations the regular annual dividend of $2 per share was paid in February, 1901. The total production of refined copper by the mine to the close of the nineteenth century was 92,178,177 pounds.

In addition to the mine proper the Atlantic company owns a square mile of land, known as Section 16, lying just one mile south of the tract on which the mine is opened. The development of the Baltic mine to the south of Section 16 led to the exploration of the latter tract in 1898-99 by the Atlantic company, the Baltic amygdaloid being the prize sought. A shaft was sunk to the depth of about 80 feet, and a crosscut driven westward for a short distance, north of No. 5 shaft of the Baltic mine. However, as the western crosscut did not cut the lode, it was speedily abandoned, and a crosscut started to the east. The latter was driven some 800 feet, until the boundary line was reached, when work was necessarily stopped. The outcome was discouraging, but the matter

was dropped in 1899, no further attention being paid to the Section 16 tract until the summer of 1901, when the shaft was unwatered and at the present writing arrangements are being made to continue the crosscut to the west. The Baltic lode has an unnatural strike to the east of north, on the Baltic tract, but conforms to the general trend of the formation where opened to the southward of the Baltic, on the lands of the Champion and Trimountain mines. It is believed that the lode takes a northward turn a short distance north of No. 5 shaft of the Baltic, various indications favoring this theory, in which case the lode should be located somewhere between the center and the eastern limit of Section 16. There remains a possibility, however, that the true Baltic amygdaloid was cut a short distance from the exploring shaft in the eastern crosscut, where a wide but barren amygdaloid was penetrated. It would soon settle all doubts were a winze sunk on this barren amygdaloid.

The new hoist at "D" shaft went into commission in May, though the mine did not get the immediate benefit of the new machinery, owing to the necessity of rebuilding the skip-tracks to carry the six-ton skips. This powerful hoist, quite fully described last year, gives the Atlantic an equipment ranking among the best in the district, as the new plant at "D" shaft can take care of the mine for a depth of a full mile below surface. New boilers have been installed to furnish steam and the boiler-house improved. The new hoist can handle one thousand tons of rock daily, and when the Baltic releases the two stamps now used at the Atlantic mill, the Atlantic can materially increase its monthly product.

The new dam being built jointly by the Atlantic and Baltic companies at Redridge is nearing completion, and will probably be finished before snow flies this season. Its crest is 20 feet above that of the old dam, which was giving some uneasiness, and the new dam will impound about 600,000,000 gallons of water, and will be capable of furnishing an adequate supply of water to both mills in even the dryest seasons, thus relieving the Atlantic and Baltic companies from the cost of pumping millions of gallons of water daily, as is done by the great majority of stamp mills in m the district. The cost of the new dam, complete, will range pretty close of $150,000, and the expense will be shared jointly by the Atlantic and Baltic companies, which are equal beneficiaries.

Some trenching was done on Section 4 in the fall of 1900, in an effort to discover the southern extension of the Pewabic lode. The work was stopped by winter, before anything of value was found, but will probably be resumed at some convenient time in the future.

BALTIC.

The Baltic mine, which has been one of the most promising properties ever opened in the district, from its inception in 1897 until the present time, has reached a stage where the croakers are silent. The mine is a regular producer, and with the starting of its new mill, which should be in September or October, 1901, will become a much larger producer than ever before. The gradual but healthy growth of the mine is best shown by the figures of production. In 1898 the mine made 42,766 pounds of refined copper; in 1899 the production was 621,366 pounds, while for 1900 the output was 1,735,060 pounds of ingot copper. The product of 1898 was exclusively from heavy copper secured in opening work, while that of 1899 was secured from the use of one stamp at the Atlantic mill for the last six months of the year. The production of last year was gotten from two stamps at the Atlantic, one of which was used for the last half of the year, and the other on full time. The 1901 production to date is about 40 per cent greater than last year, while the opening of the new mill permit a great advance on what has yet been secured, and will speedily place the Baltic in the same class of producers as the Wolverine and Atlantic.

The report given shareholders of the Baltic for the operations of the company in the year 1900 is a very comprehensive document, as can be said of the reports of all of the Stanton mines. From this report it is learned that the 1900 product was sold at an average price of 16.49 cents, bringing in a revenue of $286,046.85—a handsome figure for a property producing in a limited way with leased stamps. The gross income of the corporation, including interest earned and money refunded by the Atlantic company from advances made for the construction of the railroad branch, was $297,179.82. The running expenses at the mine were $256,791.06, and smelting charges, freight, brokerage on copper sales and general expenses of all sorts reached $25,326.85, giving a mining profit of $15,061.91. This amount may appear small, but, under the circumstances, the showing is gratifying, as the mine has been largely opened, and while mining and operating expenses have been heavy, production has been limited and costly because of the rock being treated under leased stamps. When installed in its own mill the Baltic will have reached the third stage in its career—that of actual mining upon a large scale, for profits. Heretofore the copper secured has been more in the nature of a bonus than as regular production. That the copper so secured more than paid all actual operating expenses in 1900 is proof of the richness of the mine and of the prudence and economy of its management.

The amount expended by the company for construction work in 1900 reached $241,817.89. The largest single items were $70,728.59 for the new mill and machinery, and $58,373.01 for the Baltic's half of the cost of the new gravity dam at Redridge. This dam, which was fully described in my last report, is a colossal undertaking, but will be a source of permanent revenue to its joint owners, the Atlantic and Baltic companies, as it will free them, permanently, from the cost of pumping the millions of gallons of water required daily in the mills.

The amount of rock stamped in 1900 for the Atlantic mill, for the Baltic mine, was 88,598 tons, from which 2,292,095 pounds of mineral was secured, this mineral

averaging 76.075 per cent refined copper, giving an average return of 19.583 pounds ingot copper per ton of rock stamped, equal to .9791 per cent. This is a marked gain from the preceding year, when the copper returns were only 17 pounds to the ton. For several months in the spring and summer of 1901 the rock stamped has returned 21 and 22 pounds ingot per ton. This shows that the prediction of increased returns made last year was correct, and it is probable that the maximum has not yet been reached. When the new mill is well broken in and the management has learned all the little peculiarities of the mine, the percentage should and probably will run very close to one and a quarter, placing the Baltic about midway between the Wolverine and Osceola in this regard. The extreme width of the Baltic lode will permit the mining of vast quantities of rock very cheaply, and will make the mine a highly profitable one.

The new mill of the Baltic has capacity for four stamps, but only two are being set in place for the start. These new stamps, however, will have a much greater capacity than that two stamps now in use at the Atlantic mill, and it is anticipated, with good reason, that they will be able to treat 500 tons daily, each. Allowing the usual figure of 25 working days per month, the mill will be able to crush about 300,000 tons of rock annually, which, on a one per cent basis, will give the Baltic an annual production of 6,000,000 pounds of refined copper—a production larger than is now being secured by either the Wolverine or Atlantic. The cost of making this copper will be less than at the Atlantic, and greater than at the Wolverine, but allowing even as large a cost as 12 cents per pound, a five cent profit would be secured with copper selling at its present price, giving the mine an annual profit of $300,000 per share, equal to $3 per share per annum on the capital. Eventually the production will be greatly increased, and the wide lode and great size of the property will enable it, when better opened, to feed four stamps, and bring the annual product up to twelve million pounds, or nearly the same as that of the Osceola for last year. This, however, will take time, but that it will come is certain, for the extent of the mine's great mineral resources will render a policy of expansion inevitable.

It seems more than probable, at this writing, that the Baltic, Trimountain and Champion mines, will be consolidated. Such action will make one of the greatest copper producers of the world, and will render the consolidated property much the greatest amygdaloid mine in the Lake district.

TRIMOUNTAIN.

The Trimountain mine lies next south of the Baltic and has the continuation of the great Baltic amygdaloid lode. The stock was assessed $5 per share in February, 1901, the half million so raised being intended for the development and equipment of the mine and for the construction f

A site for the mill was secured on the shore of Lake Superior, a short distance west of the mills of the Atlantic and Baltic companies, and a start was made, before the snow left the ground, at clearing the brush and otherwise preparing for the construction of the mill. Owing to a variety of delays, the work has not proceeded as rapidly as desired by the management, but a good start has been made finally, and the mill should be in commission in 1902, if no further delays of importance are encountered. The building of mills has proved exasperatingly slow in this district for the past three years, not a single one of the new milling plants having been completed at the anticipated time. This is due partly to the greater amount of labor now necessitated in the erection and equipment of a mill, but mainly to the delays caused by the concerns furnishing structural steel, and the shops building the machinery. These have been rushed with business, and in almost every case have been unable to make deliveries when promised.

The expenditures of the Trimountain company for the year 1900 reached $255,051.13, of which the item of $120,359.25 was for mining expenses, including material. For mine construction the outlay was $41,067.19; for machinery and equipment the expenditure was $45,155.40, and $24,816.71 was spent for new dwellings.

A vast amount of work was done at the mine in 1900, and the work of development is being continued on an even greater scale during the present year. The Trimountain has a phenomenally wide lode, rich in copper, and giving every promise of making a mine of the first magnitude, but the management has wisely borne in mind the fact that a mine cannot fee opened on even the best mineral showing without a vast amount of development underground, and a machinery equipment on surface in keeping with what is done in the bowels of the earth. Occasional shareholders have inclined to grumble about the large sums expended before production is begun, but those most conversant with the property approve the policy followed. Were the showing at the mine but an ordinary one, it would be the part of wisdom to open on a modest scale and begin production with a small mill, until the mine had demonstrated its ability to do well, but in this case the showing is so unusually rich that there can be no doubt of the mine making one of the largest producers in the district. Under these circumstances it is economy to push work at the beginning, and start production on as large a scale as possible.

It seems to be generally conceded that the control of the Trimountain property was secured by the Standard Oil interests in March, 1901, about 70,000 shares of the total issue of 100,000 having been bought by Thos. W. Lawson, a Boston broker whose association with the Standard Oil interests is a matter of general knowledge. The purchasers of this controlling interest have made an excellent investment, for the Trimountain is acknowledged by all judges to give every indication of

developing into a mine of unusual size and earning power. As before stated, in the article on the Baltic mine, it is probable that the Trimountain will become a portion of a consolidation to take in the mines both north and south of this property.

Much has been accomplished in the past year in the way of permanent improvements on surface. Eighteen months ago there was but a single shaft bottomed in the lode, though a sand shaft was then sinking for what has since become No. 2 shaft. There were a few permanent buildings at the mine, but merely temporary shaft houses, and no railroad connections. All this has been changed, and the iron horse now traverses the Trimountain tract for its entire length from north to south. Permanent shaft houses of the latest design have been erected and equipped with powerful crushers; big hoisting plants have been installed; air compressors of large capacity are now furnishing motive power for the rock drills working far underground, and the mining location has grown from a scrubby camp in the forest into a thriving town that will eventually become the nucleus of one of the great mining camps of the world, for it lies almost midway between the promising camps at the Baltic and Champion mines. The miners and others living at this location have unlimited faith in the future of the property, and there is scarcely an employee of the Trimountain who has not located to stay, with unfaltering confidence in its richness and permanency.

Not only has the mine location been supplied with a railroad, through the building of the eastern branch, or Painesdale division, of the Copper Range, but the millsite on the shore of Lake Superior has likewise been supplied with rail facilities by the construction of the western branch of the same enterprising line. The millsite is now known as Beacon Hill, on the maps of the railroad people, and is a lively place just at present. The work of getting the railroad through was necessarily finished before it was possible to do anything, beyond clearing the brush and doing a little excavating, at the millsite, as there is no harbor at that point, and all building material must be brought in by rail. The work of laying the foundations was started in July, and it is not likely that much can be done on the superstructure this season, but if the material is furnished promptly a good start can be made early next spring, and the mill placed in commission in six months or less, if there is no delay in obtaining material and machinery.

In the mine itself good progress is being made. Thomas Rapson has succeeded Thomas Carlyon as mining captain, and James Chynoweth remains as superintendent, with Wm. J. Uren assistant superintendent. The shafts are being sunk at the rate of about 50 feet per month, and the progress in drifting averages 60 to 65 feet per month. All opening work is being pushed as rapidly as possible, both laterally and in depth, and the mine will have a large amount of stoping ground opened when the mill goes into commission. All amygdaloids are bunchy, and the Trimountain is no exception to this rule, but as far as can be judged before the mine is put to the touchstone of actual milling, there is a greater proportion of good stoping ground than is usually found, and this, with the exceptional width of the lode, enables the management to open much more ground per foot of sinking and drifting than is usually the case.

In the olden days the mistake of not opening a mine sufficiently was a very common one. Experience has demonstrated the folly of such a course, and it is generally admitted that it is impossible to do too much opening in a new mine. When the Trimountain mill starts, the mine will come to the scratch with a large number of stopes of exceptional width, and with a good prospect of being able to feed the big mill without unduly crowding the mine—a matter of great importance in the operation of a property even so large and rich as this.

CHAMPION.

The Champion is the southernmost of the three big mines opened on the Baltic lode, and these three mines constitute the group known locally as the South Range. There seems reason to believe that the Baltic amygdaloid grows richer to the southward, which would make the Champion the richest of this wonderful trinity of mines. Whether this be true or not, it is certain that the Champion is a mine of altogether exceptional promise.

The Champion Copper company is the owner of the Champion mine, but as the shares of this corporation are held jointly, in equal parts, by the Copper Range company and St. Mary's Mineral Land company, it is apparent that those corporations are the real owners of the mine. The Champion is to be included in the South Range consolidation, according to the statement of those prominent in its management.

The development of the Champion has not been so rapid as that of the mines to the northward, but there has been greater activity this season than last year, and a great deal of work has been accomplished. Last year's work was mainly of a preliminary nature, but much that has been done this season is of a permanent character, and a great change has been effected in the property since the winter of 1900-1901. There are four shafts on this property, which are lettered instead of numbered. The shafts are being equipped with permanent structures serving as shaft houses and rock houses, which are of steel, and well designed for the heavy work they will have to do when the mine begins production. A powerful new air compressor has been installed recently, and is giving good service, as it ensures a sufficiency of power for the drills in all parts of the mine.

About fifty new dwellings have been built this season, to the great advantage of the mine. The married men are usually the steadiest workmen, and the men with families demand houses to live in, consequently the mines with the most and best houses have their pick of employees, other things being equal.

A townsite, known as Painesdale, named in honor of Wm. A. Paine, of Boston, has been laid out at the mine, and the location now has connection with the Portage Lake towns via the Copper Range railroad.

At the present writing, in July, 1901, every shaft is sinking, and a great deal of drifting is in progress, fifteen power drills being employed. Upwards of six thousand feet of drifts have been opened. "B" shaft is down 375 feet; "C" shaft 350 feet; "D" shaft 475 feet, and "E" shaft is down 600 feet. Additional drills are to be added in the near future, and fully 35,000 tons of high-grade stamp-rock have been stocked at the shafts this having been taken exclusively from opening work, as no stoping can be done to advantage before the mine begins regular production.

At the millsite the spur-track of the Copper Range line is being built in, and excavating for the foundations is started. From present indications the Champion mill cannot go into commission until 1903. Whether the Champion will or will not take one or two heads at the Atlantic mill when the Baltic surrenders their use is uncertain. The Atlantic can use one of the two heads now employed on Baltic rock to good advantage, ant| can perhaps utilize both heads. The use of one head at the Atlantic mill by the Champion would put that property in about the same situation as a producer as the Baltic occupied after July, 1899, when it begun using one stamp in the Atlantic mill. The income derivable from this production would be a nice thing for the Champion, but it is questionable whether it would not be as well, or better, in the long run, for the Champion to withhold production until its new mill is completed. The latter policy, would enable the management of the mine to devote its sole attention to, the development and equipment of the property, whereas production, even on a limited scale, would be something of a drag on the development of the mine. Even a limited production, from a single stamp, would furnish the mine with a considerable income, and would thus diminish the sums required from the shareholders for its development. The question thus resolves itself into one of finances, in the end.

The Champion is now employing about 400 men, and this force will be greatly increased when the mine becomes a producer.

The surface equipment at the Champion is a combination of temporary and permanent. There is nothing that is a cross between the two, but the temporary shaft houses, engines and other machinery are being steadily replaced with permanent machinery and buildings. Dr. L. L. Hubbard, the late efficient state geologist of Michigan, is in charge of the mine as general manager, and Capt. John Broan remains in charge of underground work.

GLOBE.

The Globe tract, owned by John Stanton, is one mile wide and five miles long from east to west, running entirely across the mineral belt. It lies just south of the Champion and is regarded as a very valuable property. Exploratory work will be undertaken this season, and at this writing, in July, 1901, arrangements are being made to begin explorations.

ELM RIVER.

There is very little to be added to what was said of this property in my last report. About 30 men are now employed, and the main shaft is still being sunk, having reached a depth of nearly 300 feet at this writing. The diamond drill has been used extensively, and a cross-section of the greater part of the Elm River tract has been secured from its borings. The formation remains disturbed, wherever tested, and the overburden of sand is heavy at nearly all points. A number of amygdaloids carrying copper have been opened by the shafts or cut by the drill, but in every case the percentage of copper is small and the lodes themselves are in unsatisfactory condition, the formation being so much disturbed and broken that it is hard to trace any given bed, owing to the walls being so illy defined.

WYANDOT.

The Wyandot is pinning its faith to the diamond drill at present, and has done a large amount of boring in the past year. The lands owned by the Wyandot company have been tested by the diamond drill to the extreme east, and over the western half of the tract. This work has been costly, owing to the great amount of sand overlying the rock ledge, and has not been attended by any very promising discoveries, although several copper-bearing beds have been located. At the present time there remains about a quarter mile of territory to probe with the drill. Like its neighbors in this district, the Wyandot is searching for the southern continuation of the great Baltic lode, which is so rich and strong to the northward, but the search has been unsuccessful so far. It is possible that the Baltic lode lies to the eastward of the limits of the Wyandot, though its location, if it exists at this point, is a matter of conjecture, where one man's guess is as good as another. Matthew Van Orden, of Houghton, remains the managing director; Frank L. Van Orden is superintendent, J. H. Hicok clerk and John Biscombe mining captain.

WINONA.

The Winona is struggling with the same discouraging factors as its neighbors, the Elm River and Wyandot, although it has the advantage of possessing one shaft in which there is a fair showing of copper at points. The mine has two shafts, of which No. 1 is apparently hopelessly bad, while No. 2 has shown stretches of good ground in the southern drifts, and sinking and drifting is now in progress in this shaft. The diamond drill is also being used to furnish a cross-section of the Winona tract, but like the other properties in the Winona district, the revelations made by the drill are not especially

encouraging, although the property has not yet been entirely proven with drill holes, and there is still hope that the much sought-for Baltic amygdaloid may be found on the company's lands. The formation is considerably broken, though perhaps not so badly disturbed as to the northward. The Winona lode, on which the shafts are opened, is fairly strong in formation after a little depth is attained, but does not carry copper in promising quantities, except in the southern drifts of No. 2 shaft, as before noted.

The Winona, to date, has proven about the greatest disappointment ever encountered by the people of the Lake district. There have been many mines, and attempts at mines, on which credulous eastern shareholders pinned their faith, though in such cases the Lake people have usually held aloof, but in the case of the Winona the Lake people were among its firmest friends. The property was originally opened by the late Jay A. Hubbell and associates, in the early sixties, and the amount and quality of copper taken from the two shallow shafts were all that could have wished. The mine remained undeveloped because many miles from road communication, but great faith was felt in it by the owners and who had visited it. The good showing of the early days has never been duplicated in later developments, and unless something better than found is soon discovered, the Winona must go out of business.

BELT.

The old Belt mine was taken under option by Capt. W. A. Dunn, of Houghton, late in 1900, and was freed from water and thoroughly examined. An attempt was made to float the property on the Boston market but the public proved apathetic, and the venture was abandoned. In the early summer of 1901 an option was taken on the mine by Mr. R. C. Pryor, of Houghton, the option being for Mr. N. F. Leopold, of Chicago, who began vigorous operations immediately. The mine was again pumped out and a thorough examination made of all the old shafts, drifts and miscellaneous openings. The inspection proved encouraging, and active work was started and is now in progress. Several power drills were set at work and new openings are being broken in a number of directions. It is Mr. Leopold's intention to give the property a thorough exploration, and, if the result proves satisfactory, the mine will probably be turned over to a stock company organized for the purpose, but no attempt will be made to float such a proposition until the actual development work has satisfield the present holder beyond question that the Belt has the makings of a good mine.

Two shafts, known as the Butler and Knowlton, have been unwatered, these being opened on the amygdaloid lodes of the same names. The work of cleaning out and securing the old shafts proved quite laborious, but has been satisfactorily completed. The plant in use is fitted for exploratory and light development work only, but is amply adequate for such uses. The limited amount of new ground broken in the three weeks since the drills started is insufficient to use as the basis for a definite opinion as to the future of the property, but some excellent rock has been taken from the new openings, and the showing is fully as good as was anticipated, and, should it continue, will certainly result in the opening of yet another big mine in Ontonagon county.

THE PENN.

The Old Penn Mining company's property, consisting of the west half of Section 36 and the east half of Section 35, Township 52, Range 37; all of Section 2, and the southeast quarter of Section 3, Township 51, Range 37, is now being explored by a syndicate of eastern people under the direction of Mr. J. R. Van Evera, of Marquette. This property was a part of the estate of the Belt Mines, Limited. Until the present exploring operations began in September, 1901, no work had been done on the property for more than thirty years, and what was done was of the most primitive kind. The Copper Range railroad now crosses the property. It is known that seven copper bearing lodes traverse this tract of land, and it is hoped the developments now under way may result in the opening of a profitable mine. The present operators are working under an option to purchase the entire tract, consisting of 1,440 acres.

ADVENTURE.

There is no property in the Lake district that has come into public favor more rapidly in the past year than the Adventure. This is reflected in the market price of the shares, now selling at about par, $25 each, an advance of nearly one thousand per cent in the past fifteen months. The property has many friends, and is now owned very extensively in the copper district, a sign favorable to the future of the mine, as the residents of the mining district rarely purchase heavily in new mines unless the properties possess unusual merit.

The management of the Adventure saw fit to levy an assessment of $6 per share early in 1901. This was at first regarded as an effort to freeze out the smaller holders, but this opinion has been changed after more careful investigation into the facts of the case. The cost of opening a new mine, or properly reopening an old mine, in this district does not fall under a half million dollars, and will more frequently reach or exceed a million dollars. The showing at the Adventure is a very promising one, and it is the part of good business judgment to develop the mine as rapidly as possible, and upon a large scale. Even the best mine finds it hard to make adequate profits when poorly opened and insufficiently supplied with machinery, while with all good mines, the percentage of profit secured from the product depends largely upon the extent of underground openings and the perfection and extent of the mechanical equipment at the mine and mill. The Adventure has the same general management as the Quincy, and that alone is a guarantee that the directors will not take any snap action, or do anything unfair to even the smallest shareholder. The talk heard at first,

after the levying of the $6 assessment, has stopped, and confidence in the integrity and ability of the management remains unimpaired.

Conditions at the Mass and Adventure mines are different from those found at mines in other parts of the Lake district. The Adventure carries no less than seven parallel copper-bearing amygdaloids in a distance of about one thousand feet across the formation, measured on surface, and this distance is even less when the formation is measured in cross section. These beds are of varying width and value, but even the narrowest is of workable size, and the leanest carries copper in quantities sufficient to justify exploratory work. The high hill on the Adventure property south of Adventure Gap, and the opening of these successive amygdaloids by adits, allow the mining of a very high "back" of good stoping ground at exceptionally low cost for opening, breaking and hoisting. Work was first started by the present company on the Knowlton lode, and the principal development remains on that lode, but considerable attention has been paid of late to several other strata, and the mine is now being developed in several directions simultaneously. As a rule the copper mines of the Lake district may be said to have two dimensions only—length and breadth—as they are opened on single lodes, but in the case of the Adventure the third dimension is added, and it is thus possible to develop an enormous amount of productive ground with the minimum amount of opening work. The Butler lode is the northernmost, and outcrops on the lowest ground, the other cupriferous strata occurring in the following order, from north to south: Merchants', Mass, North Butler, Butler, Ogima and Evergreen. The Butler outcrops on nearly the ridge of the hill, and the North Butler is a new lode, discovered last year, carrying stamp rock in promising quantities. The values of these seven lodes can be forecasted to some extent, but the actual test of stamping will be required to permanently fix their relative position as profit-makers.

The annual report of the Adventure company is clear, complete and satisfactory in the details it gives to shareholders desirous of keeping themselves fully informed regarding the property. The amount of money raised by the Adventure Consolidated Copper company to date, is $1,400,000, of which $250,000 was paid for the real estate, leaving $1,150,000 for the reopening and equipment of the mine and the construction of a mill. This is a large sum of money, but the last assessment of $600,000 is sufficiently large to give the directorate all the cash required to open the mine and complete the mill upon a very considerable scale, and shareholders will not be called upon for further contributions. The mine should become a producer late in 1902, as it is not likely that the mill can be placed in running order before that time.

The total amount of opening made to the close of 1900 was 8,199 feet, of which 1,151 feet were in shafts; 2,004 feet in crosscuts, and 5,044 feet in drifts. These openings have been added to quite largely in the seven months that have since elapsed, and the property is rapidly growing to look like a mine of good size. A considerable mining location is being built up, and the later buildings at the mine are all of a permanent nature. Because of the peculiar formation encountered at the Adventure property, sinking is not being done as rapidly as would otherwise be the case, a great deal of the energy devoted to the mine being required to extend the openings on a horizontal plane, which are unusually extensive in proportion to the incline openings, owing to the succession of parallel copper-bearing strata, and the high bluff that allows the opening of the upper levels by adits, as before explained.

The main line of the Copper Range railroad passed some distance from the shafts, but a branch track is now being constructed to the mine, and at this writing, early in August, has been graded and will soon be in running operation.

A millsite was chosen on the shore of Lake Superior, west of the Atlantic and Baltic mills. The company had in view a site east of Ontonagon, but it would have been costly to utilize, as it would have required the construction of a private railroad through a rather difficult country, and the site, when reached, was scarcely as desirable as the one finally selected. The site west of the mouth of the Salmon Trout was secured from the Copper Range company in consideration of a traffic agreement executed by the mining company, under the terms of which the rock from the mine will be carried to the mill by the Copper Range line, the bargain being a good one for both corporations. The Lake Shore branch of the Copper Range has been completed past the millsite, and a spur line is now being built in to that point. Excellent progress has been made on the preliminary work at the mill, and the foundation walls for nearly all of the structure are completed. The mill is to have three stamps, and will be fitted with the latest models of machinery throughout. It is favorably located for milling purposes, and the question of sand room can never come up, as it has all Lake Superior to pile its tailings in.

On July 1, 1901, it was estimated that the mine had at least one million tons of stamp rock blocked out, figuring upon the most conservative basis—an amount sufficient to feed three stamps to their fullest capacity for more than two years. The work of opening added stopes will not be allowed to lag, and at the present rate of progress upwards of two million tons of stoping ground will have been blocked out by the time the mill starts—a four-year supply of rock, more than sufficient to allow the careful averaging that is now a feature of mining system at the best man aged properties of the district, this process requiring that the mining of pound of exceptional richness be offset by the stoping of some of the leaner openings, and vice versa, an effort being made to secure a monthly product that will accurately reflect the average capabilities of the mine, rather than to permit the extreme fluctuations of output that would necessarily follow a haphazard system of breaking the rock to feed the stamps.

MASS.

The Mass mine began production in the last week of July, 1901, though it was found impossible, for several reasons, to furnish the mill with a full supply of rock. The mill is of size for two stamps, of which one is now in use, and it is hoped that the second may be in commission early next year. Many exasperating delays have been encountered in getting the mill ready for business, but it is now crushing about 400 tons daily, and is securing even better results than had been hoped by any but the most enthusiastic believer in the future of the property. While yet too early to give detailed figures regarding the production, it may be safely stated that the mine is starting off on a two per cent basis, a figure higher than that of any other mine in the Lake district, except the Calumet & Hecla. It is almost too much to expect that this percentage will be permanently maintained, but there is every reason to believe that the mine can maintain a large production at a percentage that will place it well to the front among the best amygdaloid mines of the district. The production of heavy copper continues large, and some of the stamp rock is among the richest ever mined in the district. The actual value of the Mass property will be determined by the proportion of stamp-rock obtainable from the various lodes, there being no question that the Mass Consolidated, at certain points, is among the richest ever opened in the Lake district—a fact demonstrated by the past history of the Ridge and Mass mines, both of which are now parts of the present condition.

The Mass mine of today is the property once known as the Ridge, but the old Mass mine, adjoining, is to be reopened. The management of the Mass Consolidated company underrated the cost of reopening and equipping the old mine, when the corporation was organized two and a half years ago, and has been very chary of calling on shareholders for funds, but the present directorate has recently taken the bull by the horns, and in July, 1901, levied an assessment of $4 per share. This money will be used to greatly increase the underground development of the mine, and it is probable that the first direction in which the policy of expansion will be pushed will be in the reopening of the old Mass mine proper. Although this mine has never paid a dividend, as the Ridge did, it was considered of exceptional richness when worked, but was never given the capital or equipment necessary to insure its success. The same remark is true of practically all the old mines of Ontonagon county, the only mines that were ever given anything like a fair chance being the Minnesota and National, and work in the former was suspended at a time when a reasonable amount of courage would have obviated such an unfortunate step. The shareholders of the Minnesota, after having received nearly two millions in dividends within a few years, were afraid to raise the small sum that would have been required to tide the mine over a temporary period of depression that was due largely to the niggardly manner in which the money taken from the mine was doled back in improvements, and the greedy haste of the shareholders, who insisted that all earnings be made net by promptly paying every penny, less actual operating expenses, over to shareholders in dividends. Such a policy is suicidal, with even the best of mines, and the Lake property that does not put part of its earnings back into new openings and betterments of plant will inevitably come to grief some time, no matter how rich the mine may be in copper.

The Mass possesses a very large tract, consisting of more than 2,400 acres, all located on the copper belt. This tract is so situated that it will be possible to mine to very great depths on the underlay, all of the shafts except No. 3 being so located that they can go down for a full mile or more on the Mass lands.

The mine is well equipped for production, and the new 50-drill compressor was put in commission in June last. When the mill was started, late in July, the force at the mine was materially increased, and now numbers about 300 men. Ten additional rock drills were set at work, to stope ground for the mill, and 35 drills are now running. The number of both men and machines will be increased gradually, as circumstances require, and with the putting in commission of the second head, about January first, 1902, the force will necessarily be considerably enlarged. The mine is now opened to a point where it can easily keep one stamp supplied, but it will require much more opening to insure selected rock for two stamps, although the amount of opening already accomplished is greater than might be thought at first view, owing to the Mass possessing five parallel copper-bearing amygdaloids, continuations of five of the lodes opened on the Adventure. The latter named mine has two lodes which the Mass has not yet secured, and which possibly are non-existent on the Mass tract, although it is probable that one, and perhaps both, will be found later.

Mr. C. A. Lamb, of Boston, was elected president of the company at the last annual meeting, and has made several visits to the mine, exhibiting a commendable desire to thoroughly acquaint himself with the property and the methods in use there. C. H. Krause has been placed in local charge of the surface work and mill, and Capt. James Wilcox, formerly of the Arcadian, is in full charge of the underground work. Capt. R. R. Trezona, who was previously superintendent, and who has since gone to the Minnesota iron fields, has been much criticised for his work at the Mass, but the criticisms directed at him are unjust. The Mass has not had as much money to spend as some of its neighbors, and, considering his limitations, Capt. Trezona deserves praise and not censure for his administration of affairs at the property. He is a thorough mining man and his work at the Mass speaks for itself. Affairs at the mill were in a chaotic condition when Mr. Krause took hold, but under his experienced hand matters have shaped themselves in better order, and the mill, while its location is perhaps not of the best, is not in shape to do excellent work—and is doing it.

MICHIGAN.

The Michigan was very fully described in my last report, and I see no reason to modify or explain the favorable prophecies then made regarding the mine's future. The property remains under the same general and local management, and the policy then in force is still in effect. The impression seems to have gotten out that the original mine openings made on the Calico lode are practically abandoned, but such is not the case. A thorough mill test of the Calico rock, made at the Atlantic mill in May, 1900, gave a return of about one per cent, which, as the rock was selected to secure an average result rather than to secure a big showing, is fully satisfactory, and as good a return as was expected by those acquainted with the property and capable of judging copper rock. The Michigan, however, has now reached the second stage of its career, and the energies of the company are now being devoted mainly to the reopening of the old Minnesota mine. In order to do this to advantage it was necessary to either unwater the old mine from the top, under almost appalling difficulties, or get at the old openings from underneath, and the latter plan was chosen, for reasons that will be satisfactory to anyone who cares to look into the matter closely. In order to get under the old mine it was necessary to sink for nearly a quarter of a mile, and this sinking was done on the Calico amygdaloid, thus killing two birds with one stone, by opening a new mine in the preparatory work of getting below the bottom of the old one in order to reopen that. The Calico overlies the contact vein on which the Minnesota was opened, at a distance, on surface, of about 140 feet. The old Minnesota was filled with water below the adit level, and when the pump shaft on the Calico was sunk deep enough, drill holes were bored into the old workings, at an upward angle, and the water was withdrawn from the Minnesota. Similar holes have been bored from level to level, and the water is now below the eighth level. A crosscut will be run from the shaft on the Calico to the bottom of the old Minnesota when the water is all drained out, and the work of cleaning out the old mine and retimbering the shafts will be begun. This work can be done to better advantage from below than from above, but the old openings are certain to be found in abominable shape, after an idleness of a third of a century, and the work of reopening and retimbering will be slow and unpleasant. The reward, however, will be proportionate with the time and labor, for the old Minnesota will yield thousands of tons of heavy copper and millions of tons of high-grade stamp-rock to the Michigan company.

The Michigan has a millsite selected on the shore of Lake Superior, in the Redridge district, where the Atlantic, Baltic, Trimountain, Adventure and Champion mills are built or building. The construction of the mill will probably require about eighteen months from the time the first sod is turned, but there is a great deal of heavy copper that can be taken out of the old Minnesota as soon as the mine is cleaned out, and the stamp rock broken in the work can be stocked at the shafts until the mill is ready. It is possible that none of the old Minnesota shafts will be utilized in the reopening of the mine, as they are narrow and tortuous, and with the timbering almost entirely rotted away, while the shafts on the Calico lode are but 140 feet distant and can readily be connected with the old workings by crosscuts, and, if necessary, sub-levels can be opened on the Calico to correspond with the old ten-fathom lifts of the Minnesota, which were laid out by rule of thumb and very irregular in every way. The old Minnesota openings on the Calico lode have already been connected with the new shafts, a drift from the new workings having reached the old stopes late last May, on the fifth level. The showing found in the old mine at this point was excellent, as masses of copper weighing several hundred pounds each were found already mined and a large amount of high-grade stamp-rock was broken, but allowed to remain on the floors, while the walls in place carry fine copper and show barrel work, with occasional small masses.

It must be remembered that the old Minnesota was mined in the way that a greedy boy eats his plum pudding—only the raisins were removed. Such a method is wasteful to the extreme, and at the present day would be totally indefensible, but the Minnesota was one of the pioneer mines in the district, opened in a day when black powder and hand drilling afforded the only means of breaking ground; when gravity stamps crushed the rock and when a sixty horse power boiler, such as is now used in exploring outfits, was a mechanical marvel of rare occurrence—in fact the first years of the Minnesota saw the mine worked by hand and horse power. A little later small boilers and hoists were installed, but the miners were after masses of native metal, and the small and ineffective stamp mill of the company earned but a small part of the dividends paid by the old Minnesota. The men who worked the mine kept on digging out the plums—one of which weighed about one million pounds, in a single slab of native copper—and the mine grew deeper. Profits were paid as fast as earned, and no new equipment added. The mine finally reached a depth where the equipment was totally incapable of hoisting; copper dropped in price, no more monstrous masses were encountered, and the mine suspended. The plums have been dug out of the center of the mine, but the pudding remains, and there are many currants yet to be found, with the certainty that a few of the big plums remain untouched.

In addition to the old Minnesota, some very rich copper-bearing ground has been opened on the Calico. An important find was made in the foot-wall of "A" shaft last spring, but the shaft is being sunk at a constant angle, and the rich ground can be taken by drifting in from the back. Both shafts are being dropped at present, and some very heavy copper has been encountered at points, ranging up to masses of a half ton in weight. The pump shaft, "B," is down 1,282 feet at this writing, early in August, and "A" shaft is nearly 800 feet in depth.

The Michigan company possesses a very large acreage on the mineral belt, the tract covering both the north and

south ranges of parallel copper-bearing lodes found in this part of Ontonagon county. Some attention has been given to the southern part of the tract, where exploratory work-have shown a copper-bearing lode worthy of further attention. The Michigan is in good hands, and is being wrought intelligently and economically. The only criticism heard regarding the management of the mine is the complaint, from some of the shareholders, that the work is not go rapidly enough. This criticism is apparently founded on ignorance of circumstances. The directors and officers of the company are its largest shareholders, and have the most at stake. The work of opening a new mine and reopening an old one simultaneously requires time, and sufficient time has been taken to do the work properly. Undue haste is sometimes slow work in the end. What has been done at the Michigan has ft been done well, and the results will be apparent within the next two or three years in the making of a dividend-paying mine.

VICTORIA.

The Victoria mine is the westernmost active property in the Lake District, with the exception of the Norwich, which is being unwatered again, and at which mining may be resumed. The property lies west of the Ontonagon river, and this location is responsible for the opinion, in certain quarters, that the Victoria can never be made a mine. The mineral was put in the rock, far below surface, some ages before there was any Ontonagon river, and the existence of that stream can in nowise affect the copper values carried to the right or to the left. There is copper far west of the Ontonagon, and the fact that heretofore no large and profitable mines have been developed west of that stream is evidence of a negative nature merely. Judging from the showing of metal made in its lower levels, the Victoria has very much more than a fighting change of making a good mine.

The development of the Victoria has been upon a more modest scale of expenditure than has been the case at the other new mines of the district. Second-hand machinery has been utilized wherever possible and there has been a constant effort to make a dollar go as far as possible. Economy has never been sacrificed to appearances, and the vast amount of work accomplished speaks highly for the efficiency of the management, both general and local. When the present Victoria company was organized and took the old Victoria and adjoining mineral lands, a cash surplus of $350,000 was placed in the treasury for development. It was felt that it was uncertain whether the property would make a mine, although the indications were favorable, or the company would not have been organized, and it was deemed the part of prudence to demonstrate the real value of the tract most thoroughly, by actual underground opening, before any attempt was made to build a mill. The mine has now reached a point where the mill is apparently looming up in the near future, but a little more development work will be done before the mill proposition is taken up in earnest by the directors. A few more levels of the same sort as the four last opened will determine the building of the mill.

The old mine was found in the bad condition common to old properties that were inadequately opened in the fifties and sixties. The main shaft! was utilized to get down into the mine, but it was necessary to cut this shaft down to modern size, straighten out the kinks and retimber throughout. All this has been done, and the shaft dropped a long distance below its former depth. The shaft is now as pretty a one as could be asked, and capable of being turned into the main artery of a producing mine on short notice, practically all that will be required being the installation of a powerful modern hoisting plant on surface, with a few unimportant changes! underground.

The main shaft is now sinking for the twelfth level, and drifting in both directors is in progress on the tenth level. At the indicated distances, uprises will be started from the tenth level drifts to meet the other shafts, which will be sunk simultaneously, thus allowing for the deepening of the two shallow shafts with the least outlay of time and money.

The lode is running strong and rich in the lower levels, its width ranging from 25 to 40 feet on the four lower levels, with a fair amount of barrel work, occasional masses and a good proportion of stamp rock that shows well in fine copper. The lode has unquestionably gained! strength and copper with depth, as was hoped would be the case, and is believed by Capt. Hooper and others connected with the mine to be the Evergreen amygdaloid, which has been opened in the Mass and Adventure mines, several miles to the eastward. Whether this is correct or not will be demonstrated by future development of the territory between the Mass and Victoria, but the principal point of interest is not the identity of the lode, but its width and the quantity of copper carried by it.

At the close of 1900, after two years' business, the company had a cash balance of $188,573.64, having expended less than half of its original development fund of $350,000. On July 1, 1901, to company still had on hand about $140,000, an amount sufficient to continue development until the end of the year 1902.

The old workings of the mine were opened with levels of ten-fathom depth, but the newer lifts are of the regulation hundred-foot distance, and are being properly laid out for economical working. The upper levels have been examined, but very little has been done beyond looking them ever, it being felt that the future of the mine depends on opening the lode to a considerable depth. The wisdom of this policy is fully apparent in the excellent showing secured some distance below the deepest of the old workings.

The mine has made several shipments of heavy copper secured from development work, and has accumulated a stock-pile of several thousand tons of stamp rock broken in opening the mine. The greater part of the rock now being hoisted from the mine is of stamp grade.

A limited amount of crosscutting has been done, and at several points a little drifting was done on the parallel lodes opened by the crosscuts, these carrying some copper. A trifling amount of work was also done on an amygdaloid at the old Glenn mine, but no attempt has been made to thoroughly explore the great mineral area owned by the company, or to do more than mark the bounds of the copper discoveries off the main lode. Such work will come in time, but it can be done to better advantage after a mine is developed and is earning money to carry on the work of exploration.

The mine is working about a hundred men, and is employing twelve power drills. The matter of developing the enormous water power now going to waste at Glenn Falls will probably be taken up by the directors in the near future.

NORWICH.

The old Norwich mine was sold by Alfred Meads, of Marquette, to a syndicate of New York and Chicago capitalists, in the spring of 1901. It was hoped that they might reopen the mine at once, but for some reason very little was done immediately. At this writing, Aug. 3, 1901, the mine is being unwatered, and it is expected that several power drills will be placed at work and a start made at actual mining. The property is in charge of Neil J. Ferguson, who has been caretaker or mining captain, according to whether the property was idle or had a few men working, for several years past. The Norwich is located about eight miles north of the hamlet of Matchwood, on the Duluth extension of the D., S. S. & A. railway, and is most easily reached from that point, a good road connecting the mine with the town.

The Norwich is a property of more than ordinary promise, and while its development will necessarily prove expensive, it is probable that railroad connections could be secured were it to be made plain to the South Shore railway people that the mine had been taken in hand by a strong corporation prepared to spend an adequate sum in developing the mine. The Norwich is so far distant from the active mines of the Lake district, and it has been idle so many years, that it is generally held to be of little account, and of no great promise. This is an erroneous estimate of the mine. It has produced more copper than all of the other mines west of Ontonagon county, leaving out the Victoria, and has made even more copper than that mine, having produced 993,360 pounds of refined copper. Some fine masses were found in the mine, including one that weighed fully ten tons. Although the Norwich was a mine of some importance for the early days, the development work done on the property would be considered mere surface scratching at the present time. It is to be hoped that the present owners may find the courage to raise a sum adequate to thoroughly explore the mine.

HAMILTON.

The four old copper properties known as the Hamilton group adjoin the Norwich, lying immediately to the west. These mines, the Hamilton, Essex, Windsor and Trap Rock, having a combined area of 480 acres, now in the hands of Dr. J. R. Moore, of Ironwood, who is negotiating with eastern parties for their sale. The Trap Rock was worked quite actively for several years, but the other properties were worked more in a speculative way than for copper. The existence of the metal in promising quantities is known, and the tract offers an alluring field for exploratory work of a thorough nature.

PORCUPINE MOUNTAINS.

Prof. George E. Perkins, of Providence, R. I., has been doing exploratory work for several seasons in the Porcupine Mountain district. It is in this field that the Nonesuch and other properties of a similar nature are located. The cupriferous matrix is a sandstone, carrying copper in very high percentages at points. It has been held that this copper is too fine to save, but Prof. Perkins assures me that he has recently conducted experiments with this rock on Wilfley tables, and that the percentage off copper saved is very gratifying. The copper sandstones seem erratic, and the upper portions of the beds are practically barren as a rule, while there are points where the beds are barren for their entire thickness between walls. A great deal of money has been thrown away by experimenting theorists in this district, but the work now being done by Prof. Perkins is of a practical nature, and the results secured, while not definitive, are encouraging.

COPPER STATISTICS.

The following table gives the production of refined copper, in pounds, avoirdupois, by Michigan mines, for the past three years. In the case of several mines it has been necessary to estimate the 1900 production, the exact figures not being obtainable as yet from the companies in question, but in such cases the estimates have been carefully figured, and can be relied on as very close approximations of the true figures. Wherever estimated, the products are prefixed by a star:

Mine.	1900.	1899.	1898.	1897.
Calumet & Hecla	77,761,382	89,610,963	86,426,320	83,248,054
Tamarack	*19,000,000	18,565,602	19,660,480	20,222,529
Quincy	14,116,551	14,301,182	16,354,061	16,924,618
Osceola	*13,000,000	11,358,049	12,682,297	11,201,102
Atlantic	4,930,149	4,675,882	4,397,339	5,109,663
Wolverine	4,789,829	4,500,373	4,588,114	2,316,296
Franklin	3,663,710	1,230,000	2,623,702	2,908,384
Baltic	1,735,060	621,336	42,766	.....
Arcadian	*1,350,000	*500,000	.....	.....
Centennial	892,500	730,240	672,000	.....
Arnold	856,000	763,911	152,320	.....
Mass	172,926	42,800	.....	62,250
Adventure	*100,000	.....	.....	.....
Phoenix	88,206	.....	.....	.....
Mohawk	*70,000	.....	.....	.....
Miscellaneous	50,000	50,000	75,000	91,798
Totals	142,576,313	146,950,338	147,965,738	142,702,586

From the foregoing figures it will be seen that the production of refined copper in 1900 was the smallest secured in four years, high water mark having been reached in 1898. But for the fire of May, 1900, in the

Calumet & Hecla, last year's output would have been the largest in the history of the district, and it is probable that not for many years to come will the output of copper by the Lake mines fall below the figures achieved in the last year of the nineteenth century. There are many new mines opening, several of which have already become producers to a considerable extent, while a still larger number will begin turning out ingot copper before the year 1903. In the case of several of the smaller producers listed in the preceding table, the figures are for heavy copper only, secured from opening work previous to the beginning of milling, this observation applying to the 1900 products of the Mass, Adventure and Phoenix mines, while the 70,000 pounds credited to the Mohawk is an estimate of the amount of ingot copper taken from the small trial shipments of mohawkite sent to the smelters in Wales. The Centennial products for several years past have been secured from the single stamp at the old mill, and afford no criterion of the mine's capabilities when furnished with a modern milling plant.

In the case of nearly all of the larger mines in 1900 figures of production may be considered low-water mark. The Calumet & Hecla production was decreased by the mine fire, but for the current year a larger output will be made, barring serious accidents in the latter half of the year, and should the new shafts on the Osceola lode be placed in commission an annual output of fifteen to twenty million pounds may be anticipated from those openings, to swell the product secured from the original mine on the Calumet conglomerate.

The Tamarack is now equipping its No. 5 shaft, one of the most wonderful ever sunk, and when that goes into full commission the production of the mine will be increased very greatly, an allowance of 25 per cent increase for 1902 over the 1900 figures probably being a conservative estimate.

The Quincy production for 1901 will be much the largest ever secured, as the mills are now making about 1,200 tons of mineral per month, and the 1902 output should be still greater. The Osceola will have one new shaft at the North Kearsarge and two new shafts at the South Kearsarge in commission within a few months, and in 1902 should be able to crowd 20,000,000 pounds production. The Atlantic will be able to increase its product when the two stamps now used by the Baltic are released, powerful new hoists having been installed to allow the economical production of a much greater quantity of rock than has ever been raised heretofore. The Franklin is now making about 200 tons of mineral monthly, and is planning on expansions that will increase its output of refined copper. The Wolverine is averaging 250 tons of high grade mineral monthly, or at the rate of fully five million pounds per annum, at present, and when its new mill goes into commission should be able to increase its output by forty per cent from the start. In 1903 the Wolverine should make at least 7,000,000 pounds of refined copper, with two stamps, with room in the new mill for a third stamp when needed.

Baltic, which will have its new mill in commission this fall, should make about six million pounds of copper next year. Arcadian is making more copper at present than ever before, and should show a gain for 1901, Centennial cannot increase its output to any great extent until it has a modern mill, which may be erected next year. Arnold's product for 1901 will decrease. Mass will show a phenomenal increase for this year, and a similar large gain for 1902. Adventure will have a mill running in 1902, and Phoenix will more than double its 1900 production this season, without a mill. The Mohawk mill should get about a half year's product in 1902, and in 1903 or 1904 should reach an output of ten to twelve million pounds of ingot copper.

From this brief review of the productive capacity and prospects of the Lake district it is evident that the next few years should show large and continuous increases in output. These expectations may be offset by serious accidents to some of the great mines, entailing enforced idleness for considerable periods, but nothing less than a great disaster, such as the closing down of the Calumet & Hecla for some months, can prevent the 1902 copper output of Lake mines being much the largest ever secured.

For those who desire elaborate statistical tables regarding the Lake mines, exhibiting their products, earnings, costs, dividends, etc., I would recommend reference to the last annual report of this office, issued early in 1901, these tables being unusually complete, and practically down to date.

CHARCOAL PIG IRON.

The most important development of the past year in the charcoal pig iron industry of Michigan is the decision of the Cleveland-Cliffs company to erect a large furnace at Marquette. T his will be on a larger and more modern scale than the furnaces and kilns of the company at Gladstone, which still rank at the head among American furnaces using charcoal for fuel. The plans of the Cleveland-Cliffs company are drawn upon a large settle, and will result in greatly stimulating the production of pig iron in this state. It is possible that the Marquette plant may eventually use coke or anthracite for fuel to some extent, but this is a matter that must be left for the future to determine.

The following figures of production of pig iron by the charcoal furnaces of Michigan have been secured from the makers, and may be relied on as absolutely correct:

Furnace.	Location.	Tons—first 6 mos. 1901.	Tons 1900.	Tons 1899.
Antrim Iron Co	Mancelona	18,795	25,506	36,073
Carp River Furnace	Marquette	8,336	14,243	2,326
Elk Rapids Iron Co	Elk Rapids	12,280	22,060	25,134
Gaylord Iron Co	Detroit	3,539	11,374	5,473
Manistique Iron Co	Manistique	16,710	20,486	.....
Peninsular Iron Co	Detroit	2,988	10,335	9,860
Pioneer Furnace	Gladstone	19,408	38,211	31,546
Spring Lake Iron Co	Fruitport	11,428	22,291	.....
Totals		93,484	164,506	110,412

The production of Michigan charcoal iron furnaces for the first half of the current year reflects the general activity prevailing in the iron trade. Prices of the product have been higher at times in the past, but there have been few periods when the demand was more steady, at fairly remunerative prices. The production of 1898 was 150,907 tons, followed by the greatly decreased output of 1899, when low water mark was reached with an output of but 110,412 gross tons.

The furnace of the Antrim Iron company was out of blast about 10 weeks in 1900, during which time needed repairs were made, T. J. O'Brien is president, J. C. Holt secretary and treasurer, and N. M. Langdon manager of the company.

The Carp River furnace is operated by the Pioneer Iron company, which is the smelting department of the Cleveland-Cliffs company. The furnace went into blast late in 1899. Noah W. Gray is manager of this furnace, and C. H. Schaffer is fuel superintendent.

The Elk Rapids Iron company manufactures wood alcohol and acetate of lime, having a modern by-product plant in connection with its kilns.

During the first half of 1901 the furnace of the Gaylord Iron company was in blast only three and a half months.

W. H. Nelson, formerly of the Excelsior furnace, at Ishpeming, is manager of the Weston furnace, operated by the Manistique Iron company. The furnace went into blast May 18, 1900.

The Pioneer furnace, at Gladstone, is operated by the Pioneer Iron company branch of the Cleveland-Cliffs company, with Austin Farrell as manager. The product for 1900 was the largest secured for some years, and the product for the first half of the present year was slightly in excess of the ratio of the preceding year.

The Spring Lake furnace, at Fruitport, is operated by the Spring Lake Iron company, with officers as follows: Irving M. Bean, president; J. Spencer, vice president; Samuel Marshall, treasurer; J. C. Ford, secretary and general superintendent.

COAL.

The coal industry of Michigan is steadily growing. The Jackson-Corunna-Grand Ledge field, which was the first opened in the state, does not show progress, but in the Saginaw-Bay City district, first opened but a few years ago, a steady gain is noted. The industry is not making any millionaires, but it is furnishing employment to a great deal of capital and a large number of workmen, with satisfactory returns to both. The building up of a large coal industry in Michigan not only retains money in the state that would otherwise go to other commonwealths for necessary fuel supplies, but it also proves of great assistance in the development of manufactures in the Saginaw valley, and territory contiguous. While the coal measures of Michigan can never vie in importance with those of Pennsylvania, Ohio and Illinois, the industry is a promising one, and bids fair to expand to many times its present size.

The coal mines of Michigan have been taken under the wing of the state labor bureau since the first developments of the mining industry in the Saginaw valley, and the statistics of the industry are prepared by that bureau. It is to be regretted that the labor bureau should not have seen fit to make its year correspond with the calendar year, but as the preparation of statistics of the Michigan coal trade for the calendar year 1900 would have necessitated the complete covering of the field for a second time, in order to correct the figures for a single month, I have thought best to use the statistics of the state labor bureau, which are for the year ending Nov. 30, 1900. These statistics, while they would be of greater value if made to correspond to the limit of the calendar year, have been carefully gathered and fully verified, and are worthy of all credence.

The number of producing mines in Michigan that reported to the labor bureau for the fiscal year 1900 was 26, while for the four months ending Feb. 28, 1901, there were 35 reporting mines, showing a gain of nine, an increase of more than one-third in the number of active properties in the state.

For the year ending Nov. 30, 1900, the production of coal by Michigan mines was 843,476 tons, an increase of more than 25 per cent over the production of the preceding year. For the four months ending Feb. 28, 1901, the output of coal by Michigan mines was 355,253 tons, and there seems every reason to believe that the

output for the year 1901 will run considerably above a million tons, for the first time in the history of the industry.

The miners and surface employees at the mine averaged 20.2 days work per month, with an average of 8.1 hours daily, and earned an average annual income of about $350. The number of mines in operation on Dec. 31, 1901, was 31. The average number of employees for the year 1900 was 1,638, giving an average force of 53 persons for each active mine. The average force employed at the larger mines is much greater, the ten largest mines of the state employing an average force of 1,430 hands, in the year 1900. The average daily wage paid each employee was $2.34, and the aggregate cost of the 1900 output of 843,476 tons was $1,164,000, giving an average cost, for the season's production, of $1.38 per ton.

About 75 per cent of the employees are termed miners, this covering practically all the men who work underground. The average cost of the coal produced in the four months ending Feb. 28, 1901, was $1.41 per ton, the slight increase above the average of the preceding year being due o increased costs of winter operation.

At the present time, in July, 1901, more than 2,000 men are employed in the coal mines of this state. The industry is on a sound footing, and while the product is sold at a low price, the operators of most of the properties are making a reasonable profit, and the consumers are benefited by the low prices. The future of the coal mining industry of the state appears bright.

SALT.

The manufacture of salt for the fiscal year ending Nov. 30, 1900, showed a gain of 81,432 barrels, equal to nearly 2 per cent, in this state, the total production being 4,820,685 barrels, and the inspection amounting to 4,738,085 barrels. The total production of salt by the wells of Michigan, from the beginning of the industry to Nov. 30, 1900, has been 91,413,483 barrels, and the production for the fiscal year last passed was the largest in the history of the industry.

In the fiscal year 1900 there were 56 separate firms engaged in the manufacture of salt in this state, with 60 salt blocks and one thousand solar salt covers in use.

The salt producing portions of Michigan are divided into eight districts. These districts, with their limits and the plants and capacity of each, are as follows, according to the last official report of the state salt inspector:

District No. 1, Saginaw county, has seventeen salt companies, with seventeen steam blocks and one thousand solar salt covers, having a manufacturing capacity of 800,000 barrels of salt per annum.

District No. 2, Bay county, has eleven salt companies, with ten steam blocks and one vacuum pan block, and has a manufacturing capacity of 800,000 barrels of salt.

District No. 3, St. Clair county, has eight salt companies with six steam and four vacuum pan blocks, and a manufacturing capacity of 1,000,000 barrels.

District No. 4, Iosco county, has one salt company, a steam block, and has an annual manufacturing capacity of 50,000 barrels.

District No. 5, Midland county, has two salt companies, both steam blocks; manufacturing capacity of 50,000 barrels.

District No. 6, Manistee county, has nine salt companies with nine steam and three vacuum pan blocks, and has a manufacturing capacity of 3,000,000 barrels.

District No. 7, Mason county, has three salt companies, with three steam and two vacuum blocks; manufacturing capacity of 1,000,000 barrels.

District No. 8, Wayne county, has seven salt companies, with seven steam and one vacuum pan blocks, and a manufacturing capacity of 1,000,000 barrels.

Total annual capacity of all Michigan salt manufacturers, 7,700,000 barrels.

Improvements and changes noted during the fiscal year 1900 are as follows:

J. F. Brand, of Saginaw, completed a new block and is making salt.

The Wright block, of Saginaw, has been remodeled and has resumed the manufacture of salt.

The Traction company, of Saginaw, has built a block with a capacity of 225 barrels per day.

The Somers Coal company, of St. Charles, Saginaw county, is building a new block.

The Old McLean plant, of Bay City, has been remodeled and is now operated by the Garrison Salt company, with a daily capacity of 150 barrels.

The Port Huron Salt company has built a large plant at Port Huron, with a capacity of 2,500 barrels per day. It has 12 grainers, and one vacuum pan.

The Diamond Crystal Salt company, of St. Clair, has added two new cement grainers, increasing its capacity to 600 barrels per day, and has also built large warehouses and packing houses.

The old Owen salt block, at Marine City, has been rebuilt, and will resume the making of salt in a short time, with a capacity of 150 barrels per day.

Salliate & Ferguson, of Wayne county, have built a new block on the River Rouge, and will manufacture about 300 barrels per day.

W. W. Kelley has built a block of three grainers at Trenton, Wayne county, with a capacity of 250 barrels per day.

Irving Wise & Co. are sinking a well on the River Rouge, Wayne county, with the intention of building a salt block.

MISCELLANEOUS MINERALS.

GOLD AND SILVER.

Despite the known existence of exceptionally rich gold deposits, Michigan has no producing mines at the present time. The Ropes, the only largely developed gold and silver mine in the state, was closed down in 1897, and sold by a receiver appointed by the court to wind up the affairs of the corporation owing the property. The mine is at present owned by Corrigan, McKinney & Co. of Cleveland, Ohio, who have extensive iron mining interests in the various Lake Superior districts. The present owners have contented themselves with saving what gold was found under the mill and in the old amalgamating plates, and in retrieving a portion of the metal lost in the tailings, through the operation of a cyanide plant. It has been hoped, by those interested in the development of the Ishpeming gold district, that Corrigan, McKinney & Co. might reopen the mine, which has extensive underground developments, but there seem no indications of such an intention on the part of the firm. W. H. Rood, of Ishpeming, president and principal owner of the Deer Lake company, has recently made a trip to the Colorado gold fields, where he familiarized himself with the latest processes of reduction, and it is probable that he will erect a small cyanide plant on the lands of the Deer Lake company, adjoining the mine, as a large part of the tailings coming from the mill during fifteen years of active operation were deposited on the Deer Lake lands. Gold has been found at many points in the country north of Ishpeming, and it is rather remarkable that nothing is being done to develop some of the more promising prospects of the district. Peter Gingrass, of Ishpeming, the owner of the fee of the celebrated Michigan mine, which turned out some of the richest gold-bearing quartz ever secured anywhere, is endeavoring to do something in the way of interesting capital in his mine, the career of which was wrecked, before it was fairly started, by an unfortunate combination of litigation, stock-jobbing and theft. Were this prospect located in Colorado or some other western gold mining state, the money for its development would be found quickly, but there seems a prejudice against Michigan gold mines, due partly to the unfortunate career of the Ropes, and partly to the idea, generally prevalent, that because no profitable gold mine has yet been opened in this state, none such ever will be opened.

MANGANESE.

Manganiferous iron ores are mined on all three of the Michigan iron ranges, the proportion of manganese ranging from less than 2 per cent to as high as 25 per cent. An attempt was made in the winter of 1900-1901 to reopen the old Clark copper mine, near Copper Harbor, Keweenaw county, for manganese, detailed reference to which will be found at the beginning of the section of this work devoted to copper, but the showing was insufficient to warrant extensive development, and the work was soon abandoned.

SANDSTONE.

The quarrying of sandstone for building purposes continues to be and important industry. A medium grade of gray freestone is quarried at a number of points in the lower peninsula, but the fine-grained red and brown sandstones are found only in Marquette, Houghton and Baraga counties, in the upper peninsula, and are quarried only in the two counties first named, the quarries in the Portage Entry district of Houghton county furnishing the largest output. The Superior Red Sandstone company is a new concern that has opened a large quarry of fine red sandstone north of Portage Entry, at a station called Arnheim, in honor of Jeremiah Arn, manager of the quarry.

The Portage Entry Quarries company shipped 131,525 cubic feet of block stone and 6,726 cords of rubble during the year 1900. For the fist six months of 1901 shipments were 27,416 cubic feet of block stone and 515 cords of rubble. The shipments for the latter half of the year will be larger. The Portage Entry Quarries company has its general offices in the Chamber of Commerce building, Chicago, with local office at Jacobsville, Houghton county, George Froney being superintendent. The quarries of the Kerber-Jacobs Redstone company are being operated by the Portage Entry Quarries company, under lease.

MARBLE.

The county of Houghton owns a promising marble quarry in the Felch Mountain district, Dickinson county, which has been under lease for some years past to the Northern Michigan Marble company, a Chicago corporation. The quarry has not been extensively developed, and at the present writing it is uncertain what arrangements will be made for its development and operation, as a considerable difference of opinion has arisen between the owner and the lessee.

GYPSUM.

The gypsum industry of Michigan is practically confined to the city of Grand Rapids, where gypsum is quarried very extensively, for use as the basis of a number of patent plasters, stuccos and wall finishes. The production for 1900 was about the same as in the preceding year, when the output was 144,776 tons,

valued at $283,537, as it came from the quarries. The greater portion of this product was calcined, but a few thousand tons were ground into land plaster.

MARL.

The marl deposits of Michigan are extensive and valuable, and marl beds at Quincy and Coldwater have been developed to supply cement factories built at those points. Owing to questionable financiering these factories are now placed in bad shape financially, and the reorganization of the Michigan Portland Cement company seems a necessary preliminary to the successful manufacture of cement in this state. The factories are well planned and fairly well equipped, and with a few changes can be made profitable, providing the financiering of the enterprise is placed upon a sounder basis than in the past. The marl measures of Michigan are of great value, perhaps unexcelled in the entire union, and the making of cement should become one of the important industries of the state.

FELDSPAR.

A little attention is now being given to the deposits of feldspar in the vicinity of Republic, and it is hoped that a permanent industry may result. Careful examination of the spar deposits leads to the conclusion that they are valuable, and of sufficient extent to justify their development and regular operation.

GRAPHITE.

The Hathaway Graphite company is operating the graphite quarry near L'Anse, and is manufacturing a portion of the product into carbons for electric light. The deposit is of fair grade and considerable extent, hence there seems no good reason why a permanent and profitable business should not be built up, in the present capable hands, although past efforts to operate the quarry have not proved profitable. The uses for plumbago are steadily increasing, and when the value of this mineral as a preserver of iron surfaces is more fully understood the manufacture of mineral paint alone will consume more graphite than is now produced in the entire country.