MISSOURI BUREAU OF GEOLOGY AND MINES
H. A. BUEHLER, Director.

Vol. X., Second Series.

THE IRON ORES

OF

MISSOURI

BY
G. W. CRANE

THE HUGH STEPHENS PRINTING COMPANY,
JEFFERSON CITY, MISSOURI.

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LETTER OF TRANSMITTAL.

Missouri Bureau of Geology and Mines
Rolla, Mo., February 1, 1912.

To the President, Governor Herbert S. Hadley, and the Members of the Board of Managers of the Bureau of Geology and Mines:

Gentlemen: I have the honor to transmit herewith a report on the iron ores of Missouri by Mr. G. W. Crane. Mr. Crane was assisted by Mr. V. H. Hughes, who examined and prepared the descriptions covering a majority of the deposits of the hematites of the filled sinks, the limonites of the northern and western portions of the Ozarks, and the hematites of the Carboniferous. He also prepared the general and county indices and the tables of production. The limonite deposits, over a portion of the Southeast district, were examined by Mr. J. W. Bodman.

In addition to the general chapters devoted to physiography and geology, and occurrence and distribution of the various types of ore, there have been included brief descriptions of all the known deposits of the State. Because of the number of these it has been necessary to condense each to essential facts and many details have necessarily been omitted. The general geologic map, accompanying this report, shows graphically the number of known deposits and the extensive area throughout which they occur. These locations are chiefly such as have, from their surface indications, attracted the attention of the prospector.

In a work of this character it has been impossible to visit and describe each outcrop as this would necessitate a detailed geologic survey of practically the entire Ozark region. It is hoped, however, that the present volume will serve to point out clearly the geologic conditions under which each type of ore occurs and thereby help to stimulate proper prospecting and development.

Respectfully submitted,

H. A. BUEHLER,

State Geologist.

ACKNOWLEDGMENTS.

Only through the hearty co-operation of those interested in the iron mining industry of the State is the completion of a report of this character possible. Without exception, owners and operators have extended every courtesy possible, and to each the Bureau is under deep obligation.

Among those to whom the author is especially indebted are: Mr. J. B. White, President and General Manager, and Mr. C. C. Sheppard, General Superintendent of the Missouri Lumber and Mining Company; Mr. J. H. Hahn, Secretary and Assistant Manager of the Ozark Land and Lumber Company; Mr. C. W. Hays, President of the Wayne Iron and Lumber Company; Mr. J. S. Strong, Superintendent of the St. Francois Land and Iron Company; Mr. C. J. Crawford, President, and Mr. A. J. Meyer, Secretary and Treasurer of the Puxico Iron Company; Mr. Chas. E. Fryberger, Mr. Chas. M. Cady, Mr. J. P. Thomas, Mr. W. H. Smollinger, Prof. W. B. Potter, Mr. B. M. Griffith, Mr. F. B. DeCamp, Vice-president and General Manager of the St. Louis Blast Furnace Company; Mr. C. L. Rogers, President and General Manager of the Sligo Furnace Company; Mr. W. H. H. Myers, Secretary of the Missouri Copper Mountain Mining Company; Mr. C. H. Martin, Mr. F. E. Smelzer, Mr. W. H. Ohnsorg, Mr. J. B. Morrison, and Mr. J. C. Kingsbury.

In the preparation of the report acknowledgments are due to the late Dr. E. R. Buckley, former State Geologist and to Mr. P. N. Moore, Vice-president of the State Board of Managers of this Bureau, for valuable suggestions regarding the subject matter and the arrangement of the report; and to Prof. G. H. Cox, for the examination of thin sections.

G. W. C.

INTRODUCTION.

The iron bearing region of Missouri lies chiefly within the Ozark plateau and covers approximately 30,000 square miles or half the area of the State. The iron ores have been the subject of a number of investigations by the earlier Geological Surveys. The most detailed of these was made by Mr. F. L. Nason in 1892. Earlier reports, covering portions of the field, were published in 1854, 1872, and 1874. These volumes, however, are no longer available and the present report has been prepared in response to a renewed demand for information concerning the occurrence and distribution of the iron ores. This demand has been occasioned chiefly by the partial development of the limonite deposits of Southeast and Southwest Missouri.

Several types of ore occur within the iron bearing region. The deposits of each type are so segregated that they can easily be described by districts and in the following chapters these have been designated as; (1) brown ores, including the deposits of primary and secondary limonites in Southeast and Southwest Missouri, (2) hematites of the filled sinks, including the ores of the Central Ozark district, (3) specular ores in porphyry, including the deposits in the St. Francois Mountains, and (4) hematites of the Carboniferous and Silurian, including the, as yet, undeveloped deposits occurring in those formations.

In the present report particular attention has been devoted to the brown ore deposits of Southeast and Southwest Missouri. The partial development of these ore bodies, during the past few years, has attracted considerable attention to the possible future of this class of deposits. The brown ores have been produced chiefly since 1900 and, up to the present time, comparatively few of these deposits have been worked in a systematic manner or under conditions favoring cheap production or large recovery. While these ores were formerly considered of too low grade to be utilized, they are shown in Chapter V to be equal, in all respects, to the limonites produced so extensively in the Southern States.

Usually the deposits are not large and in many instances the smaller ore, which comprises a considerable proportion of the deposits, can be recovered only by washing, and, in most cases, a simple log washer, one that can be dismantled and transported easily, will be found to give the greatest returns on the investment. In exceptional cases only will the size of the deposits justify the erection of large or expensive plants.

The future production of the red and specular hematites of the Central Ozark region will depend chiefly upon the discovery and opening of new mines. The properties, now in operation, are being exhausted rapidly and cannot maintain the present output for any considerable time.

The geologic structures favorable for the occurrence of this type of deposit are described in detail in Chapter VI. Since a number of the more important mines have been marked by little or no outcrop, prospecting for red and specular hematite should be guided chiefly by a consideration of the sink structure. Inadequate transportation facilities are responsible for the lack of development in many parts of the district. For this reason, promising properties, such as the Christy bank, have not been mined.

Many of the old mines, now abandoned, probably contain a considerable tonnage of ore which was either lost, due to improper methods of mining, or not recovered during the operations of the properties, due to the high grade of ore required in the earlier day. Much of this ore could be utilized profitably at the present time.

While the richer ore bodies at Iron Mountain and Pilot Knob have been exhausted, the present investigation indicates that there are still important reserves on both properties. These reserves consist chiefly of conglomerate and boulder ores which could not be mined profitably in the early day but which are available under present conditions. Each of these properties probably contains as large a tonnage as any other individual deposit in the State.

The hematite and carbonate ores of the Carboniferous do not offer any encouragement as commercial sources of iron ore.

The most important factor in the development of Missouri's iron ores, at the present time, is adequate smelting facilities for the ores occurring in the southeastern portion of the State. There is no smelter now in blast that can absorb the ores of either the primary or secondary limonite districts and, as a consequence, during the past year practically no ores of these types have been produced. Pilot Knob has been operated during the entire year, the ore, however, being shipped to Ohio and the East.

The production for 1910 represents but a small fraction of what can be produced from the Missouri deposits if properly developed.

CHERRY VALLEY MINE NO. 2, LOOKING SOUTH.

CHAPTER I.

HISTORY, DEVELOPMENT, AND PRODUCTION OF MISSOURI IRON ORES.

HISTORY AND DEVELOPMENT.

On a voyage down the Mississippi in 1673 Marquette* noted the occurrence of iron ore on the river bluffs just north of Apple Creek, in the southeast corner of Perry county. The deposit is described as consisting of "several veins of ore and a bed a foot thick and one sees large masses of it united with pebbles." This is probably the first record of the discovery of iron in Missouri. That the early inhabitants knew of and recognized the possible value of these deposits is indicated by the fact that, in 1789 citizens of Ste. Genevieve offered to show Col. John Morgan**, who visited southeast Missouri during that year, "good iron and lead mines only one short day's journey from the river."

Although the mining of lead had flourished for almost a century and had attracted much attention to this State as a great mineral bearing area, there is no record of any attempt to mine or smelt the ores of iron until 1815 when, what is known as the Ashebran Furnace was erected at the Shut-In, two miles east of Arcadia, Iron county. The establishment of this primitive industry gave Missouri the distinction of being the first state west of Ohio to mine and smelt the ores of iron.

Although the brown ores were the first to be discovered and were, in part, much nearer to the Mississippi river, which was then the great highway of commerce, the specular hematite of the St. Francois Mountains and the red and blue specular hematites of the Central Ozarks were the first to be generally utilized, due chiefly to their higher grade. The ore smelted at the Ashebran furnace in 1815 was

*Houck, L., History of Missouri, vol. 2, 1908, p. 161.
**Ibid, vol. 2, 1908, p. 115.

specular hematite obtained chiefly from Shepard Mountain, although a small quantity was mined near the Shut-In.

The first attempt to utilize the red and specular hematite of the Central Ozarks was made in 1819-20 when the Harrison-Reeves furnace was built on Thicketty creek, three miles southeast of Bourbon, Crawford county. The ore was obtained from deposits in the neighboring hills.

According to Dr. Litton*, the first attempt to utilize the brown ores was made at Perry's old iron furnace located five miles north of Caledonia, Washington county, about 1823. The ore, which was chiefly brown hematite (secondary limonite), was obtained from a hillside on Absalom Eaton's place and was mixed with ore brought from Iron Mountain.

In 1826 Wm. James opened what is known as the Meramec bank located five miles southeast of St. James, Phelps county. A furnace, which was erected at Meramec Springs a short distance east of the deposit, was put in blast in January 1829. With the exception of the Meramec furnace which was operated at intervals for 30 years, these early industries had a comparatively short life and only a small output.

Not until the opening of the large deposits at Iron Mountain and Pilot Knob between 1845 and 1850, did Missouri attain very great importance in the iron industry. During the next 30 years, while these deposits were being worked extensively, the industry flourished, and Missouri became an important center of the iron world. The State held this position until 1888 when there was a rapid decline in production. This decline may be attributed chiefly to the exhaustion of the more available high grade ores at Pilot Knob and Iron Mountain, and to the working out of a number of the more important deposits in the Central Ozarks. At about this time there was a rapid decline in the price of iron ore and iron products throughout the United States, due chiefly to the discovery of immense deposits of high grade bessemer ore in the Lake Superior region, which could be mined at a very low cost, causing the market to drop below the possible cost of production in Missouri.

Not until the past decade have the brown ores attracted any considerable attention. While they were known to occur abundantly in the southern portion of the State, their commercial importance had not been generally recognized. Although a few sporadic attempts to

*Litton, A., Preliminary report on some of the principal mines in Franklin, Jefferson, Washington, St. Francois, and Madison counties: Missouri Geol. Survey, 1855, Part. II, page 74.

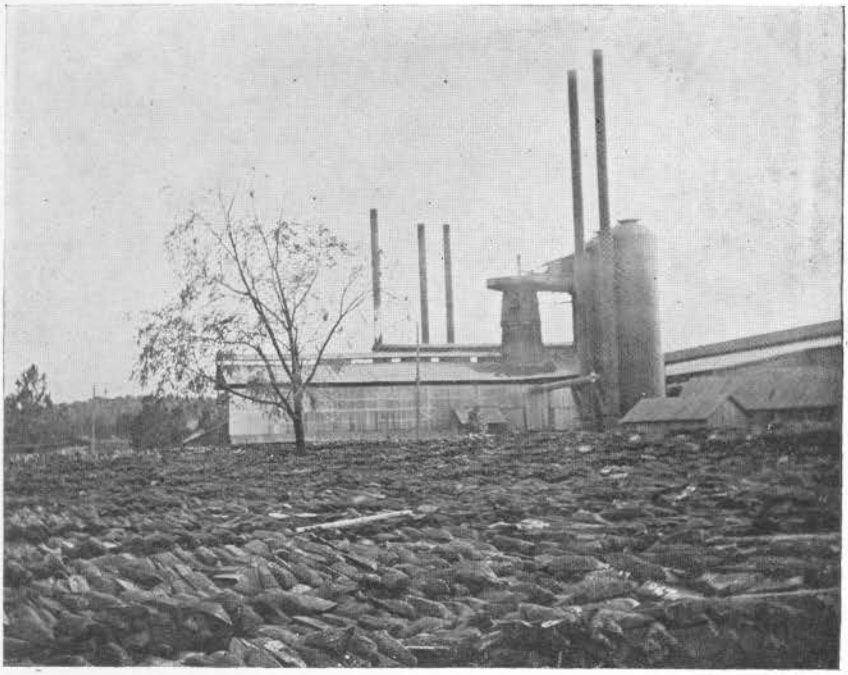

Fig. 1. SLIGO FURNACE, SLIGO, DENT COUNTY.

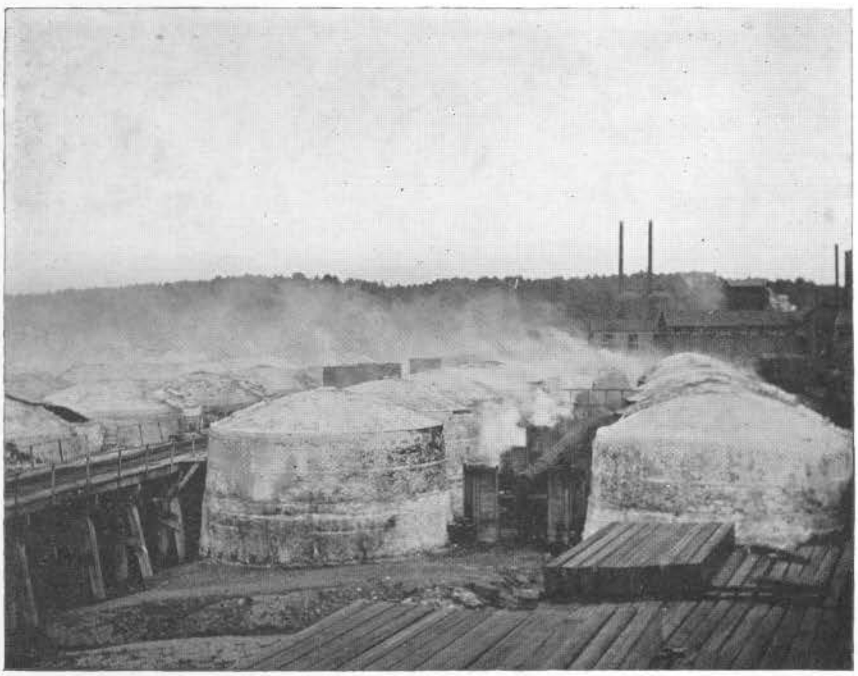

Fig. 2. CHARCOAL OVENS, SLIGO FURNACE, SLIGO, DENT COUNTY.

mine these ores were made in the early 70's in Bollinger, Madison, Butler, Washington, and Camden counties, and again in the 80's in Wayne, Madison, and St. Francois counties, it was not until 1889 that any important shipments were made and not until 1900 that they began to be generally utilized.

The deposits of red hematite occurring in the Lower Coal Measures, in the counties bordering the Ozark plateau on the north and northwest, are still undeveloped and many of the outcrops and pits described in the earlier reports are now covered and filled to such an extent that the value of the ore bodies cannot be determined without additional work. Although much of the ore is merchantable, it is probable that the deposits are not large enough to warrant exploitation under present conditions.

Thin beds of carbonate of iron have been drilled quite extensively in the Lower Coal Measures of Northwest Missouri but, up to the present time, none thick enough to be utilized have been discovered.

At the present time there is but one iron furnace in blast in this State. This plant is owned by the Sligo Furnace Company of St. Louis and is located at Sligo, Dent county. It is so situated as to absorb the output of the Central Ore District, but is not available for the ores of Southeast Missouri. Its product consists entirely of charcoal iron.

The furnace of the St. Louis Blast Furnace Company, located at South St. Louis, until recently absorbed most of the ore mined in Southeast Missouri. This furnace went out of blast in August, 1911, and since that time Southeast Missouri has been without furnace facilities. This fact has necessitated the closing down of all the limonite deposits of the Southeast district. The ore from Pilot Knob is being shipped to smelters in Ohio, and this property will probably continue operations in spite of the almost excessive freight rate occasioned by the long haul.

The most important factor in the revival of the iron industry in the State is adequate smelting facilities for the ores of Southeast Missouri. The partial development of these deposits during the past few years has materially increased the yearly output of the State. As shown in Chapter V, the Missouri limonites are equal in value to any produced in the United States, and the numerous deposits when properly developed are capable of maintaining a yearly tonnage equal to if not greater than the former annual production of the State.

PRODUCTION.

Up to January 1st, 1911, Missouri has produced a total of 9,134,-624 tons of iron ore valued at $32,576,049. In part these figures are estimates, based upon the most reliable information available and the totals, while approximating the actual figures, may vary somewhat from the true output. Nason summarizes the total production up to 1893 in his report on the iron ores of Missouri and, excepting where additional records have been obtained, his figures are accepted as being as accurate as can be procured at the present time. Few of the early operators kept accurate records of production and not infrequently their records have been destroyed by fire. While the productions of such properties are necessarily estimates of operators and owners, it is thought that the figures are approximately correct.

The following table shows the total annual production, average price per ton, and total value of the iron ore mined in Missouri to January 1st, 1911:

TABLE NO. I.

Annual Production and Value of Iron Ore in Missouri.

Year.	Production gross tons.	Estimated average value per ton.	Total value.	Authority for tonnages.
Prior to 1850..	100,000			
1850 to 1860...	310,000	$3.00	$3,105,000	Edwin Harrison.
1861 to 1870...	625,000			
1870..........	316,000			
1871..........	240,000	5.00	15,693,470	Edwin Harrison.
1872-1879 incl..	2,582,694			
1880..........	386,197	4.33	1,672,233	Tenth Census, vol. XV, p. 48.
1881-1882 incl..	604,007	4.50	2,718,031	" " " "
1883..........	295,430	3.40	1,004,462	Min. Res. U. S., 1883, p. 262.
1884..........	233,235	3.40	792,999	" " " " "
1885..........	234,160	2.70	632,232	" " " 1885, p. 188.
1886..........	379,776	2.60	987,418	" " " 1886, p. 14.
1887..........	427,785	2.80	1,197,798	Swank, Ann. Stat. Rept. Am. Iron and Steel Asso., 1889.
1888..........	217,931	2.60	566,620	Swank, Ann. Stat. Rept. Am. Iron and Steel Asso., 1889.
1889..........	265,718	2.20	584,580	Birkinbine, Am. Iron and Steel Asso., 1891.
1890..........	232,835	2.20	512,237	Report of State Mine Inspector.
1891..........	138,356	2.50	345,890	" " " "
1892..........	126,000	2.50	315,000	" " " "
1893..........	86,983	2.07	180,055	" " " "

TABLE NO. 1—Continued.

Year.	Production gross tons.	Estimated average value per ton.	Total value.	Authority for tonnages.
1894..........	73,688	1.28	94,321	Compiled from figures obtained from the following sources: Reports of State Mine Inspector. Reports of State Labor Commissioner. St. Louis Blast Furnace Co. Sligo Furnace Company. Missouri Furnace Company. Meramec Iron Company. Midland Blast Furnace Co. Individual Mine Owners.
1895..........	40,202	1.36	54,675	
1896..........	41,826	1.36	56,883	
1897..........	56,256	1.08	60,756	
1898..........	81,799	1.14	93,251	
1899..........	84,306	1.42	119,715	
1900..........	88,791	1.52	134,962	
1901..........	72,202	1.60	115,523	
1902..........	73,609	1.60	117,774	
1903..........	54,350	1.74	94,569	
1904..........	49,045	1.88	92,205	
1905..........	116,666	1.43	166,832	
1906..........	103,992	1.95	202,784	
1907..........	109,273	2.02	220,731	
1908..........	95,721	2.21	211,543	
1909..........	112,100	2.34	262,314	
1910..........	78,691	2.15	169,186	Mo. B. of G. and M. in co-operation with U. S. Geol. Sur.
Total....	9,134,624	....	$32,576,049	

According to the above table approximately 1/9 of the total output was mined prior to 1870. The most active period of production was between the years 1870 and 1890 during which time 6,415,768 tons, or approximately 2/3 of the total were mined. From 1890 to 1895 there was a rapid decline in production accompanied by a rapid fall in price from which the industry has not fully recovered. The decreased output for 1910 was due to the closing down of the St. Louis Blast Furnace for a portion of that year.

The following table shows the total tonnage of each type of iron ore mined in the State:

TABLE NO. II.

Total Production of each type of Iron Ore to Jan. 1st, 1911.

Type of Ore.	Tons.	Precentage of total.
Specular Hematite in Porphyry..............................	5,627,799	61.61
Red and Specular Hematite of the Central Ozarks.............	3,072,637	33.64
Brown Ore...	291,656	3.19
Miscellaneous*..	142,532	1.56
Total...	9,134,624	100.00

*This figure is obtained by subtracting the sum of the known productions of the several counties up to 1893 from the total production of the State to that date as recorded in table No. 1. It represents that part of the total State production for which the data showing the distribution either by county or type of ore is not at hand. It includes, in part, shipments reported by Nason from Saline, Callaway, Washington, Camden, and Marion counties, not shown in the accompanying tables.

According to Table No. II approximately 62% of the total production of the State has been derived from the deposits of specular hematite in the St. Francois Mountain, 34% from the red and specular hematite deposits of the Central Ozarks, and only slightly over 3% from the brown ores.

In the following table is shown the total production of each of the various types of iron ore by counties, which are arranged according to their rank as producers:

TABLE NO. III.

Total Production by Counties.

County.	Hematites.		Brown Ores.		Total.
	Specular Ores in Porphyry.	Hematites of Central Ozarks.	Secondary Limonite.	Primary Limonite.	
St. Francois	3,939,299		500		3,939,799
Iron	1,688,500		1,119		1,689,619
Crawford		1,408,095	30		1,408,125
Dent		904,841			904,841
Phelps		613,390			613,390
Franklin		146,311	834		147,145
Howell			91,684		91,684
Wayne			44,864	7,478	52,342
Shannon			40,363		40,363
Christian				30,112	30,112
Greene			4,382	14,768	19,150
Stoddard				15,993	15,993
Butler			13,660	2,150	15,810
Madison			10,424		10,424
Bollinger			4,731	1,630	6,361
Carter			1,962	1,555	3,517
Ripley			705	2,064	2,769
Osage			161		161
Lawrence			115		115
Polk			99		99
Oregon			83		83
Gasconade			76		76
Dade				39	39
Maries			32		32
Cape Girardeau				25	25
Jefferson			18		18
Total	5,627,799	3,072,637	215,842	75,814	8,992,092
Miscellaneous					142,532
Total production of State					9,134,624

The production of the various mines of the porphyry region is shown in the following table:

TABLE NO. IV.

Total Production by Mines* of Specular Hematite in Porphyry.

Name of Mine.	Tons.
Iron Mountain	3,939,299
Pilot Knob	1,580,640
Shepherd Mountain	75,000
Cedar Hill	25,000
Buford Mountain	3,000
Russell Mountain	3,000
Shut-In	600
Miscellaneous	1,260
Total	5,627,799

With the exception of Iron Mountain and Pilot Knob, these properties have not been worked in many years. Iron Mountain has produced some ore every year with the exception of 1897, and the results of recent drilling indicate that the property is by no means worked out. Pilot Knob, after being closed down since 1892, is again in operation. Although the high grade ore of the main bed has been exhausted, there appears to be a sufficient reserve in the conglomerate and low grade beds to prolong mining operations at this place for many years.

The following table shows the known annual productions of the Iron Mountain and Pilot Knob mines up to date:

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*With the exception of those for Iron Mountain and Pilot Knob, these figures are taken from Nason's report of 1892. The figures for Iron Mountain and Pilot Knob were obtained from the sources indicated in the foot note to production table No. V.

The ore included under miscellaneous was reported by the Missouri Labor Commissioner to have been shipped from Iron county during 1894 and 1896; source not indicated.

TABLE NO. V.

Annual Production of Iron Mountain and Pilot Knob.*

Year.	Iron Mountain.	Pilot Knob.
Prior to 1871	1,103,453	....
1871	157,904	....
1872	269,480	....
1873	235,130	....
1874	103,680	....
1875	107,220	....
1876	107,430	....
1877	75,468	....
1878	95,930	....
1879	142,368	....
1880	108,045	....
1881	77,434	501,892
1882	62,043	90,477
1883	51,352	116,699
1884	47,220	124,636
1885	52,993	136,737
1886	138,082	198,909
1887	113,589	206,273
1888	60,993	98,298
1889	70,027	57,630
1890	85,268	33,819
1891	66,914	5,835
1892	78,969	7,049
1893	65,518	....
1894	45,727	....
1895	23,551	....
1896	14,724	....
1897	18,736	....
1898	65,553	....
1899	51,873	....
1900	38,797	....
1901	59,181	....
1902	47,751	....
1903	26,259	....
1904	9,841	....
1905	21,194	....
1906	12,476	....
1907	None.	....
1908	8,300	....
1909	11,826	2,368
1910	7,000	....
Total	3,939,299	1,580,640

*With the exception of the figures for the years 1888 and 1889, which were derived from the original records of the Iron Mountain Company, the production for the years 1871 to 1892 inclusive are taken from Nason's report of 1892. The figure covering production prior to 1871 was derived by deducting the output during the years 1871 to 1887 inclusive from 3,048,821, which is given in the original records of the Iron Mountain Company as the total production of Iron Mountain to January 1, 1888. Figures for the years 1870 to 1890 are of shipments and do not include ore in stock. Figures for the years 1890 to 1895 were obtained from the State mine inspectors' reports and cover ore mined during years ending June 30th. Figures for 1895 and 1896 are of shipments made to the Missouri Furnace only. Some ore is reported to have been shipped east of the Mississippi river during that time. Figures for 1897 to 1907 and 1909 are of shipments made to the St. Louis Blast furnace. The figure for 1908 is of shipments reported by the Labor Commissioner, and that for 1910 was reported by Mr. W. H. Smallinger, the present owner of the property.

Figures for the production of Pilot Knob during 1882 to 1891 inclusive are those reported by Nason. The figure for 1892 is that reported by the State Mine Inspector. The figure for 1909 is that reported by the St. Louis Blast Furnace Company and represents shipments from ore in stock. The figure showing production prior to 1882 was derived by deducting the production during the years 1882 to 1893 from 1,578,272, which Nason gives as the total production to 1893.

The books of the Iron Mountain Company were destroyed by fire in 1870 and earlier records are not available but it is probable that prior to that year the mine was worked more or less continuously since its opening in 1844.

The books of the Pilot Knob Company were destroyed by fire in 1882 prior to which records are not obtainable. It is probable that this mine also was worked more or less continuously from its opening in 1847. The shipment for 1909 was from ore in stock.

Next to the porphyry ores, the red and specular hematite deposits of the Central Ozarks have been the important producers. Deposits of this type occur chiefly in Crawford, Dent, Franklin and Phelps counties. In the following table is shown the recent annual production of this type of ore by counties, the total approximating 3,073,000 tons:

TABLE NO. VI.

Total and Annual Production, by Counties, of Red and Specular Hematite of the Central Ozarks. (Filled Sinks.)*

Year.	Crawford.	Dent.	Franklin.	Phelps.	Total.
Prior to 1893........	1,068,154	748,827	69,700	562,772	2,449,453
1893........	7,553	12,112	....	....	19,665
1894........	1,115	25,560	6	60	26,741
1895........	16,651	....	....	....	16,651
1896........	21,862	4,880	80	220	27,042
1897........	36,160	1,160	....	200	37,520
1898........	1,046	14,960	....	240	16,246
1899........	1,880	29,520	125	575	32,100
1900........	9,540	29,520	....	480	39,540
1901........	5,640	6,000	369	720	12,729
1902........	11,770	2,940	2,079	549	17,338
1903........	3,780	6,465	5,402	870	16,517
1904........	14,156	4,567	1,939	900	21,562
1905........	44,931	105	6,959	4,840	56,835
1906........	37,658	5,947	3,551	6,009	53,165
1907........	37,017	27	18,265	8,597	63,906
1908........	36,864	332	8,928	7,665	53,789
1909........	24,118	11,919	17,782	8,870	62,689
1910........	28,200	....	11,126	9,823	49,149
Total..........	1,408,095	904,841	146,311	613,390	3,072,637

*Figures prior to 1893 are taken from Nason's report of 1892. Those for 1893 to 1910 inclusive are compiled from figures obtained from the following sources:

State Mine Inspector's reports.
State Labor Commissioner's reports.
St. Louis Blast Furnace Company records.
Sligo Blast Furnace Company records.
Meramec Iron Company records.

A number of these deposits were opened before Iron Mountain and Pilot Knob; several, as early as 1825. The Cherry Valley mines which were opened in 1878 have produced 736,000 tons and are the largest deposits of this character so far exploited. Other mines have produced from 150,000 to 375,000 tons. Many of the deposits were abandoned before being exhausted, while others are still undeveloped —due chiefly to lack of transportation facilities.

In the following table is shown the annual production of the Cherry Valley mines to date, according to figures submitted by the Meramec Iron Company:

TABLE NO. VII.

Cherry Valley.

Year.	Production.	Year.	Production.
1878	6,772	1896	21,862
1879	43,991	1897	19,595
1880	53,448	1898	1,046
1881	22,195	1899	....
1882	31,847	1900	....
1883	15,132	1901	....
1884	13,680	1902	....
1885	21,436	1903	....
1886	24,515	1904	10,864
1887	74,545	1905	43,247
1888	45,462	1906	30,239
1889	51,078	1907	24,377
1890	64,476	1908	20,268
1891	16,472	1909	24,026
1892	12,405	1910	22,350
1893	3,706		
1894	1,115	Total production	736,800
1895	16,651		

During the period between 1898 and 1904 this mine was not operated.

The brown ores, of which there are two types described in this report as primary and secondary limonite, have been mined in all but two counties producing iron ore, the total output being 291,656 tons.

In the following table is shown the relative amounts of secondary and primary limonite produced by the various counties, which are arranged according to their rank as producers of brown ore:

TABLE NO. VIII.

Total Production of Secondary and Primary Limonite by Counties.

County.	Limonite.		Total.
	Secondary.	Primary.	
Howell	91,684	....	91,684
Wayne	44,864	7,478	52,342
Shannon	40,363	....	40,363
Christian	....	30,112	30,112
Greene	4,382	14,768	19,150
Stoddard	....	15,993	15,993
Butler	13,660	2,150	15,810
Madison	10,424	....	10,424
Bollinger	4,731	1,630	6,361
Carter	1,962	1,555	3,517
Ripley	705	2,064	2,769
Iron	1,119	....	1,119
Franklin	834	....	834
St. Francois	500	....	500
Osage	161	....	161
Lawrence	115	....	115
Polk	99	....	99
Oregon	83	....	83
Gasconade	76	....	76
Dade	....	39	39
Maries	32	....	32
Crawford	30	....	30
Cape Girardeau	....	25	25
Jefferson	18	....	18
Total for State	215,842	75,814	291,656

Approximately three-quarters of the above total production consists of secondary limonite and one-quarter of primary limonite. Fourteen counties have produced exclusively secondary, four exclusively primary limonite, while six have produced ore of both types.

In the following table is shown the annual production of brown ore from 1898 to date, by counties, arranged according to their rank as producers. Also the total production of this type of ore:

TABLE NO. IX.

Annual Production of Brown Ore by Counties.*

County.	Prior to 1899.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	Total.
Howell	11,800		9,803		288	4,133	4,860	11,037	14,882	11,580	6,039	12,509	4,753	91,684
Wayne	20		130	91		94		1,676	3,878	14,246	13,255	13,257	5,695	52,342
Shannon					7,290	3,680	3,500	3,700	5,964	8,536	7,412	218	63	40,363
Christian					30	75	2,137	11,940	8,369	2,640	2,410	2,406	105	30,112
Greene						729	3,185	5,225	2,924	5,720	1,121		246	19,150
Stoddard				30					858	1,800	485	2,809	10,011	15,993
Butler	500		60			648	3,100	2,001	1,072	590	2,688	3,599	1,552	15,810
Madison	10,000		150						68	120	68		18	10,424
Bollinger	6,275		75									11		6,361
Carter					540	1,313	117	1,076		40	57	374		3,517
Ripley						705	603	1,461						2,769
Iron			42	90	120	27	120	482	238					1,119
Franklin		315	194	21	196	108								834
St. Francois	500													500
Osage									70		57	34		161
Lawrence									28	47	40			115
Polk													99	99
Oregon				60						23				83
Gasconade					56		20							76
Dade								39						39
Maries						32								32
Crawford						30								30
Cape Girardeau										25				25
Jefferson		18												18
State total	29,095	333	10,454	292	8,520	11,574	17,642	38,637	38,351	45,367	33,632	35,217	22,542	291,656

*For the source of the figures in this table, see table No. I.

Table No. IX shows that less than 30,000 tons of brown ore were mined prior to 1900 and that the output has been restricted largely to the past seven years. The decline during 1910 was due to the St. Louis Blast Furnace being out of blast during a portion of that year.

In the following table is shown the annual production of all types of Missouri ores from 1892 to date, by counties, arranged according to their rank as producers:

TABLE NO. X.

Annual Production of Iron Ore since 1892, by Counties.*

County.	Prior to 1893.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	Total.
St. Francois	3,411,492	65,518	45,727	23,551	14,724	18,736	65,553	51,873	38,797	59,181	47,751	26,259	9,841	21,194	12,476		8,300	11,826	7,000	3,939,799
Iron	1,684,872		1,200		60				42	90	120	27	120	482	238			2,368		1,689,619
Crawford	1,068,154	7,553	1,115	16,651	21,862	36,160	1,046	1,880	9,540	5,640	11,770	3,810	14,156	44,931	37,658	37,017	36,864	24,118	28,200	1,408,125
Dent	748,827	12,112	25,560		4,880	1,160	14,960	29,520	29,520	6,000	2,940	6,465	4,567	105	5,947	27	332	11,919		904,841
Phelps	562,772		60		220	200	240	575	480	720	549	870	900	4,840	6,009	8,597	7,665	8,870	9,823	613,390
Franklin	69,700		6		80			440	194	390	2,275	5,510	1,939	6,959	3,551	18,265	8,928	17,782	11,126	147,145
Howell	10,000	1,800							9,803		288	4,133	4,860	11,037	14,882	11,580	6,039	12,509	4,753	91,684
Wayne			20						130	91		94		1,676	3,878	14,246	13,255	13,257	5,695	52,342
Shannon											7,290	3,680	3,500	3,700	5,964	8,536	7,412	218	63	40,363
Christian											30	75	2,137	11,940	8,369	2,640	2,410	2,406	105	30,112
Greene												729	3,185	5,225	2,924	5,720	1,121		246	19,150
Stoddard										30					858	1,800	485	2,809	10,011	15,993
Butler	500								60			648	3,100	2,001	1,072	590	2,688	3,599	1,552	15,810
Madison	10,000								150						68	120	68		18	10,424
Bollinger	6,275								75									11		6,361
Carter											540	1,313	117	1,076		40	57	374		3,517
Ripley												705	603	1,461						2,769
Osage															70		57	34		169
Lawrence															28	47	40			111
Polk																			99	95
Oregon										60						23				83
Gasconade											56		20							76
Dade														39						39
Maries												32								32
Cape Girardeau																25				25
Jefferson								18												18
Miscellaneous**	142,532																			142,532
State total	7,715,124	86,983	73,688	40,202	41,826	56,256	81,799	84,306	88,791	72,202	73,609	54,350	49,045	116,666	103,902	109,273	95,721	112,100	78,691	9,134,624

*For source of figures see production table No. I.

**For source of this figure see production table No. II.

CHAPTER II.

THE ORES OF IRON, FACTORS CONTROLLING THEIR VALUE, AND THE IRON ORES OF MISSOURI.

THE OCCURRENCE OF IRON.

According to Clarke*, iron forms 4.64% of the original rocks of the earth's crust. It occurs in nature in the metallic or uncombined state known as native iron and in chemical combination with other elements as a part or constituent of many minerals.

Native iron is rare. It appears in meteorites, of which it forms occasionally the entire mass; oftener only a part. More commonly it is found in basic, eruptive rocks, sometimes in masses of considerable size, but usually in small particles. In Missouri it is known to occur at but one place, small particles having been found embedded in a deposit of shale near Nevada in Vernon county.

Deposits containing native iron are so uncommon and generally so small that they are neither sought nor considered as a source of iron for economic purposes.

Iron in combination with other elements occurs in a great variety of forms, is very widely distributed, and comprises all the great deposits of iron ore. Its most common form is the oxide in which the iron is combined with oxygen, both with and without water. In combination with oxygen alone, it forms the anhydrous oxides commonly known as the black, red, and blue iron ores; with both oxygen and water it forms the hydrous oxides, or brown and yellow ores. Combined with oxygen and carbon, it forms an iron carbonate known as siderite. In combination with sulphur, it forms the sulphide minerals, marcasite, pyrite, and pyrrhotite; and combined with oxygen and sulphur, it forms the sulphate of iron.

Other less common compounds of iron are those with arsenic, phosphorus, silica, and copper, forming arsenides, phosphates, silicates, and copper-iron sulphide.

*Clarke, F. W., Analyses of rocks: U. S. Geol. Survey Bull. No. 168, p. 15.

THE ORES OF IRON.

Theoretically, a majority of the above named compounds contain a sufficient percentage of iron to be considered as ores of iron but commercially they are not. In order to have commercial value, an iron mineral must be so constituted that, when treated by some standard method of smelting, it will yield its metallic iron at a profit. Thus, the sulphides are not considered ores of iron because sulphur, which is an undesirable impurity in commercial iron, cannot be completely removed by ordinary methods of smelting. For a similar reason, the compounds of iron with phosphorus and arsenic are not included as iron ores. The source of commercial iron is limited to three groups of iron minerals, namely: the anhydrous oxides, the hydrous oxides, and the carbonates.

In the following table, the various commercial ores are arranged in the order of their value from the standpoint of iron content:

TABLE NO. XI.

Chemical Character.	Mineral Name.	Physical Character.
Anhydrous Oxides of Iron.	Magnetite.	Crystalline. Massive or Granular. Black Sands. Bog-Magnetic ore.
	Hematite.	Crystalline or Specular and Micaceous. Compact fibrous. Granular, Earthy, Ocherous. Oolitic or Fossiliferous, Argillaceous, and Pseudomorphous.
Hydrous Oxides of Iron.	Turgite.	Botryoidal.
	Goethite.	Botryoidal. Fibrous. Stalactitic.
		Primary.. { Porous, cellular bog ore. Hard, dense replacement ore. Botryoidal. Ocherous.

TABLE NO. XI—Continued.

Chemical Character.	Mineral Name.	Physical Character.
	Limonite.	Secondary: Pseudomorphous (Stalactitic. Botryoidal, etc.) Massive. Ocherous.
	Xanthosiderite.	Soft Ocherous.
Carbonate of Iron....	Siderite or "Spathic Iron."	Brown Carbonate. Clay-ironstone. Black band.

ANHYDROUS ORES.

MAGNETITE.

Magnetite or magnetic iron ore when pure contains 72.4% of metallic iron, and thus constitutes the highest grade of iron ore. Chemically, it is the double oxide, consisting of ferric and ferrous iron, expressed by the formula Fe_3O_4. The rather unstable ferrous oxide of iron (FeO) is sometimes replaced by magnesium oxide and rarely by the oxide of nickel or of titanium. Magnetite may be readily distinguished by its strong magnetic properties. It is usually crystalline in form and iron black in color, and when scratched, gives a black streak.

Magnetite usually occurs in rocks of Archean or pre-Cambrian age; it is confined chiefly to crystalline rocks, and is most abundant in metamorphous rocks. It also occurs widely distributed as grains in eruptive rocks and as a black sand.

Deposits of magnetite are sometimes of great extent, and generally occur under much the same conditions as the crystalline hematites. Perhaps the most notable deposits of magnetite in the United States is that at Cornwall, Pa. In Missouri there are no known deposits of magnetite of importance, although the deposits at Shepherd Mountain are somewhat magnetic.

HEMATITE.

Hematite, when pure, contains 70% of metallic iron and is second only to magnetite as a high grade ore. Consisting of the single and rather stable ferric oxide of iron (Fe_2O_3), it is less apt than magnetite to contain combined impurities.

Hematite exists mainly in two varieties: (1) blue specular; and (2) red.

(1) Specular hematite is blue to steel gray in color, possesses a metallic luster, and often shows beautiful crystal faces. When the structure has much the appearance of mica, the ore is called "micaceous hematite."

(2) Red hematite appears in a great variety of forms. It may be granular, earthy, oolitic, fossiliferous, or argillaceous, also pseudomorphous after marcasite and pyrite. It is uniformly softer than the specular ore and somewhat lower in specific gravity, in some varieties as low as 4.2.

The granular variety may be produced by the replacement of granular rocks, such as coarsely crystalline limestone. An ore of this type usually contains considerable material similar to that which has been replaced. The earthy variety has a fine grained, homogeneous, chalk-like texture, and is usually rather soft; it may be a replacement of fine grained, homogeneous rocks, such as decomposed chert, in which case it often retains some of the physical structure of the replaced material. The oolitic variety may be at once recognized by its characteristic seed-like and pitted structure. Sometimes it is highly fossiliferous, in which case it is known as fossil ore. The argillaceous variety contains considerable clay, and usually has a laminated or shaly parting, resembling red shale or clay.

When pseudomorphous after marcasite, hematite usually exhibits more or less of the dendritic, feathered, and botryoidal structures of that mineral; after pyrite it often retains the crystal forms of that sulphide. In either case it may be massive or ocherous.

When in massive, crystalline form, hematite resembles magnetite in texture and color, but may be distinguished from the latter by its red streak and non-magnetic property.

Fully nine-tenths of the iron ore mined in the United States is hematite. Hematite normally occurs in rocks of all ages and in much larger masses than either magnetite or limonite. The most extensive deposits known in the United States are those of Algonkian or Huronian age in the Lake Superior region. The soft ores of the Mesabi range, however, are not wholly anhydrous but contain a variable amount of combined water ranging from 2.09 to 8.23%, representing all gradations between a hematite and a limonite.

All the various phases of hematite described above occur in Missouri and will be discussed more fully in a later chapter.

HYDROUS ORES.

The hydrous or brown ores, turgite, goethite, limonite, and xanthosiderite, form a series of hydrated oxides of iron containing combined water in increasing proportion in the order named. Limonite is usually the most abundant of the above minerals and forms the major portion of the deposits of brown ore. The composition of carload shipments approximates the composition of this mineral and the brown ores are commonly designated as limonites.

TURGITE.

Turgite ($2Fe_2O_3 . H_2O$), the first member of the group, is intermediate in composition between hematite and limonite. It contains 5.3% water and resembles limonite, but gives a red streak. While it is frequently present, it is not so common in deposits of brown ore as the other members of the group.

GOETHITE.

Goethite ($Fe_2O_3 . H_2O$), the second member of the group, occurs much more commonly than Turgite. Containing 10.1% of combined water, it answers more nearly the description of a true brown ore in that it gives a brown streak. It commonly occurs in crystals of botryoidal and stalactitic growths, having concentric and radiated structure with a nearly black varnish-like exterior.

Goethite may be distinguished from hematite by its brownish-yellow streak, and from limonite by its crystal habit and lower percentage of combined water. It is formed very generally in primary deposits of brown ore, and in Missouri commonly occurs lining cavities in this class of deposits.

LIMONITE.

Limonite ($2Fe_2O_3 . 3H_2O$), sometimes called brown hematite, contains 59.8% metallic iron and 14.5% combined water. It is not, as far as known, an original constituent of the igneous rocks, but is produced either as an original chemical precipitate or chemically by the alteration of other iron minerals. An important source of limonite is direct precipitation from iron bearing solutions, forming what may be designated as primary limonite. Bog iron ore is the chief representative of primary limonite. Formed under bog conditions, limonite usually has an open, cellular texture, though it may be somewhat laminated. It is usually highly silicious, due to the presence of precipitated silica and of detrital material such as chert, sand, and clay. Limonite resulting from the replacement of other rocks, such as decomposed chert, is also usually very silicious, due to the presence of unreplaced materials. In addition to the above limonites, there are some soft, ocherous varieties, which may also be of primary origin.

Through oxidation and hydration the sulphides marcasite and pyrite form an important source of limonite. Such ores are known as secondary limonite. They commonly retain some of the crystalline structure of the sulphides, and can usually be recognized by this means.

XANTHOSIDERITE.

Xanthosiderite ($Fe_2O_3 . 2H_2O$), the fourth member of the hydrous oxides of iron, contains 18.4% combined water which is four times that of turgite, twice that of goethite, and a third more than limonite. It occurs in fine needles or fibers with either stellate or concentric structure, and as an ocher. In color, it is a golden yellowish-brown to brownish-red. While not known to form large deposits, it is frequently associated with limonite, especially where the ocherous variety is common.

The brown ores or limonites, due to their origin, are usually found near the surface. They are common to all kinds of rock and are more irregular in form than the hematite deposits.

CARBONATE ORES.

The carbonate ores, even when pure, contain the lowest percentage of metallic iron (48.20%) of any of the ores of iron. Siderite ($FeCO_3$), also known as "Spathic Iron," occurs principally in stratified rocks, and in those of a metamorphic character. It is particularly common in mica and clay slates. As clay-ironstone, it is found chiefly in the Coal Measures.

The chief varieties of the carbonate ores are: (1) brown carbonate; (2) clay-ironstone; and (3) black band. The first is the ordinary, relatively pure, brown siderite. The second is the impure, argillaceous carbonate occurring in nodules and beds. "Black band" is a carbonate ore carrying carbonaceous material which is often so abundant as to cause the ore to be nearly self roasting.

Commercial deposits of iron carbonate are rare as compared with those of either the red or brown ores. During 1909, Ohio was the only producer of ores of this type, the output amounting to less than 1/30 of 1% of the total production of iron ores in the United States for that year.

CHEMICAL COMPOSITION.

The chemical relation and composition of the principal iron minerals, together with their comparative value as ores, are shown in the following table:

TABLE NO. XII.

Ores.	Mineral Name.	Chemical Formula.	Chemical Composition.
Anhydrous Oxides of Iron.	Magnetite.	Fe_2O_4	Metallic iron.....72.4% Oxygen..........27.6
	Hematite.	Fe_2O_3	Metallic iron.....70.0 Oxygen..........30.0
Hydrous Oxides of Iron....	Turgite.	$2Fe_2O_3.H_2O$.	Metallic iron.....66.29 Oxygen..........28.41 Water........... 5.30
	Goethite.	$Fe_2O_3.H_2O$.	Metallic iron.....62.93 Oxygen..........26.97 Water...........10.10
	Limonite.	$2Fe_2O_3.3H_2O$.	Metallic iron.....59.8 Oxygen..........25.7 Water...........14.5
	Xanthosiderite.	$Fe_2O_3.2H_2O$.	Metallic iron.....57.12 Oxygen..........24.48 Water...........18.40
Carbonate of Iron.	Siderite.	$FeCO_3$	Metallic iron.....48.2 Carbon dioxide...51.8

In this table it will be seen that, other things being equal, magnetite contains the highest percentage of iron; and that the other ores follow in descending order. It will be noted that the five minerals; hematite, turgite, goethite, limonite, and xanthosiderite constitute an increasing series with respect to their percentage of combined water, and that with the increasing hydration there is a corresponding decrease in the metallic iron content.

The carbonate ores, though they contain no water, consist of iron in the ferrous form combined with a large proportion of carbonic acid, resulting in an ore, which, when perfectly pure, cannot exceed 48.2% metallic iron.

The percentages recorded above are for theoretically pure ores. No furnace, however, yields the full percentage of iron in the ores that go to blast, and commercially there are practically no ores that are normally pure. For this reason the recovery depends not only upon the furnace practice, but also upon the nature of the materials associated with the ore.

FACTORS CONTROLLING THE VALUE OF IRON ORES.

The commercial value of an iron ore is based upon the following important considerations: (1) composition, (2) manner of occurrence, and (3) proximity to market.

Composition: Other things being equal, the comparative value of the several classes of iron ore depends chiefly upon their iron content. Thus, in pure ores, the order of value is as follows: (1) magnetite, (2) hematite, (3) the brown ores, and (4) siderite. In the majority of workable deposits, this classification will hold good, for while few deposits of any class are strictly pure, those of the normally low grade brown and carbonate ores carry as high, if not higher, percentages of impurities than do the normally high grade magnetite and hematite ores. There are, however, important exceptions, due to the texture of the ore and to the associated materials. The texture of an ore is often an important factor in smelting, for porous, open textured ores are more easily reduced than those of a compact, dense nature.

Practically all the iron ores contain impurities. From the nature of their effect upon the final product, these may be regarded either as inert, injurious, or beneficial.

Inert impurities are those which may be sufficiently eliminated by the process of smelting to render a merchantable product. Chief among these are silica and alumina.

Silica exists principally as crystalline quartz, chert, sand, and the silicate minerals. Alumina occurs chiefly in the form of clay and other silicate minerals. These minerals may be largely eliminated in the blast furnace by means of proper fluxing, but, when present in large quantities, they add greatly to the burden of the furnace, materially increasing the cost of smelting, and often rendering an ore unmerchantable. Limestone is used as a fluxing material for the silica and lumina in the ore, and, therefore, is not injurious where present in amounts sufficient for the removal of these materials; but when present in greater quantities, it becomes a source of expense in smelting.

Injurious impurities may be designated as those which cannot be successfully removed by smelting, and the presence of which, except in very small quantities, unfits the iron for commercial use. In this class, and depending largely upon the quantity in which they are present and the purpose for which the pig iron is to be used, may be included phosphorus, sulphur, arsenic, and antimony.

Phosphorus renders steel weak and brittle when cold, and may be present in very small quantities only. According to Hurd,* the following is a typical analysis of Lake Superior bessemer ore: "Bessemer ore dried at 212° F. has a typical analysis of 61.55% iron, 0.047% phosphorus, 4.6% silica, and 1.5% manganese. With a generally accepted moisture of 10% this is equivalent to 55.39% natural iron. The per cent of iron may be diminished provided there is a diminution of phosphorus equal to 0.0075 for each per cent of iron loss."

Phosphorus in small quantities, however, renders cast iron easily fusible and when cold, hard and brittle, qualities that are desirable in making certain varieties of castings requiring great fluidity of the metal. In pig iron for this purpose, 2.5% of phosphorus is sometimes used. In smelting, phosphorus may be removed by the basic bessemer process, although it is not removed by the acid bessemer process. In the latter process the percentage of phosphorus may be increased in the iron over that in the ore, due to the removal of other impurities and the loss of some iron. A large proportion of the steel in this country is manufactured by the basic open hearth process. Through this method ores that could not be employed by the acid process became available for the manufacture of steel.

Sulphur, while increasing the strength of cast iron, renders both wrought iron and steel brittle while hot and thus unforgeable. Ores producing a pig containing more than 0.08% of sulphur are considered non-bessemer, and those producing a pig containing over 0.10% are not suitable for the manufacture of wrought iron. In the case of cast iron, sulphur not only makes the metal very tender while at a red heat, but causes solidification to take place more rapidly, producing blow holes and dirty iron.

*Hurd, R., Iron ore manual: Lake Superior District, 1911, p. 6.

In the process of smelting, small amounts of sulphur are removed as calcium sulphide by combination with the lime of the flux. However, the slag will take up only a small percentage of sulphur in this manner and to eliminate high percentages of sulphur correspondingly large amounts of slag would be required.

Among the other injurious elements to be reckoned with are arsenic and antimony, which, even in small quantities, are detrimental to steel and wrought iron, and are not beneficial to cast iron.

Among the minerals commonly associated with iron ores are a few which add to its value for certain purposes. Chief among these is manganese, which, when present in iron ore, forms what is known as manganiferous iron ore.

Manganese alloyed with iron in proportions of from 8 to 20% forms what is known as spiegeleisen; where the manganese equals about 80%, the product is known as ferro-manganese.

In the manufacture of steel, manganese is used to counteract the effect of sulphur by forming a manganese compound with that element. Manganese in small amounts gives steel hardness, ductility, and strength, fitting it for the manufacture of burglar proof safes, car wheels, ore crushers, dipper teeth for steam shovels, etc.

Manner of Occurrence: In many instances, the manner in which an iron ore deposit occurs is an important factor in determining its value. For example: ore occurring in thin veins walled in by hard rock; ore mixed with so large a proportion of clay and chert as to render its separation very expensive; thin beds of ore separated by strata of waste material, such as chert or quartzite, rendering mining difficult and expensive; and ore so deeply buried as to make deep and expensive mining necessary, frequently becomes unavailable though it may be high grade.

On the other hand, low grade ores become available where found in large deposits with a thin over-burden and little foreign matter intermixed. A striking illustration of this is afforded by the red hematite or fossil ore of Alabama, which, though averaging as low as 35 to 40% metallic iron, occurs in uniform beds 5 to 12 feet thick and of great lateral extent. Under such favorable conditions, the low cost of mining off-sets the low grade of the ore.

Proximity to Market: Other things being equal, proximity to market or, in other words, the cost of transportation is an essential factor in determining the value of an iron ore. Since, however, the conditions of grade, purity, and occurrence usually vary greatly, the cost of transportation is a relative factor only.

Based on the cost of transportation ores may be said to be available and unavailable. An available ore is one which will bring a price sufficiently high to pay a profit over the cost of mining and transportation. Obviously, where transportation is expensive an ore to be available must be of relatively higher grade, or more favorably situated regarding markets than an ore which is relatively more accessible.

Transportation is very important in a consideration of the commercial importance of the iron ores of Missouri. The lack of cheap transportation has prevented the development of many deposits which under more favorable conditions might be worked at a profit.

THE IRON ORES OF MISSOURI.

The important deposits of iron ore occurring in this State consist of hematite and limonite. The hematite deposits vary greatly in their manner of occurrence and have a wide geologic range, being found in rocks of pre-Cambrian, Cambrian, Silurian, and Carboniferous ages. The limonites are also represented by several types but do not have so wide a geologic range, occurring chiefly in the area underlain by Cambrian formations, although a few important deposits occur in the Mississippian.

Commercial deposits of magnetite and iron carbonate are not known to occur in Missouri. Although certain of the vein ores in the porphyry at Shepherd Mountain are strongly magnetic, these ores are more largely hematite than magnetite.

The carbonate ores, which are known to occur in the Lower Coal Measures, have not been prospected for the purpose of development, and no deposits of commercial importance have been discovered.

The following types of iron ore deposits have been recognized in Missouri, each being distinct as regards origin and geologic occurrence:

1. Specular hematite in porphyry (pre-Cambrian).
2. Hematites of the filled sinks (Central Ozarks).
3. Hematites of the Carboniferous.
4. Carbonate ores of the Carboniferous.
5. Red oolitic hematite of the Silurian.
6. Limonite secondary after marcasite and pyrite.
7. Primary limonite of Southeast Missouri.
8. Primary limonite of Southwest Missouri.

Each of the several types of ore deposits appears to be confined rather closely to a certain geologic province which aids greatly in determining their probable distribution.

Type No. 1 includes the massive, coarsely crystalline, blue, specular hematite occurring in porphyry at Iron Mountain and Shepherd Mountain, and the banded and somewhat silicious, specular hematite occurring in porphyry breccias at Pilot Knob. Deposits of this type are confined exclusively to the porphyry of the St. Francois mountains, and are marked with a star upon the general geological map of the State, accompanying this report.

Type No. 2 includes red and specular hematite and important quantities of brown ore in various stages of hydration which occur in sink-like depressions in the Cambrian of the north-central Ozarks. The geologic province occupied by these ore bodies is fairly well defined. Deposits of this type are represented by a solid triangle upon the general map.

Type No. 3 includes a number of deposits of earthy, red and some blue, specular hematite occurring in lenses and nodules in the basal member of the Pennsylvanian series, usually where that series lies unconformably upon the older rocks. Deposits of this type are therefore confined to a relatively narrow strip of country following the margin of the Pennsylvanian rocks. They are shown upon the general map by a solid diamond.

Types Nos. 4 and 5 do not outcrop and are not indicated on the map by smybol. Type No. 5 is known to occur at one point only, as disclosed by a deep drill hole at Forest City, Holt county.

Type No. 6 includes both the pipe and boulder variety secondary after marcasite and pyrite. Deposits of this type have a very wide distribution throughout the Ozark plateau, encroaching upon the provinces of several of the other types. They are especially well developed in those parts of the region where the residual clays are thick. They are represented upon the general map by a solid, round dot.

Type No. 7 includes the primary limonite deposits presumably of Tertiary age, which are confined to a relatively narrow strip of country bordering upon the southeastern Lowland plain. Type No. 8 includes the primary limonite deposits confined to a limited area in the southwestern part of the State, including parts of western Greene and Christian counties. Types Nos. 7 and 8 are represented upon the general map by a solid square.

Types Nos. 1 and 2 include all of the well known merchantable deposits of hematite in Missouri and are very largely responsible for whatever record the State has made as an iron ore producer.

Type No. 6 represents a class of brown ore that first gained attention during the early 70's, when the ores were used largely as flux in local lead smelters, and also in part for the manufacture of pig iron. A little later the mining of these ores was practically discontinued, not to be resumed until about 1900.

The primary limonites were not seriously mined until as late as 1905-6, and only recently have any large shipments been made. The hematites of the Carboniferous are still undeveloped.

In the succeeding chapters the several types of ore are discussed to the degree of detail that their importance seems to warrant.

CHAPTER III.

PHYSIOGRAPHY OF THE IRON BEARING REGION.

PHYSIOGRAPHIC DIVISIONS OF THE STATE.

Missouri has three very distinct physiographic regions, viz.: the Upland plain of the northern and western portions of the State; the Ozark plateau, occupying chiefly the southern half of the State; and the Swamp area of Southeast Missouri.

The Upland plain and the Ozark plateau may be divided roughly by a line following the Missouri river from its mouth westward to Boonville, thence nearly due southwest along the Missouri, Kansas and Texas R'y to the Kansas-Missouri boundary. The Ozark plateau and the Lowlands are separated by a well marked escarpment extending from Cape Girardeau, on the Mississippi river, southwest through Poplar Bluff to the Missouri-Arkansas boundary. These divisions are remarkable for the great difference in both their geologic and physiographic features.

The Upland plain is essentially a broad, undulating, prairie region tilted gently to the southeast. In the extreme northwest corner of the State, where it is highest, it has an altitude slightly above 1200 feet, while along its lowest portion, the flood plain of the Missouri river, the altitude is from 400 to 600 feet.

This region is underlain by a great series of shales, sandstones, and limestones which have a gentle dip to the west and northwest. The highest portions of the region have the gentlest surface features, while the lower parts are generally more deeply trenched. The area north of the Missouri river is more or less thickly covered with glacial drift, and is drained by nearly parallel streams tributary to the Missouri river on the south or to the Mississippi river on the east.

That part of the Upland plain which lies south of the Missouri river is underlain by soft shale, limestone, and sandstone. It has a gently undulating surface and is drained chiefly to the east by tributaries of the Missouri river.

The Ozark plateau is a dome-like region which rises above the Upland plain on the north and west and the Swamp area on the southeast. While the general surface of the plateau slopes gently in all directions from a central highland area, the flanks of the dome are deeply trenched and the larger part of the country has a decidedly rough topography. The surface rocks of the plateau, consisting of granite, porphyry, and a series of magnesian limestones and sandstones are the oldest outcropping in the State. Much of the plateau lies at an altitude of from 1200 to 1700 feet above tide.

In marked contrast with the Upland plain and the Ozark plateau, is the extremely flat and poorly drained Swamp area, the altitude of which is not more than 300 to 350 feet above the tide.

THE OZARK PLATEAU.

Virtually all the commercial deposits of iron ore in Missouri occur in the Ozark plateau. Their economic importance is governed largely by their topographic location with respect to streams and to transportation. The location of roads and railroads in the iron bearing region is also conditioned chiefly by the topography, and because of the importance of the surface relief in relation to the production of the ore, this feature of the Ozarks will be described in some detail.

GENERAL TOPOGRAPHIC FEATURES.

The Ozark region, as a whole, consists of the Shawnee hills, largely in Illinois, which mark the extreme eastern limits of the Uplift; the Ozark plateau in southern Missouri and northwestern Arkansas; and the Boston and Ouachita mountains of northern Arkansas. It has an area of approximately 75,000 square miles and in general outline is a low elliptical dome with a major axis of over 500 miles which extends from the Mississippi river in a broad double curve, first west, then southwest, and again west. The maximum breadth of the region is about 200 miles.*

Surrounded on all sides by lands having a relatively low relief, this elevated region stands out as the one prominent topographic feature in all that vast plain reaching from the base of the Appalachians to the foothills of the Rocky Mountains.

The expression "Ozark plateau," as used in this report, includes the entire area of the Ozarks in Missouri and as a consequence is of chief interest in a consideration of the iron deposits of the State. It is composed of several provinces having rather distinct topographic and geologic features which have had a direct influence on the de-

*Keyes, C. R., Missouri Geol. Survey, vol. VIII, 1894, p. 321.

velopment of the mineral resources. These provinces are the St. Francois mountains, the Central Ozark upland, and the flanks of the Ozarks.

THE ST. FRANCOIS MOUNTAINS.

The St. Francois mountains are the most striking physiographic feature of the plateau. They consist of an extensive group of granite and porphyry hills which occupy an area of about 1200 square miles, and are located chiefly in St. Francois, Washington, Iron, Reynolds, Wayne, and Madison counties, with outliers in Shannon, Carter, Ste. Genevieve, and Crawford counties.

The outliers as a rule do not present the aspects of mountains and may not figure conspicuously in the local surface features, but in a strict geologic sense they belong to the St. Francois group.

Taken as a whole, the mountains consist of rounded, conical masses of porphyry and granite. They occur, for the most part, in groups, although single individuals are frequently entirely isolated and have their bases surrounded by sedimentary rocks which commonly occupy the valley areas. Unlike the ridges and hills of the remainder of the Ozark plateau, the crests of the St. Francois mountains have no common level but vary from 100 to 800 feet above the relatively flat valleys at their bases. Taum Sauk mountain rises 1800 feet above tide and forms the highest known elevation in the State.

In the eastern portion of the district the sedimentary rocks have been largely removed, while toward the borders the effect of erosion is less advanced, and the mountains, although rounded, are lower and smaller with their bases completely surrounded by sediments.

The inter-mountain valleys are in general rather broad. They are floored with sedimentary rocks, above which the granite or porphyry hills rise steeply. A sudden change in slope often marks the change from the softer sandstone and limestone to the harder granite and porphyry.

Approximately four-fifths of the drainage of the St. Francois mountains is accomplished by tributaries of the St. Francois river which crosses the eastern half of the area from north to south. The head waters of Big river drain the southwestern portion.

One of the striking topographic features of the St. Francois mountain district is the so called Shut-In, a short, narrow canyon eroded in the granite or porphyry. At the beginning of the present drainage cycle, the igneous rocks were covered with sedimentary deposits. As the latter were eroded the granite and porphyry were gradually exposed. Where the course of a stream was transverse to a ridge of igneous rocks it cut its channel through the granite or porphyry each of which weathers more slowly than the limestones and sandstones comprising the sedimentary series. The formation of such canyons usually establishes a base level beneath which the upper reaches of the stream cannot lower its bed. Where the upper valley traverses sedimentary rocks the stream has broadened its channel, forming wide, flat valleys, which end abruptly at the base of the hills formed by the more resistant granite and porphyry. Valleys of this character are common in the St. Francois mountains, a typical example being the Arcadia valley in Iron county.

The St. Francois mountains probably include the area of greatest combined uplift in the State. From these a great series of limestones and sandstones dip away in all directions toward the margin of the plateau, steepest where the distance is shortest and most gently where longest. Thus, in general, the rocks of the plateau are found to dip steepest toward the east, relatively less to the north and south, and most gently to the west, in which direction it is hard to detect any dip except over long distance.

THE CENTRAL OZARK UPLAND.

The Ozark plateau in its highest parts consists of a central upland belt extending from the St. Francois mountains in western Iron county to Texas county, then south and southwest to northern Barry county. In western Iron county the upland has an elevation of about 1600 feet, continuing at that altitude through Reynolds county, falling to 1400 feet in Dent county where there is a large area of relatively flat upland at about this elevation. Continuing southwest through Texas county into Wright county the plain rises to near 1700 feet at Cedar Gap and from this point falls again to about 1550 feet at the State line.

Within this central upland belt, the topographic features are remarkably gentle for the Ozarks. The surface is undulating rather than hilly. The valleys are relatively broad and shallow and the higher elevations are seldom more than 100 feet above the valleys. Under ordinary conditions these valleys are dry and are flooded only during excessive rains. Locally, where the surface waters are absorbed by sinks to which the stream courses have not yet cut back, the drainage lines are indistinct and the divide is inconspicuous.

THE FLANKS OF THE OZARKS.

From the St. Francois mountains on the east and the Central highland area on the west, the general level of the plateau slopes away in all directions toward its border, its stream courses generally becoming deeper and the surface increasingly rugged as the margin is approached. There is, however, considerable difference in the surface features of the southern and northern slopes. The southern slope is generally much the rougher, being deeply dissected by numerous widely branching streams, forming upland ridges that are exceedingly crooked and irregular in width. While this type of topography is characteristic of the greater part of the southern Ozarks, there are large areas in which the valleys are broad and shallow and the surface is rolling rather than hilly. Such is true of large parts of Howell and Oregon counties, while the southeastern part of Carter county and the adjacent parts of Butler and Ripley counties also have a rather low relief.

In contrast with the widely branching streams of the southern Ozarks, those of the western part of the northern slope run nearly parallel for long distances with tributaries that are short or have a trend nearly parallel to the main streams. Except in the case of the larger streams, the valleys are not so deep as those on the south. Between the parallel streams are relatively broad, flat topped divides representing long strips of but slightly eroded plateau differing in character from the narrow, crooked ridges of the southern Ozarks.

There are, however, belts of very rough country lying along each side of the larger streams and in that part of the region between the main line of the St. Louis and San Francisco R. R. and the St. Francois mountains, including the basins of the Meramec and Big rivers, the topography is more like that of the southern Ozarks.

On the other hand, the extreme western portion of the plateau or that part west of range 21 W., is more nearly an even plain cut by streams of moderate depth with comparatively narrow belts of hilly country along their courses.

The extreme eastern portion of the plateau has a topography resembling more nearly that of the southern slope than that of the northern slope.

DRAINAGE.

STREAMS.

The Ozark plateau is drained largely by a system of nearly radial streams flowing into the Missouri river on the north, the Mississippi river on the east and the Swamp area on the southeast.

The northern portion of the plateau is drained by the Osage, Gasconade, and Meramec, while the chief river systems of the southern slope include the Current, Black, St. Francois, and Castor.

The narrow strip of country east of the St. Francois mountains is drained by a number of short, rapid streams flowing into the Mississippi river.

The drainage of the extreme southwestern part of the plateau, including all of Jasper county and large parts of Barton, Lawrence, and Newton counties, is over the western border of the State, the water finally reaching the Mississippi through the Arkansas.

In each of the above mentioned drainage districts, the direction of the stream courses coincides closely to the general dip of the upland surface and it may be inferred that the direction of the former has been controlled largely by the slope of the latter. With this idea in mind, a glance at the drainage lines of the region, as shown on the accompanying geologic map, conveys at once a general idea of the major dome-like structure of the Ozarks.

The difference in degree of slope of the north and south sides of the Ozark plateau has affected the character of the two sets of streams. With head-waters rising at practically the same elevation they empty into areas differing in elevation by at least 250 feet, those on the southern slope discharging upon the Swamp area at an elevation of approximately 350 feet, while those on the northern slope join the Missouri at about 600 feet A. T. The southern streams have an average fall of 12 feet to the mile, while the northern streams have an average fall of about seven feet per mile.

The courses of the short, rapid streams draining the eastern margin of the area conform closely to the direction of the dip of the rocks in that region. These rocks are tilted much more steeply than those of the northern, southern, and western slopes, and the streams have correspondingly greater fall, are shorter, and have little or no flood plain.

In general features, however, the streams of the several slopes of the Ozark plateau are very similar. The valleys of their uppermost tributaries through the first 100 feet of fall are usually wide and open, like a flat pitching trough with low divides which, as a rule, are covered with soil and chert. The fall of these tributaries usually exceeds 25 feet per mile. They are produced more largely by solution than by erosion. The average rainfall does not flow off the surface in streams, but sinks through the loose, cherty soil, dissolving the underlying limestone and leaving a mantle of insoluble material. These valleys are best developed along the southern slope, although they also occur north of the divide. In Texas, Howell, Shannon and Oregon counties, they afford a large part of the tillable soil.

Proceeding down the valley numerous springs appear, the wide open valleys gradually becoming deeper and narrower, and develop permanent streams of considerable size. As the valleys grow deeper, the topography becomes correspondingly rough, frequently resulting in bluffs from 200 to 300 feet in height.

SPRINGS.

A remarkably characteristic feature of the drainage of the Ozark plateau is the numerous mammoth springs that appear at intervals along the main streams. Such springs are common to both sides of the plateau but are best developed in the upper valleys of the Meramec, Gasconade, Osage and Current rivers. Springs of smaller size are found in all parts of the region.

Prominent among the larger springs are the Hahatonka, Meramec, Greer, Bennett's, and Mammoth springs, each of which flows millions of gallons per day. Measurements at the Meramec spring show that its average flow is about 110,000,000 gallons in 24 hours.

These springs have their catchment area in the wide, open, dry valleys of the upland area, their waters following underground solution channels to the point at which they reappear at the surface.

CAVES.

The extensive underground drainage as shown by the enormous springs has resulted in the solution of the limestone and the formation of extensive caves. Conditions most favorable for the formation of large openings occurred after the principal streams had cut their channels well into the formations, but before the tributary valleys were fully developed. Under these conditions, ground-water level was depressed near the gorges of the larger streams, making it possible for the underground drainage to cut extensive and deep caverns before reaching drainage level. Such conditions exist today throughout a large part of the Central Ozark region. In the Central ore district, solution caves are very common in the Gasconade. They exhibit different stages of formation. Some contain large streams of water and some, lying near or just above ground-water level, are still in the process of formation. Others are nearly dry or quite so and are evidently very old, for they have started to refill through the accumulation of stalactites and stalagmites of calcium carbonate. In some instances the caves have been virtually closed by this material.

SINK HOLES.

Another characteristic feature of the plateau region is the so-called "sink hole." Sink holes are common to those parts of the

Ozark plateau which are underlain at the surface by limestone. They are typically developed upon the flat topped divides and where the stream courses are normally dry. Generally circular in outline, they are largely solution basins marking the entrance to underground channels. They may be formed in two ways; either through the caving of the roof of underground channels that have failed to support their loads, or by the enlargement, through solution, of joints leading from the surface to the underground channel. It is probable that the first process explains the origin of the very large surface sinks and that the second explains the origin of the smaller ones, while some may be the result of both processes. Occasionally the sinks occur in groups or clusters providing the entire drainage of a large area and imparting a unique form of topography. Usually they vary from 100 to 300 feet in diameter, although single sinks are known to include as high as 150 acres and to drain a much larger area. Frequently they are found to hold water, and this is the nearest approach to the formation of natural lakes in the Ozarks.

The "filled sink" of the Central ore district has no relation to present topographic features, although extremely important in its relation to the hematite deposits of that district. The formation of these sinks is discussed in Chapter VI.

HIGHWAYS.

From the foregoing description of the surface features of the Ozarks, it may be inferred that the roads are correspondingly rough. They do not conform to range and section lines as is so generally the case in both the Upland and Lowland plains of Missouri, but follow the ridges and valleys, making occasional transfers from one to the other upon the more gentle hillsides.

Since in a few cases only, the iron ore occurs near the railroads, a haul by wagon is generally required. This is seldom possible for distances exceeding a few miles, for the roads being generally unimproved, are rapidly cut up by heavy loads and, during the winter seasons, often become impassable.

Compared with the other physiographic divisions of the State, the Ozark plateau is but poorly supplied with railroad facilities. The accompanying geologic map shows the chief systems and their more important branches. The lack of adequate transportation facilities has greatly retarded the development of the brown ore deposits of the southeastern portion of the State.

CHAPTER IV.

GEOLOGY.

INTRODUCTION.

The iron ores of Missouri are so varied in their nature and in the manner of their occurrence that a knowledge of at least the more salient geologic features of the ore bearing region is essential to a discussion of their economic importance. For this reason, a brief review of the stratigraphy and structure is here given to meet the wants of those who are not familiar with the geology of the state. Detailed descriptions of the various formations are to be found in the earlier reports of this Bureau.

The geological map of the state accompanying this volume shows, in a general way, the surface distribution of the principal geologic divisions, as well as the location of the several types of ores. From this, it will be seen that the rocks of the iron bearing region consist chiefly of Cambrian dolomite with interstratified sandstone and chert, although there are also important areas underlain by sediments of post-Cambrian, and by igneous rocks of pre-Cambrian age.

GEOLOGICAL SECTION.

The following geological section, based upon the work of the Missouri and the U. S. Geological Surveys, is the latest provisional age classification of the known formations of the State:

Quaternary	Recent	Alluvial deposits.	
		Residual deposits.	
	Pleistocene	Loess.	
		Glacial drift.	
Tertiary		Lafayette.	
		Lagrange.	
		Porters Creek.	
UNCONFORMITY.			
Pennsylvanian (Coal Measures)		Missouri.	
		Des Moines	Pleasanton.
			Henrietta.
			Cherokee.

UNCONFORMITY.

Mississippian	Chester	Birdsville.
		Tribune.
		Cypress.
	St. Louis	Ste. Genevieve.
		St. Louis.
	Spergen.	
	Warsaw.	
	Keokuk, Burlington.	Called the Boone in S. W. Missouri by the U. S. G. S.
	Chemung or Kinderhook	Chouteau.
		Hannibal (Vermicular).
		Louisiana (Lithographic).
Devonian	Sulphur Springs	Bushberg.
		Glen Park.
		Unnamed shale.
	Grand Tower	Hamilton.
		Onondaga.
	Clear Creek (Oriskany).	
Silurian	Bailey (Lower Helderberg).	
	Niagara (Bainbridge).	
	Girardeau (Cape Girardeau).	
Ordovician	Hudson River (Thebes or Maquoketa).	
	Kimmswick (Receptaculites).	
	Plattin (Trenton, Black River or Bird's-eye.)	
	Joachim.	
	Unconformity.	
	St. Peter.	

UNCONFORMITY.

Upper Cambrian (Ozarkian of E. O. Ulrich)	Jefferson City.	
	Roubidoux (Incl. Bolin sandstone).	
	Gasconade (Incl. Gunter sandstone).	
	Unconformity (?).	
	Proctor.	
	Eminence.	
	Potosi.	
	Unconformity (?).	
	Doe Run	Elvins of Ulrich.
	Derby	
	Davis	
Middle Cambrian (Taconic or Cambrian, restricted of E. O. Ulrich)	Bonneterre.	
	Lamotte.	

GREAT UNCONFORMITY.

Pre-Cambrian	Diabase.
	Breccia and Tuff (Pilot Knob iron formation).
	Porphyry.
	Granite.

PRE-CAMBRIAN.

THE GRANITE.

The granite composes about one-fourth of the igneous rocks of the State. It is confined chiefly to the eastern portion of the St. Francois Mountains, but outcrops at intervals throughout the district characterized by igneous rocks. It consists principally of quartz and feldspar with smaller quantities of rutile, zircon, and black mica, and is usually pink to red in color, though occasionally grayish. It varies in texture from coarse grained holo-crystalline varieties to those resembling a coarse porphyry, there being, according to Haworth*, all gradations between the two.

Commercial deposits of iron ore are not known to occur in the granite. However, small disseminations of micaceous hematite are known and at one place have been mined as a filler for paint.

THE PORPHYRY.

The porphyry comprises about three-fourths of the igneous rocks of the State and weathering more slowly than the granite forms the higher mountains. It consists of crystals of feldspar and quartz embedded in a fine grained, although generally holo-crystalline, groundmass containing numerous small grains of iron oxide. In color it is usually some shade of red or brown, much of it being quite dark. It varies greatly in texture, grading from a fine grained, glassy rock, showing flowage lines, on the one hand, to one having a coarse granitic texture on the other.

THE BRECCIA AND TUFF.

Closely associated with the porphyry and apparently of the same age are certain pyroclastics consisting of porphyry breccia and volcanic tuff. According to Haworth**, the breccia occurs abundantly at many places but is best developed at Pilot Knob, Buzzard Mountain, and Cedar Hill. The ground-mass of the breccia is usually porphyritic while the included fragments are sub-angular to angular and always consist of porphyritic and felsitic materials which are themselves often brecciated. At Pilot Knob the breccia and the in-

*Haworth, E., Crystalline rocks of Missouri: Mo. Geol. Survey, 1894, p. 209.

**Haworth, E., Age and origin of the crystalline rocks of Missouri: Mo. Geol. Survey, Bull. No. 5, 1891, p. 28.

cluded iron ore has a thickness of 140 feet and constitutes the so-called Pilot Knob Iron Formation which is described in detail in a later chapter.

Volcanic tuff has been observed at a number of places in the St. Francois mountains, but in small quantities only. According to Haworth*, "On the south side of Shepherd Mountain a rock was found in broad thin layers, often not over $1\frac{1}{2}$ inches thick, which closely resembled a quartz porphyry-tuff. In section 19, township 33 N. 4 E., in the vicinity of Mr. W. W. Heywood's, a rock is quite common which is distinctly stratified, and has, in general, a fine, even texture with an occasional larger fragment in it. It is of a light bluish grey color, shading off into a reddish brown in places. It has the peculiar property of exploding with considerable force when heated, so much so that it has been called 'explosive rock.' This is probably a tuff. Near the same place, on the south and west sides of the hill, at the manganese mines, are rocks which, though different from those described, resemble some varieties of tuffs more than they do any other rock. Some of these are comparatively coarse with odd-shaped fragments enclosed. This type is abundant near Mr. Heywood's spring, west of the barn. Others are very fine grained and have a jaspery or flinty appearance, but under the microscope are seen to be neither glassy nor composed of quartz. They very closely resemble the 'dense' or 'compact' tuff described by Rosenbusch**."

All of the known commercial deposits of iron ore associated with the igneous rocks occur either in the porphyry or porphyry breccia. The more important of these deposits including Iron Mountain, Pilot Knob, and Shepherd Mountain are described in detail in a later chapter.

THE DIABASE (GREENSTONE).

This rock is easily distinguished by its uniformly dark color, usually being some shade of dark green or black. In texture, it varies from coarsely crystalline to compact and glassy.

It constitutes but a small part of the St. Francois mountains but occurs at intervals over the entire area, most frequently in the eastern and southern parts. The diabase usually occurs in dikes, but in a few instances, as circular, boss-like masses. It appears to cut the granite and the porphyry with equal frequency but in no case is it known to intrude the Cambrian sediments. At Iron Mountain it oc-

*Haworth, E., Age and origin of the crystalline rocks of Missouri: Mo. Geol. Survey Bull. No. 5, 1891, p. 31.

**Rosenbusch, Mikroskopische Physiographie der Massigen Gesteine, p. 419.

curs cutting the porphyry and the iron ore. The dikes vary in width from a fraction of an inch to more than 150 feet but are usually under three feet. With few exceptions they trend northeast and southwest and usually cannot be traced farther than 150 to 300 feet. While many of the dikes are mere stringers, the largest boss covers an area of 160 acres.

With the exception of that occurring at Iron Mountain, the diabase is not known to bear any definite relation to the iron ore deposits*.

CAMBRIAN.

Between the period of the formation of the igneous rocks and the earliest Cambrian sediments there was a very long period of erosion during which the granites and porphyries were carved into mountainous forms. Following this erosion interval there was a long period of deposition during which the Cambrian sediments were laid down.

The Cambrian includes all the sedimentary formations beneath the St. Peter sandstone. Its lowest known beds, consisting of conglomerates and sandstones, are considered of middle Cambrian age, which indicates that the region was a land surface, and undergoing erosion, during Lower Cambrian time. From the beginning of the Middle Cambrian, however, there appears to have been almost continuous sedimentation throughout the remainder of the Cambrian period with no well defined structural or stratigraphic break until near its end. The division between Middle Cambrian and Upper Cambrian falls near the middle of the Davis shale formation, and is based upon a change in life forms only.

THE LAMOTTE FORMATION**.

The Lamotte, the oldest recognized Cambrian formation in the State, consists chiefly of medium and fine grained sandstone grading into a conglomerate at its base. It is exposed over an area of approximately 250 square miles in the vicinity of the St. Francois mountains. Since it is everywhere unconformable with the underlying igneous rocks, it varies greatly in thickness, the maximum being approximately 250 feet.

*For a detailed discussion of the occurrence, origin, and chemical composition of the igneous rocks of Southeast Missouri, see Haworth, E., The crystalline rocks of Missouri: Mo. Geol. Survey, vol. 8, p. 84.

**For a detailed description of the Cambrian formations up to and including the Potosi, see Buckley, E. R., The disseminated lead deposits of St. Francois and Washington counties: Mo. Bureau of Geol. and Mines, vol. 9, 2nd series, 1908, pp. 18-57.

Between the Lamotte sandstone and the Bonneterre dolomite, there is usually a transition zone of from 40 to 50 feet of alternating beds of chloritic and somewhat shaley dolomite and sandstone. Occasionally, this transition is much more abrupt.

The conglomeratic beds at the base of the formation vary from a few inches to 30 feet in thickness. They are usually composed of water worn pebbles and boulders of the granite and rhyolite embedded in a coarse arkose which has resulted from the decomposition of these rocks. Locally, as at Iron Mountain and Pilot Knob, the conglomerate includes also numerous pebbles and boulders of specular hematite, and has a maximum thickness of 100 feet.

In the above named localities only is the formation known to be iron bearing. The iron ore occurring in the conglomerates has been of great commercial importance and is described in detail in a later chapter.

THE BONNETERRE FORMATION.

This formation is composed almost entirely of relatively heavy bedded, non-cherty dolomite, and has a maximum thickness of about 400 feet. Like the Lamotte sandstone which it directly overlies, its surface distribution is confined to the region of the St. Francois mountains, and its total areal extent is about equal to that of the Lamotte formation. The upper part of the Bonneterre consists chiefly of light gray, porous dolomite, while the lower portion is composed of dark gray dolomite with intercalated beds of gray to dark blue shale which, in places, attains a thickness of from 10 to 15 feet. Where it overlies the Lamotte, the Bonneterre passes into the transitional phase of alternating sandstone and chloritic limestone described as characteristic of the Upper Lamotte; but where it overlaps the granites and porphyries, a few feet of conglomeritic material usually intervenes at the contact. As a rule, this conglomerate consists of but a few feet of sandy, conglomeratic limestone, but, in certain localities, it is much thicker and appears to be co-extensive with the conglomerate at the base of the Lamotte.

A few limonite deposits are known to occur within the area underlain by the Bonneterre formation, but these have been found to be generally shallow and are seldom of commercial importance.

THE DAVIS FORMATION.

The Davis formation consists mainly of alternating beds of soft shale, shaley limestone, and conglomerate. Though virtually a single shale formation, it has been divided near the middle into an upper and lower member belonging respectively to the Upper and Middle Cambrian.

The lower member is about 100 feet thick and consists of very shaley magnesian limestone, thin beds of conglomerate, and thicker beds of soft shale containing horizontal thin plates or discs of limestone. Beds of pure shale are thin and rare. The conglomerates are, for the most part, of a peculiar type known as "edgewise" on account of the generally tilted or nearly vertical position of the thin plates or discs of limestone of which they are largely composed.

The upper member of the Davis is normally about 70 feet thick. It may be distinguished from the lower member by the comparative abundance of soft shale beds which vary from a few inches to nine feet in thickness, and by the entire absence of the "edgewise" conglomerate.

The contact of the upper and lower members is well marked by the occurrence of a layer of rounded boulders of nearly pure, finely crystalline, fossiliferous limestone imbedded in about four to five feet of soft, blue shale. The boulders rest directly upon the highest of the edgewise conglomerates and mark one of the most persistent and easily traced horizons in the Cambrian.

Neither member of the Davis formation is known to be iron bearing. In the vicinity of Irondale, float limonite has been gathered from the surface of the Upper Davis, but this can be traced to the overlying Potosi formation occurring in that vicinity.

THE DERBY FORMATION.

Lying conformably upon the Davis shale, is the Derby formation, consisting of about 38 to 40 feet of highly magnesian limestone. Alternating thick, soft, porous beds and thin, hard beds weather to form a characteristic shelving outcrop, having a hackly, pitted upper surface. Like the Bonneterre, with which it is often confused, it is a noncherty, magnesian limestone. Nowhere is the formation known to be iron bearing.

THE DOE RUN FORMATION.

This formation overlies the Derby and has a normal thickness of about 50 feet. It consists largely of relatively heavily bedded, finely crystalline, impure, magnesian limestone which weathers to a light buff color. Much of the formation has a typical "cotton rock" texture and contains numerous small druses of quartz.

The formation is not known to be iron bearing.

THE POTOSI FORMATION.

This formation, immediately overlying the Doe Run, includes approximately 300 feet of very silicious, cherty and drusy dolomite, and is the lowest decidedly cherty horizon in the Cambrian. Most of the silica is present as thin coatings of chalcedony and drusy quartz, lining irregular cavities or coating joint and bedding planes. In this particular, this formation is distinctive and may be readily recognized by the presence of the drusy quartz. The Potosi has a large surface distribution, principally east, north, and west of the granitic area.

A few relatively unimportant deposits of brown iron ore have been found in the residual materials derived from this formation. The most important of these are the Irondale mines, which, at one time, supplied the now dismantled Irondale furnace.

THE EMINENCE FORMATION.

In the southeastern part of the State, Dr. E. O. Ulrich has recognized, above the Potosi formation, a cherty dolomite, which he has named the Eminence formation.

THE PROCTOR FORMATION*.

This formation is a heavy bedded, relatively non-cherty, porous, dolomitic limestone which overlies the Potosi. It has an estimated thickness of from 60 to 100 feet and is the highest essentially non-cherty formation of the Cambrian.

The surface distribution of the Proctor is not fully known. The upper portion of the formation is well exposed along the Osage river in Morgan and Miller counties, and it has been recognized along the Current River in Shannon county.

So far as known, the formation is not iron bearing.

THE GASCONADE FORMATION.

This formation consists of an upper, cherty, dolomite member and a lower sandstone member, the latter being known as the Gunter sandstone. The Gunter directly overlies the Proctor and has a correspondingly limited distribution.

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*Detailed descriptions of the Cambrian formations, from the Proctor up to and including the Jefferson City, may be found in the following reports of the Mo. Bureau of Geol. and Mines.

Geology of Miller County, Vol. 1, 2nd series, 1903, pp. 23-81.
" " Moniteau " Vol. 3, 2nd series, 1905, pp. 21-33.
" " Morgan " Vol. 7, 2nd series, 1907, pp. 24-46.
Biennial Report to the 46th General Assembly, pp. 55-59.

It varies in color from white to deep brown and in composition from calcareous to quartzitic. There is also considerable variation in thickness within short distances. It is generally exposed as a single shelving ledge from 2½ to 18 feet thick, although in Morgan county it attains a local maximum thickness of 36 feet.

Nowhere is this sandstone known to be iron bearing.

The dolomite member consists chiefly of cherty and non-cherty dolomite with intercalated beds of solid chert and occasional thin beds of sandstone. In Miller County, where fully exposed, it is very uniform in thickness, averaging between 240 and 250 feet. It is rather heavily bedded, and has a crystalline to granular texture and a light to dark gray color. Near the base it becomes somewhat shaley.

The cherts, which comprise from 10 to 15% of the formation, occur either in beds, as scattered nodules, or as irregular masses disseminated through the dolomite.

The bedded cherts are the more porous and seldom exceed a thickness of three or four feet. Where thickest, they frequently have a crushed and brecciated appearance. These beds usually grade laterally into cherty dolomite.

The nodular cherts are usually scattered indiscriminately through certain beds and may be connected by thin sheets or bands of the same material.

The irregularly disseminated cherts occur in sheets and masses, branching out in every direction through the dolomite, or may exist as isolated irregular patches.

The beds of sandstone in this member are usually thin, highly calcareous, and generally occur in lenses of limited lateral extent.

The Gasconade forms the surface rock throughout the lower portions of the valleys of nearly all the larger streams of the Ozark region, including the Meramec, Gasconade, Osage, White, Current, Black, St. Francois, and Castor rivers and their larger tributaries. Wherever it forms the surface rock, it imparts a rough topography. High, narrow, chert covered ridges, and many precipitous bluffs mark its distribution.

Many of the important deposits of limonite of Southeast Missouri and many of the red and specular hematite deposits of the Central Ozarks are directly associated with this formation. It is one of the principal iron bearing horizons of the State.

THE ROUBIDOUX FORMATION.

This formation directly overlies the Gasconade and is believed to have the widest surface distribution of any of the Cambrian formations. It extends throughout the Ozark plateau, occupying chiefly the highland areas or inter-stream divides. Like the Gasconade, it is directly associated with many important deposits of iron ore.

Consisting largely of sandstone interbedded with thick beds of chert and cherty dolomite, it varies so greatly within short distances both in thickness and composition that no single descriptive section can be made to apply generally over the wide area in which it outcrops. This is especially noticeable on comparing the detailed descriptions of the formation as it occurs in Miller, Morgan, and Phelps counties. The Phelps county section, however, appears to be more nearly representative of the formation as it occurs in the Central district, which lies chiefly within Phelps, Dent, Crawford, and Franklin counties; and since it is with the Roubidoux of this district that we are more directly concerned, the Phelps county section is here taken as the type.

In the vicinity of Newburg, the formation averages 100 ft. in thickness and includes two well defined sandstone members separated by a cherty dolomite member. The upper sandstone is overlain by a second cherty dolomite member, which grades into the overlying pitted dolomite of the Jefferson City formation.

The lower sandstone member is from three to sixteen feet in thickness, averaging about ten feet. Although sometimes massive, the beds are generally thin and somewhat soft and porous. Cross-bedding, ripple marks, and sun cracks are common.

The upper sandstone is 25 feet thick and is generally brownish red in color and comparatively coarse grained. The upper part frequently contains small fragments of chert, is more massive, finer grained, and generally of a lighter color than the lower portions.

The upper and lower sandstone members are separated by a cherty dolomite, which has a thickness of 35 feet. This member of the Roubidoux varies greatly in character within short distances. The chert layers grade laterally into cherty dolomite and the dolomite often becomes sandy or argillaceous. Lenses of sandstone are of common occurrence and certain of the dolomite beds bear a close resemblance to those of the Gasconade.

The upper sandstone is overlain with 30 feet of thinly bedded "cotton rock" and crystalline, cherty dolomite comprising the upper dolomite member. This member of the Roubidoux formation commonly occupies the crests of the ridges but seldom outcrops, due to the rapidity with which it weathers.

THE JEFFERSON CITY FORMATION.

This is the youngest of the Cambrian formations of the Ozark plateau. It consists chiefly of dolomite and lies conformably upon the Roubidoux. Its surface distribution is confined mainly to the uplands of the northern, western, and southern outer margins of the Ozarks, together with a number of the highest hills and divides of the Central plateau. In Morgan county it reaches a maximum thickness of 450 feet.

In the vicinity of Rolla, the formation is 130 ft. thick and consists of a lower horizon of very hackly, pitted dolomite and an upper horizon of fine grained, argillaceous dolomite or cotton rock with thin intercalated beds of chert and sandstone. The hackly, pitted dolomite forms the most persistent beds of the lower half of the formation and varies chiefly in the amount of chert that it contains. Its mottled appearance is caused by inclusions of a white, powdery, silicious material filling cavities and distributed along the bedding planes.

Many deposits of limonite resulting from the alteration of iron sulphides occur within the residual materials of the Jefferson City formation.

ORDOVICIAN.

During Gasconade, Roubidoux, and Jefferson City time, there were many sudden changes in the conditions of sedimentation, due to general shallow sea conditions; but there appear to have been few if any interruptions in deposition, and no marked periods of erosion.

Not until the end of Jefferson City time, was there a decided and general uplift of the Ozark region which brought the deposition of the Cambrian sediments to a close. Following this uplift, there began a period of erosion during which the upper Cambrian sediments were partly removed. This period of erosion was brought to a close by a period of submergence that resulted in the deposition of the Ordovician formations upon the eroded surface of the Cambrian.

The Ordovician consists of a group of five formations, viz.: the St. Peter, the Joachim, the Plattin, the Kimmswick, and the Hudson River. This group, as a whole, is confined chiefly to narrow belts of territory in Ralls, Pike, Lincoln, Montgomery, Warren, St. Charles, St. Louis, Jefferson, Ste. Genevieve, Perry, and Cape Girardeau counties.

The St. Peter sandstone lies unconformably above the Jefferson City. This unconformity marks the first considerable erosion interval above that at the base of the Cambrian.

The St. Peter has a maximum thickness of 175 feet and consists of white to yellowish, massive, friable sandstone.

The Joachim formation lies unconformably upon the St. Peter sandstone. It has a maximum thickness of 150 feet and consists chiefly of relatively thinly bedded, yellowish to dark gray, calcareous dolomite.

The Plattin formation consists of heavy bedded, fine grained, compact limestone having a maximum thickness of 350 feet.

The Kimmswick formation overlies the Plattin and consists of heavy bedded, coarsely crystalline, highly fossiliferous, gray to buff colored limestone. As a whole, it is easily recognized because of the abundant remains of the well known and generally well preserved fossil Receptaculites, commonly called the "Sunflower Coral."

Overlying the Kimmswick is the Hudson River formation. This is essentially a shale horizon and the first of its kind above the Davis formation. Where typically exposed at Thebes, Ill., it consists of two shale members separated by a sandstone member. According to Shumard*, the upper shale member consists of about 45 feet of bluish gray and yellow, sandy shale, beneath which is about 100 feet of yellowish, fine grained, argillaceous sandstone underlain in turn by about 60 feet of dark, calcareous shale, making an estimated total thickness of 205 feet. In Pike county** it has a recorded thickness of 100 feet and consists chiefly of a light blue, sandy shale divided at intervals by thin flags of shaley limestone one to six inches thick. It occurs at the surface chiefly in Ralls, Pike, and Lincoln counties, with smaller areas in Perry and Cape Girardeau counties.

The Ordovician rocks, besides having so limited a surface distribution, are not known in any important particular to be iron bearing.

SILURIAN.

Overlying the Ordovician series, is a group of three formations, viz.: the Girardeau, the Niagara (Bainbridge), and the Bailey (Lower Helderberg), which are referred to the Silurian age. The Silurian, like the Ordovician, has a very limited surface distribution in the State, being confined chiefly to Pike, Lincoln, Ste. Genevieve, Cape Girardeau, and Perry counties.

*Shumard, B. F., Mo. Geol. Survey, 1855-71, p. 124.

**Rowley, R. R., Geology of Pike county, Missouri: Missouri Bureau of Geol. and Mines, vol. 8, 2nd series, 1907, p. 16.

The above formations consist mainly of limestone. The Girardeau, which occurs chiefly in Cape Girardeau county, consists of approximately 60 feet of bluish gray, compact, thinly bedded limestone. It is somewhat cherty in the upper portion. The Niagara in Pike county has a thickness of 25 feet and consists of dolomitic, argillaceous limestone. The Bailey formation in Cape Girardeau county consists of thinly bedded, blue to bluish gray, cherty limestone having an estimated thickness of 350 feet.

The Silurian rocks outcropping in this State are not known to be iron bearing. While the Clinton iron ore described in a later chapter is thought to be Silurian in age, it is associated with a shale formation which does not outcrop and appears to be confined to the northwestern part of the State.

DEVONIAN.

The surficial distribution of the Devonian rocks is very limited, being confined to small areas in those counties bordering the northern, eastern, and western portion of the Ozark plateau, together with certain counties along the Mississippi river north of St. Louis. The series includes, in rising succession, the Clear Creek (Oriskany), the Onondaga, the Hamilton, and the Sulphur Springs formations.

The Clear Creek (Oriskany) consists of cherty limestone which is typically exposed south of Wittenberg, Perry county.

The Onondaga consists of limestone which varies in texture from crystalline to oolitic. In Cooper county it has a thickness of 60 feet. It is typically exposed at Grand Tower, Perry county.

The Hamilton formation consists of blue to black, slightly arenaceous shale which is well developed in Marion, Ralls, Pike, and Lincoln counties. In Pike county it varies greatly in thickness, ranging from 7 to 63 feet. The Onondaga and Hamilton formations have been included by E. O. Ulrich under the name of "Grand Tower".

The Sulphur Springs formation consists of three members, viz.: a yellow friable sandstone, known locally as the Bushberg; a sandy limestone, known locally as the Glen Park; and an unnamed shale. Above the Bushberg sandstone in St. Louis county, there occurs a series of pink or purple, cherty shales and thin limestone beds known locally as the Fern Glen.

There are no known deposits of iron ore associated with the Devonian rocks.

MISSISSIPPIAN.

The Mississippian consists chiefly of limestone, but includes also some shale and sandstone. It is the surface formation over extensive areas in both the northeastern and southwestern parts of the State. These areas are connected by a relatively narrow belt of Mississippian which extends irregularly through the central portion of the State. Smaller, but important, isolated areas occur along the Mississippi river in Ste. Genevieve and Perry counties.

The Mississippian is commonly divided as follows: The Chemung group—also known as the Kinderhook; the Burlington; the Keokuk; the Warsaw; the Spergen; the St. Louis group; and the Chester group.

THE CHEMUNG GROUP.

The Chemung consists of three formations; the Louisiana limestone; the Hannibal shale; and the Chouteau limestone. As a group, they are well defined in the counties bordering the Mississippi river north of St. Louis, and have representatives as far south as Wittenberg, Perry county.

The Louisiana, the lowest member, consists of thinly bedded, close grained, hard, buff to bluish colored limestone, which breaks with a conchoidal fracture. Where typically exposed at Louisiana, it has a thickness of 40 feet.

The Hannibal consists mainly of a bluish green, slightly calcareous, sandy shale, capped by a shaley sandstone exhibiting numerous worm borings, on account of which it has been called the "Vermicular" sandstone. In Pike county this formation has a thickness of from 60 to 70 feet.

The Chouteau is a dense, fine grained, ashy gray to buff limestone that is frequently somewhat argillaceous. It has a maximum thickness of 100 feet and occurs throughout the region bordering the Cambrian sediments of the Ozark plateau where, in many instances, it lies unconformably upon the Cambrian.

THE BURLINGTON FORMATION.

This formation, as a whole, is a coarsely crystalline, nearly pure, highly fossiliferous, white to buff colored limestone, containing nodules and beds of chert. One chert member, known as the Grand Falls Chert, has a thickness of from 5 to 40 feet in Jasper and adjoining counties. The Burlington formation has a maximum thickness of 350 feet, and underlies the major portion of the area occupied by the Mississippian series.

In the western part of the State, the Burlington has considerable importance as an iron bearing formation, the ore occurring as limonite, filling cavities and fissures in the limestone.

THE KEOKUK FORMATION.

This formation is typically developed in the northeastern part of the State. In Pike county, it has a thickness of 25 feet and consists of cherty limestone and shale.

THE WARSAW FORMATION.

This formation, consisting of shale and limestone, is confined mainly to the eastern part of the State. In St. Louis county, it consists of about 75 feet of soft bluish to yellow shale, through which are distributed occasional beds of limestone.

THE SPERGEN FORMATION.

This formation consists of a massive, oolitic limestone, resembling that of the famous quarries near Bedford, Ind. It is confined to the counties bordering the Mississippi river, south of the mouth of the Missouri. In St. Louis county, it has a thickness of 60 feet; in Ste. Genevieve and Perry counties, its thickness is estimated at from 150 to 200 feet.

THE ST. LOUIS GROUP.

This group includes the St. Louis and Ste. Genevieve limestone formations. The St. Louis consists of fine grained, light colored, limestone, containing some chert. It is not known to occur in western Missouri but is well developed along the bluffs of the Mississippi river, where it has a maximum thickness of 300 feet.

The Ste. Genevieve formation is known to occur only in Ste. Genevieve county. As described by Shumard, it consists of about 50 feet of heavily bedded limestone grading imperceptibly into the St. Louis formation.

THE CHESTER GROUP.

This group includes three members: the Cypress, the Tribune, and the Birdsville. It has a very limited distribution in Ste. Genevieve and Perry counties.

The Cypress formation consists of 40 to 80 feet of ferruginous sandstone. The Tribune formation consists of about 200 feet of thinly bedded, gray limestone and bluish fossiliferous marl. The Birdsville, which is considered the top of the Mississippian series, consists of shale, sandstone, and thinly bedded, impure limestone; and has a maximum thickness of 300 feet.

With the exception of the Burlington, the Mississippian formations are not known to be iron bearing.

PENNSYLVANIAN.

Unconformably upon all the underlying rocks, is the Pennsylvanian or Coal Measures series, having a thickness of nearly 2000 feet and consisting of shale, sandstone, limestone, and coal. The Pennsylvanian underlies the greater part of the north half of the State and extends south of the Missouri river along the western boundary of the State to the vicinity of Joplin. It is divided into two main groups known as the Des Moines and the Missouri. These are in turn sub-divided into formations, some of which are composed of several members.

THE DES MOINES.

The Des Moines, or Lower Coal Measures, has an approximate thickness of 700 feet. It consists mainly of shale and sandstone, with comparatively thin and unimportant beds of limestone. It contains the principal productive coal seams in the State. In its surface distribution it occupies a broad, irregular belt, extending in a northeasterly direction from Jasper county to the eastern half of the Iowa state line. An important outlier occurs in the northeastern part of St. Louis county, and numerous smaller outliers are scattered throughout the north, west, and central portions of the Ozark plateau.

The Des Moines has been separated into three divisions known as the Cherokee, the Henrietta, and the Pleasanton.

The Cherokee consists chiefly of sandstone and shale and contains a number of important coal seams. Overlying unconformably the Mississippian formations, it occurs irregularly along a belt extending from Barton county on the south to the Iowa state line on the north. Important outliers occur in St. Louis county and in those counties located on the northern and western slopes of the Ozark plateau. The sandstone comprising the lower portion of the Cherokee has been called Graydon* by Shepard and is typically developed in southwestern Missouri.

*Shepard, E. M., Geology of Greene county, Missouri: Mo. Geol. Survey, vol. 12, 1898, p. 13.

The Henrietta is made up of limestone, shale, and sandstone, the limestone forming noticeable escarpments in the area of low relief occupied by the Des Moines.

The Pleasanton, forming the upper member of the Des Moines, consists chiefly of shale. Due to the ease with which it weathers, outcrops are not common.

With the exception of a few thin beds of earthy, red hematite occurring chiefly near the base of the Cherokee and occasional thin beds of iron carbonate, the Des Moines is not known to be iron bearing. These deposits are described in a later chapter.

THE MISSOURI.

The Missouri includes about 1300 feet of alternating beds of shale, sandstone, and limestone and represents the latest of the Paleozoic sediments deposited in this State. In its surface distribution it is confined entirely to the northwest quarter of the State, mainly north of the Missouri river.

With the exception of a few thin beds of iron carbonate of no commercial importance, the Missouri series is not known to be iron bearing.

TERTIARY.

Much younger than any of the foregoing series, and separated from them by pronounced unconformities, is a series of unconsolidated sediments which are assigned to the Tertiary and Quaternary. The lowest of this series, the Tertiary, includes three divisions known as the Porters creek, the La Grange, and the LaFayette.

The Porters Creek and the LaGrange groups, each consisting of about 200 feet of loose sands and clays, are confined entirely to the southeast Lowlands. Overlying the LaGrange is the LaFayette formation, consisting chiefly of rounded and water-worn chert gravel, which, in places, is cemented by iron oxide.

The LaFayette is best developed along Crowleys ridge on the Lowlands where it varies from 10 to 60 feet in thickness. It also occurs as scattered patches along the river bluff of the southeastern Ozarks and at intervals upon the tops and upper slopes of the hills and ridges throughout that part of the Ozark plateau encircling the St. Francois mountains on the northeast, east, south, and extending southwest to the eastern boundary of Ozark county.

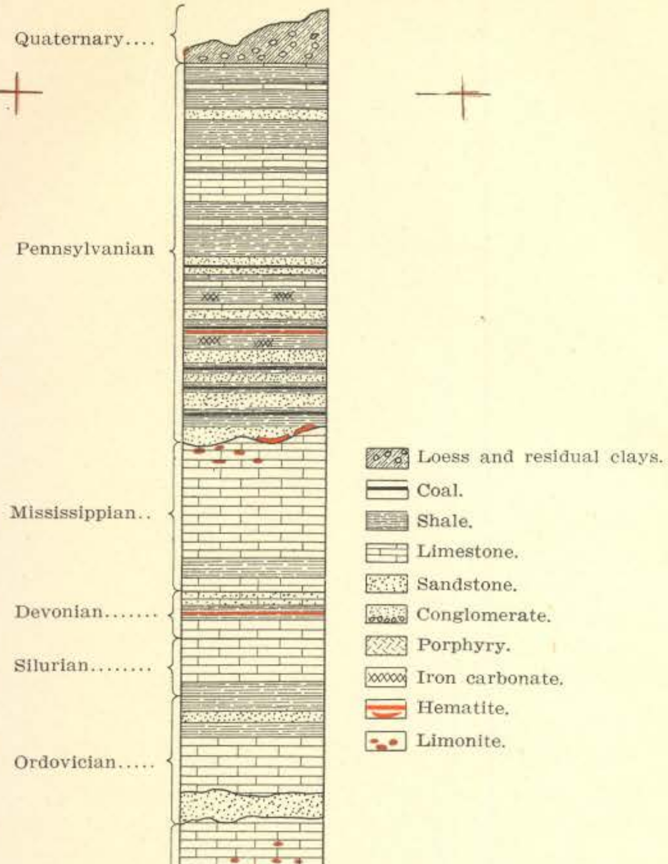

Fig. 1. GEOLOGIC SECTION SHOWING OCCURRENCE OF THE VARIOUS TYPES OF IRON ORE.

QUATERNARY.

THE PLEISTOCENE.

Next later than the LaFayette is the Pleistocene, which includes the glacial drift and the loess.

The glacial drift consists of intermingled boulders, gravel, sand, and clay, and occurs as a relatively thin veneer over the surface of the northern part of the State as far south as the Missouri river and beyond it into Jackson, Saline, and St. Louis counties.

The loess is a fine, yellow to buff colored clay without marked stratification. It has a maximum thickness of about 200 feet, and is confined chiefly to the banks of the Missouri and Mississippi Rivers. Neither the glacial drift nor the loess are known to be iron bearing.

RECENT.

This, the youngest geologic formation, consists of residual and alluvial clays, sand, and gravel.

The residual clays* are formed chiefly through the weathering of the underlying formations and consist of a heterogeneous mixture of clay, chert, and sand. They occur over the entire Ozark plateau, but are most extensively developed in the southern and southeastern parts of the State, particularly in the area bordering the Lowlands. Here, they frequently have a thickness of from 100 to 200 feet.

Much of the brown iron ore of the State is embedded in residual clay, the character and distribution of which is described more in detail in a later chapter.

The alluvial deposits are developed chiefly upon the flood plains of the Mississippi and Missouri rivers and their larger tributaries. They consist of gravel, clay, sand, and loam which have been washed from the residual deposits into the valleys. Aside from its association with certain unimportant bog ore deposits of the Lowlands, the alluvium has no direct bearing on the subject of this report.

*Strictly speaking, the residual clays have been in the process of formation since Pennsylvanian time, and are not therefore truly Quaternary. However, as they are being formed at present, they are referred to in this report as belonging to that division.

CHAPTER V.

BROWN ORES.

CLASSES OF BROWN ORES.

The limonites or brown iron ores of Missouri belong to two distinct classes which differ widely in physical and chemical character, mode of occurrence, and distribution. As mentioned in a previous chapter, these two classes of brown ore are designated as (1) secondary limonite and (2) primary limonite, the former being derived through the oxidation and hydration of marcasite and pyrite, while the latter was precipitated directly from solution as hydrous ferric oxide.

Deposits of secondary limonite are of frequent occurrence and are widely distributed throughout the Ozark plateau. They include all of the relatively pure pipe and boulder ores, which, because of their higher grade, have been more extensively mined. Among the better known mines which have produced ore of this type, are the Luke near Keener, the Cady near Blum, the Buffington near Williamsville, the Janis, King, and Sawyer near Greenville, and the Carson and Kingsbury southeast of West Plains.

The deposits of primary limonite are confined chiefly to a relatively narrow belt bordering the Tertiary lowlands in the southeastern part of the State, but they also occur in a few localities in Christian, Greene, and Dade counties in southwest Missouri. They include all of the relatively low grade, cellular, cherty, and sandy ores, which, because of their silicious nature, have attracted less attention, it being only within the last few years that they have been developed to any considerable extent. The only mines which produced this type of ore during 1910 are located at Puxico and Orchard switch. Recent shipments have also been made from the Myers, Burton, and Zippy mines, located a few miles northeast of Greenville, in Southeast Missouri, and from the Angus, Frisco, and Jackson mines located in Southwest Missouri.

During the field work incident to the preparation of this report, all the known developed and many of the undeveloped deposits of both secondary and primary ores were examined. There are hundreds of outcrops, particularly throughout southeast Missouri, which were not visited. To locate and report upon each of the deposits would require a detailed geologic survey of a large part of the Ozark plateau.

SECONDARY LIMONITE.

THE ORE DEPOSITS.

Distribution: The secondary limonite has a wider areal distribution than any of the other types of iron ore of the State, and is known to occur in greater or less abundance in nearly every county within the Ozark plateau*.

That the secondary deposits are not equally well developed or uniformly abundant in all parts of the region, is indicated on the accompanying geologic map, where the deposits of this type are shown by a solid round dot. For convenience, these apparent segregations will be referred to as districts under the following heads:

(1) The Fredericktown—Marble Hill district, including the deposits of Madison and Bollinger counties;

(2) The Williamsville—Greenville district, including the deposits of Butler, Wayne, and Reynolds counties;

(3) The Winona—West Plains district, including the deposits of Carter, Ripley, Oregon, Shannon, Howell, Ozark, and Douglas counties;

(4) The Osage River district, including the deposits adjacent to that stream.

In addition to the deposits embraced in the above districts, there are a number that are relatively isolated and so widely scattered as not to be readily grouped. As shown on the map, these include deposits in the vicinity of Caledonia; scattered deposits along the northeastern border of the plateau in Ste. Genevieve, Jefferson, Franklin, Gasconade, and Osage counties; a few deposits occurring in Polk and Greene counties on the west flank of the Ozarks; and an occasional deposit within the region of the "filled sinks" of the Central ore district.

From the foregoing, it will be noted that a majority of the known secondary deposits of commercial importance are confined to the marginal portions of the Ozark plateau, and that by far the greater number are located on the southeastern slope.

*An examination of the wash along the bed of almost any of the Ozark streams will disclose the presence of small fragments or boulders of limonite of this character.

Geologic Relations: With the exception of a few deposits associated with formations of Mississippian age in Polk and Greene counties, the secondary ores are confined entirely to the region underlain by the Cambrian formations. They are associated chiefly with the Gasconade limestone, Roubidoux sandstone, and the Jefferson City limestone, although a few deposits occur in other Cambrian formations. Among the latter are those in the vicinity of Caledonia, which occur in Potosi residual material, and those near Fredericktown, which overlie the Bonneterre limestone. A few unimportant and undeveloped deposits occur at other geologic horizons.

While the deposits of secondary limonite are underlain by the above formations, comparatively few are directly associated with them. On the contrary, by far the larger number, including all the more important deposits, are embedded in residuum which usually so completely envelopes the ore as to quite obscure its relation to the underlying formation.

The residuum consists of a heterogeneous mixture of clay, chert, and sand derived chiefly from the decomposition and disintegration of impure, cherty, magnesian limestone and sandstone of the Cambrian formations. These materials are generally much confused and, with the exception of occasional horizontal beds of chert or sandstone, retain but little evidence of stratification. The entire Ozark plateau is enveloped in a mantle of residuum which has a maximum thickness along the southern slope, attaining in certain portions of the Williamsville-Greenville and Winona-West Plains districts, a known depth of over 200 feet. Where it is thickest, it almost completely obscures the underlying formations.

Topographic Relations: The secondary limonite deposits bear no definite relation to the topography. They may occur either on the crest of the highest hills or along their slopes, a few having been observed even upon the banks of the larger streams, at or near groundwater level. However, the larger deposits usually cap the hill tops.

Manner of Occurrence: The deposits associated with the underlying formations sometimes occur in the form of ledge-like masses in part enclosed by the limestone. More frequently they occur as residual boulders, resting upon the exposed surface of the formation.

The ore occurring in the residuum is chiefly in the form of scattered boulders. Occasionally it forms stringers and sheets in the residual material as though originally filling fissures, joints, and bedding planes in limestone which has subsequently been removed through weathering. Not infrequently it occurs as irregular pockets enclosed by clay. Many of the ore bodies are composed of a series of irregular pockets of ore bearing clay separated by "clay horses" or areas of barren clay which cannot be detected from an examination of the surface.

Size of the Deposits: The deposits vary greatly in size, those directly associated with the limestone being usually small, often containing only a few tons of ore, while those embedded in residual clays are frequently large, some of them having produced more than 60,000 tons. Where the ore outcrops over several acres the tonnage will probably exceed this figure. It is hardly probable, however, that many deposits will exceed 100,000 tons.

Depth of the Deposits: The thickness of the deposits appears to be as variable as their lateral dimensions. In case the ore occurs upon or is closely associated with limestone it frequently extends only a few feet beneath the surface. Where the ore is embedded in a thick mantle of residual material, it often has a considerable thickness, several such deposits having been worked to a depth of 50 feet without reaching the lower limits of the ore body. The pit at the Kingsbury mine, in Howell county, is 70 feet deep and is still in ore. In the immediate vicinity of this mine a 200 foot hole, drilled for water, while not showing ore, was entirely in residual material and indicates the possible depth to which the ore might extend.

Outcrop: Outcrops of this class of deposits vary greatly in size and form and often indicate the nature of the deposits. However, in most cases the character and size of the outcrop are insufficient criteria upon which to base a reliable estimate of the size of an ore body.

A very promising form of outcrop consists of large and small fragments of ore, forming a small knoll on the crest of a hill or ridge. Outcrops of this type are particularly characteristic of those localities where the residuum is thickest, and are generally indicative of important deposits of ore. Among the developed properties which were marked by outcrops of this type, are the Janis, Ojibway, and H. K. mines in Wayne county, and the Kingsbury mine in Howell county, all of which have been important producers.

A less promising form of outcrop, though of frequent occurrence, consists of a ledge of ore, protruding from the base of the hill. Such ledges vary from a few inches to ten feet in thickness, and from a few feet to 100 feet in length. The ore may be stalactitic, but is more frequently massive. Outcrops of this type characterize deposits which are closely associated with limestone. They are usually shallow, the overburden increasing as they are followed into the hill. The W. C. Meyers bank in Bollinger county, the Hicks mine in Wayne county, and the J. B. Old bank in Oregon county are typical examples of such deposits.

Still another form of outcrop is that in which a large mass of nearly solid ore lies exposed upon the surface of the limestone. Outcrops of this type are most common near the courses of the larger streams where the limestone is best exposed, and are seldom indicative of large bodies of ore. The Chilton bank, near Jacks Fork, a few miles north of Eminence, is a typical example of such an outcrop.

Overburden: The amount of overburden varies with the mode of occurrence of the ore. Deposits directly associated with limestone, usually outcrop, while those embedded in residual material may have an overburden of from a few inches to 20 feet or more.

The overburden usually consists of cherty clay, similar to that in which the ore is embedded. In a few cases the deposits are overlain by river silts and gravel, and by gravels of Tertiary age.

THE ORE.

Mineral Composition: The ore consists chiefly of limonite, with an occasional admixture of hematite. Goethite does not occur. In this respect the secondary ore differs materially from the primary in which goethite is common, and in which hematite does not occur. The chief impurities are silica, alumina, and iron sulphide.

The silica is present mainly in the form of chert and small crystals of quartz. The chert occurs embedded in the ore while the quartz occurs lining cavities and occasionally as grains of sand.

Alumina is present in the form of clay, either coating the surface or filling cavities in the ore. Where the ore is exceedingly porous, clay may be so abundant as to materially lower its grade but can be removed in part by washing.

Iron sulphide is present in the form of marcasite and pyrite, the former being the more prevalent. It occurs chiefly near the bottom of the deposits either in boulder form incased in limonite or as soft marcasite embedded in clay. The latter mode of occurrence is characteristic of deposits situated near ground water level. In a few cases marcasite has been observed filling fissures and cavities in limestone underlying the ore. However, it is not usually present in sufficient quantity to materially affect the commercial possibilities of a deposit.

Manganese, although present in small amounts, as shown by analyses, is rarely found in visible quantities.

Physical Characters: There are three easily recognized forms of secondary limonite, viz.: (1) hard boulder and tabular ore; (2) stalactitic or "pipe" ore; and (3) soft granular or ocherous ore.

The boulder ore is usually present and frequently constitutes the major portion of the deposit. Where associated with pipe ore, it

Fig. 1. Secondary limonite showing arborescent forms. Reduction ⅓.

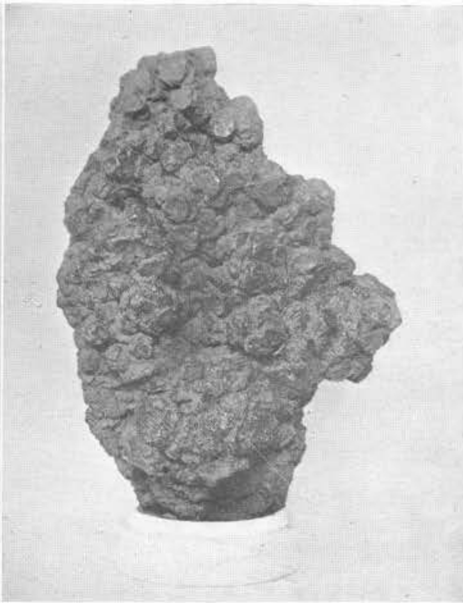

Fig. 2. Secondary limonite pseudomorphous after pyrite. Reduction ½.

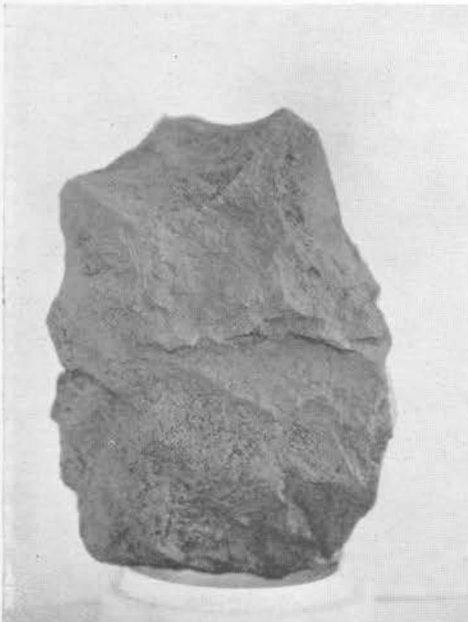

Fig. 3. Massive secondary limonite. Reduction ⅓.

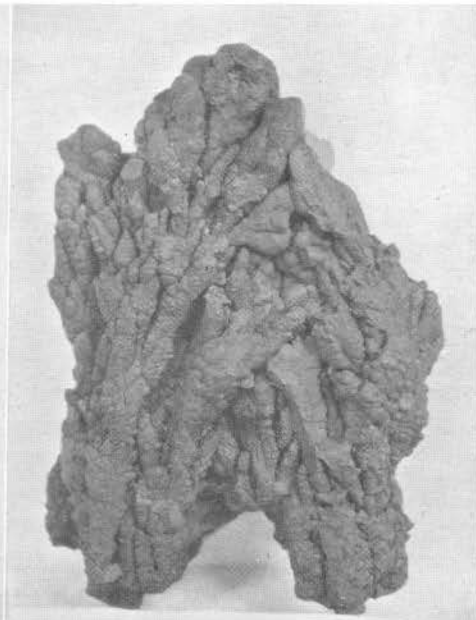

Fig. 4. Secondary limonite pseudomorphous after marcasite. Reduction ½.

usually underlies the latter, forming the lower portion of the ore body. It is, for the most part, finely cellular to close grained, but the larger boulders frequently consist of a compact shell or "bomb" enclosing a porous, ocherous interior, which occasionally contains unaltered marcasite. The exterior of the boulders is usually rough and angular and coated with clay. Many have an ocherous coating and occasionally grade into the ocher, in which they are often embedded. Figures 1 to 4, Plate III, shows the general texture of the boulder ore.

The tabular ore is equally as common as the boulder ore and is associated with both the other forms. It occurs in rectangular fragments varying from one-eighth to one inch in thickness, which appear to have been deposited along joints and bedding planes in the limestone.

There are two forms of tabular ore marking successive stages in the process of vein filling: (1) one side conforming to the rock surface upon which it was deposited, with pseudomorphous, botryoidal, and cockscomb crystal forms after marcasite, on the other, representing incomplete vein filling; (2) both sides conforming to the surface of the wall rock and compact throughout, representing complete vein filling.

The stalactitic or "pipe" ore comprises so large a part of the secondary limonite that the term "pipe-ore" is used freely in referring to it. In many instances the deposits are composed largely of pipe ore which, as a rule, is associated with both the boulder and tabular ore and, in some instances, with the ocher.

The pipe ore occurs chiefly in the upper portion of the deposits, giving place to ocher and boulder ores below. Except where exposed by erosion, it is usually embedded in red clay.

The pipes vary in size ranging from 1/20 of an inch to six inches in diameter and from a few inches to several feet in length. They are usually about a quarter of an inch in diameter and six to eight inches long, their length being governed by the size of the opening in which they were formed. They are usually nearly circular in cross-section and for the most part, nearly uniform throughout. Some, however, show tapered or enlarged ends. Occasionally they branch, forming two or more pipes which may unite again to form a single pipe. They may occur as single individuals but more often in parallel aggregates, forming bundles. Occasionally they have a confused criss-cross or twisted structure, the pipes being frequently twinned. The parallel arrangements is much the more common, being particularly characteristic of the smaller pipes, notably the wire pipes, having a diameter of one-tenth of an inch or less. The wire pipes, when in massive bundles, coalesce so firmly in some cases as to form a nearly solid mass, while in others they are so loosely cemented that, when exposed to the air, the whole mass crumbles to a heap of individual pipes.

In cross-section, the pipes exhibit either a simple concentric banding or both a radial and banded structure. The concentric banding is due to alternating light and dark rings of limonite encircling a closed center, the outer surface being relatively smooth and without crystal, botryoidal, or other pseudomorphous forms.

Where the ore has both the radial and banded structure, there has apparently been a concentric growth of radial crystals of iron sulphide. The center of a pipe of this character is frequently a continuous thread-like opening, and the exterior is usually covered with pseudomorphs of limonite after marcasite. In some instances these pseudomorphs are perfectly truncated cubes after pyrite. Occasionally the pipes consist wholly or in part of unaltered marcasite. Figs. 1 to 4, Plate IV, illustrate the more common forms of pipe structure.

The soft granular and ocherous ore often forms an important part of the secondary deposits. It is more commonly associated with the boulder ore than with the pipe ore, usually forming the gangue in which the boulder ore is embedded. There are all gradations from powdery, light brown to yellow ocher to that which is soft, somewhat granular, and dark brown in color.

Relations of the Ore to Waste: In a majority of the deposits the distinction between minable ore and waste is a relative term only, depending entirely upon the proportion of fine ore in the dirt. Where the deposit consists chiefly of small fragments of ore embedded in clay, it cannot be profitably mined unless washed. In case the deposit contains considerable boulder ore it may be worked by hand, the finer ore and clay being removed as waste. In many cases this waste, which is usually a source of expense, could be made to return a profit through the installation of a small log washer.

The amount of chert in the residual clay varies greatly in the different deposits. In many instances the chert may be removed from the ore by hand picking after washing. Where it is relatively abundant and occurs in small fragments, the ore must be passed through crushers and over jigs in order to concentrate it economically.

Chemical Composition: The pipe ore is high grade, the boulder ore medium grade, non-bessemer limonite. Analyses of 51 shipments from various mines show the pipe ore to be fairly uniform in character and to average 55.27% iron, 7.56% silica, .082% phosphorus, and .138%

Fig. 1. Cluster of needle pipes of secondary limonite. Reduction ⅔.

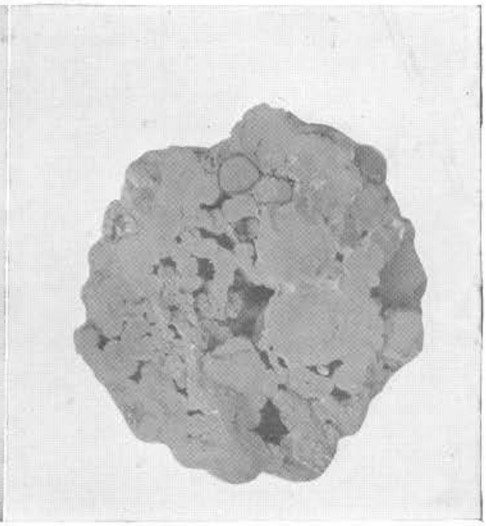

Fig. 2. Cross section of pipe ore showing concentric structure of the pipes. Reduction ½.

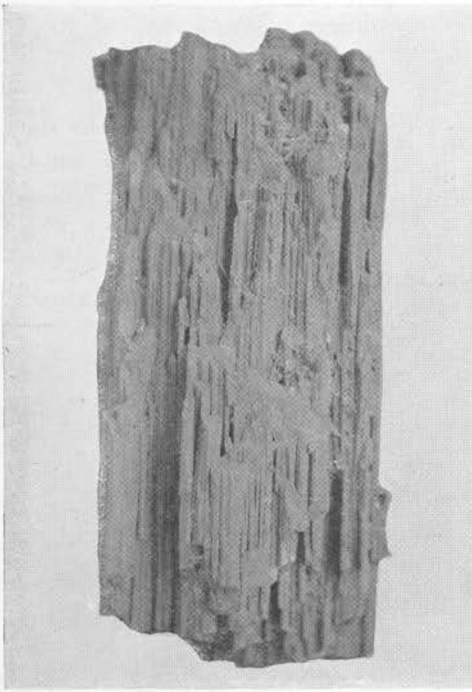

Fig. 3. Pipe ore in which the pipes are coalesced. Reduction ½.

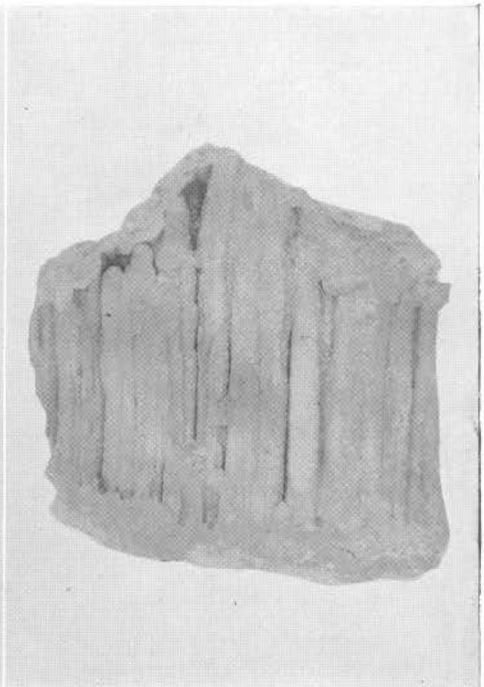

Fig. 4. Pipe ore showing cavity filling. Reduction ⅓.

manganese. One hundred and five shipment analyses from ten mines show the boulder ore to be somewhat less uniform in composition, but to average 52.98% iron, 10.40% silica, .091% phosphorus, and .133% manganese. Sulphur, while often present in considerable quantities, particularly in the boulder ore, is usually so well segregated that it can readily be removed in hand mining, and shipments have been uniformly low in this element. Usually the percentage of sulphur increases somewhat with depth, depending upon the completeness of the oxidation of the original sulphides. It is only in exceptional cases, however, that the secondary ores contain over 0.2% sulphur and they occasionally run as low as 0.05%. The average sulphur content of 15 samples analyzed by this Bureau was found to be 0.079%. Aluminum is present in quantities varying from 1 to 3% and, where the ore is not washed or carefully cleaned, the percentage of this element may run relatively high.

The pipe ore is the purest of the brown ores. It is never sandy and contains very little included chert. When freed from the clay, in which it is embedded, it will average 57% iron. The best boulder ore, when carefully sampled, runs but slightly lower in iron. However, this ore usually contains more impurities than the pipe ore and, in car load shipments, runs several per cent lower in iron.

The soft ocherous ore is occasionally nearly pure iron oxide, but, on the whole, contains considerable clay, and has not been recognized as valuable ore. In certain instances, however, it has been found in such quantities as to suggest the possibility of mining it.

The following analyses are of shipments of lump and washed ore from mines producing ore chiefly of the pipe variety*:

TABLE NO. XIII.

LUMP ORE.

No.	Mine.	Iron.	Silica.	Phos.	Mn.	Moisture.	Shipments Averaged.
1	Alley	55.40	6.90	.07	.11	5.00	1
2	Buffington	53.46	9.45	.097	.10	3.26	7
3	Cady	55.51	7.55	.078	....	3.30	11
4	Estes	55.13	8.31	.087	.10	4.10	6
5	Harness and Lundy	54.61	8.76	.088	.215	3.50	12
6	King	55.41	7.55	.074	.08	3.00	1
7	Landau	53.75	9.53	.07	.12	5.00	1
8	Sawyer	57.26	2.87	.064	.32	....	10
9	Snyder	54.90	8.15	.083	....	....	1
10	Staggs	57.20	6.51	.109	.06	3.00	1
	Average of 10 mines	55.27	7.56	.082	.138	4.77	....

*Analyses Nos. 8 and 12 were made by the Wayne Iron and Lumber Co.; the balance by the St. Louis Blast Furnace Company.

WASHED ORE.

No.	Mine.	Iron.	Silica.	Phos.	Mn.	Moisture.	Shipments Averaged.
11	Luke	52.65	11.60	.080	.11	4.00	26
12	Sawyer	50.31	13.37	.069	.38	....	13
13	Williamsville Iron Mountain Ore Co	53.04	12.04	.076	.10	4.00	1

The following table contains analyses of shipments from mines producing only boulder and ocherous ore, pipe ore being absent; (Analyses by St. Louis Blast Furnace Company.)

TABLE NO. XIV.

No.	Mine.	Iron.	Silica.	Phos.	Mn.	Moisture.	Shipments Averaged.
1	Carson	53.83	9.85	.115	.124	5.30	33
2	Cordz-Fischer	49.95	14.13	.094	.145	4.95	11
3	Holliday-Klotz	52.36	11.79	.070	.160	3.70	7
4	Kingsbury	54.29	8.22	.166	.120	3.50	17
5	Melton	48.00	16.70	.063	.115	6.10	6
6	Ojibway	53.24	9.63	.056	.095	4.30	8
7	O'Keefe No. 1 and No. 3	53.75	9.73	.067	.14	3.00	9
8	Pearson	54.72	8.13	.111	.180	3.50	10
9	Pittsburg Iron Mining Co.	55.57	7.10	.080	....	....	1
10	Janis	54.11	8.74	.092	.12	3.70	3
	Average of 10 mines	52.98	10.40	.091	.133	4.23	....

The following table illustrates the difference in lump and washed ore produced at the Sawyer mine in Wayne county: (Analyses made by the Wayne Iron and Lumber Company.)

TABLE NO. XV.

LUMP ORE.

Number.	Iron.	Silica.	Phos.	Alumina.	Mn.
1	58.65	3.34	....	.46	.40
2	56.99	2.70	.066	.48	.23
3	55.59	2.69	.059	.39	.26
4	57.26	2.87	.064	.55	.32

No. 4 is an average of 10 shipments of Lump Ore.

WASHED ORE.

Number.	Iron.	Silica.	Phos.	Alumina.	Mn.
1	53.63	10.63	....	.38	.43
2	51.52	12.39	.086	.18	.52
3	49.45	15.45	....	.61	.30
4	46.06	19.10	....	.59	.29
5	50.31	13.37	.069	.50	.38

No. 5 is an average of 13 shipments of washed ore.

The lump ore is obtained by hand mining and is loaded directly upon cars. It consists of the largest pieces of pipe and boulder ore freed, as far as possible, from the cherty clay in which it is embedded. The washed ore is the product of a log washer treating the residual materials for the finer ore particles which are too small to be recovered by hand picking. The washed ore averages about 7% lower in iron than the lump ore. This is due to the admixture of small pieces of chert which are not removed by the washer. Although lower in grade than the lump ore, the product of the washer is derived chiefly from materials that would otherwise be waste.

The following table of analyses made by this Bureau, indicates the general grade of the pipe and boulder ores as obtained by sampling either the mine face, outcrops, or ore lying on the dumps of prospect shafts. Nos. 1, 2, and 3 are mine samples; Nos. 4 and 5 are from prospect shafts; and Nos. 6, 7, and 8 are from undeveloped outcrops.

TABLE NO. XVI.

No.	Deposit.	Iron.	Silica.	Phos.	Sul.	Combined Water.	Moisture.
1	Hendrickson Mine	57.58	3.17	.374	.171	10.09	.93
2	Melton Mine	53.93	9.68	.005	.063	12.47	.776
3	Mo. Lumber & Mining Co., Mine No. 1	49.58	9.20	.163	.112	10.70	....
4	Mo. Lumber & Mining Co., Mine No. 18	58.11	3.91	.094	.370	11.22	.444
5	Mo. Lumber & Mining Co., Mine No. 22	59.29	2.99	.096	.299	11.254	.485
6	Mo. Lumber & Mining Co., Tract No. 32	58.67	3.92	.142	.083	10.725	.455
7	Chilton Outcrop	59.47	3.14	.161	.076	8.45	1.070
8	C. W. Myers Outcrop	61.32	0.86	.041	.007	10.74	.100

To test the value of the ochers, three samples were taken, which when analyzed, gave the following results:

Number.	Iron.	Silica.	Phos.	Sul.	Combined Water.
1.	41.17	23.314	0.272	0.177	9.551
2.	42.28	26.16	0.028	0.134	8.036
3.	52.156	....	0.152	0.025	10.744

No. 1 represents a sample from Mine No. 1, Missouri Lumber and Mining Company, Ripley county. It was taken from a large stock pile of ocherous ore mixed with red clay, from which the boulder ore had been removed. No. 2 represents a fair sample of a 10-foot face of ocherous and boulder ore which was taken from one of the larger pits at the Melton mine, located near Congo, Shannon county. No. 3 represents a fair sample of a seven-foot face of ocher and boulder ore taken from the Janis mine, Wayne county.

The above results warrant the assumption that, in certain instances, the ocher may be found valuable as iron ore.

PRIMARY LIMONITE.

DISTRIBUTION.

In contrast with the regional distribution of the secondary limonite, deposits of the primary type are confined to two widely separated, but well defined and relatively small areas, one of which is located in the southeastern part of the State, and the other, in the southwestern part. The ore deposits of the two localities, while consisting of primary limonite, differ sufficiently in grade, mineral composition, and manner of occurrence to warrant separate treatment and are therefore described separately.

THE SOUTHEAST DISTRICT.

Location and Extent: The primary limonite of southeast Missouri is confined to a narrow belt, extending from the eastern boundary of Cape Girardeau county on the Mississippi river southwest along the southeastern border of the Ozark plateau, to the southern boundary of Ripley county. Except for a few deposits occupying the low hills near Puxico and Idlewild, the southeastern limit is well defined by the escarpment extending from Cape Girardeau to the Missouri-Arkansas line. The northern boundary is not so well marked, and has not been definitely outlined. It is thought, however, that the district, as shown on the general map, includes practically all of the more important deposits. The area embraced by the known deposits is about 15 miles wide and 100 miles long.

Production: The first mining of the primary limonite of this district was done in Bollinger county during the early seventies, at which time 1630 tons were shipped. No further operations are on record until the year 1902, when 270 tons were shipped from Carter county. Since that time, some ore has been shipped each year, resulting in a total production of 30,895 tons.*

Topography: The district is characterized by a hilly topography, the only flat lying areas being the flood plains of the main streams. Bluffs and canyons, such as characterize the upper reaches of these streams, do not occur. On the contrary, the streams flow in wide flood plains which frequently extend some distance up the valleys of their larger tributaries.

The inter-stream areas are each composed of a system of divides and secondary ridges, highest on the northwest and dropping gradually towards the southeast, until the escarpment is reached, where they abruptly give place to the Lowland swamps. This escarpment is perhaps the most distinct physical feature of the district. While it seldom forms a bluff of any considerable height, it is very clearly marked by the abrupt replacement of the typical, cherty Cambrian hills by a low, flat, and generally swampy plain.

The elevation of the Lowlands varies from 330 feet at Cape Girardeau to 300 feet A. T. at the Arkansas line. The adjacent hills and bluffs rise approximately 150 feet above the Lowlands and therefore have an elevation of approximately 450 to 480 feet above tide. In the absence of topographic surveys, it is estimated on the basis of railroad elevations that the northwestern or higher part of the district has an elevation of from 600 to 700 feet A. T.

Drainage and Water Supply: This district, like the Ozark region in general, is perfectly drained. It is crossed in a northwest-southeast direction by several large, nearly parallel streams, including the Current, Black, St. Francois, and Castor rivers. These streams and their larger tributaries contain an abundance of water for washing-plants throughout the year. In the upland areas where the streams flow only during the rainy season, water can be had from drilled wells at a depth of from 200 to 300 feet.

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*For annual and total production of the various counties within the district see production table No. VIII.

Geology: The district, as a whole, is covered by a thick blanket of residual clay and chert, and outcrops of the underlying formations are unusual. The few exposures which have been found, chiefly along the larger streams, indicate that the Roubidoux sandstone occupies the deeper valleys of these streams. The residual chert covering the hills appears to have been derived chiefly from the Roubidoux formation, although it is probably, in part, derived from the Jefferson City and other formations which, at one time, evidently overlay the entire district.

The Roubidoux sandstone is well exposed in certain portions of the district. In the vicinity of Granite Bend, it lies conformably upon the Gasconade limestone and unconformably upon the granite. Here, the Roubidoux consists of about 70 feet of sandstone, including a few thin layers of limestone and chert. Two miles south of Granite Bend, the base of the Roubidoux descends to the level of Black river and, unless elevated by faulting or reverse dips, very probably occupies the channel of that stream through the remainder of its course to the Lowland plain. The same conditions are thought to exist in the lower courses of the St. Francois, Castor, and Current rivers where they cross the district.

No outcrops of the Jefferson City limestone are known, although it is probable that it occurs under the heavy mantle of residual material. A tunnel at the Puxico mine encountered limestone which is apparently of Jefferson City age.

While formations belonging to the Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian may have been deposited throughout this district, with the exception of the Ordovician and Silurian of Cape Girardeau county they have since been entirely removed by erosion.

Overlying all the above described formations, including the residual materials, are deposits of gravel which are thought to belong to the Lafayette formation, which is of Tertiary age. These deposits occur along the eastern and southern flanks of the Ozark plateau, as far north as St. Louis and as far west as Howell county. They are well developed within the primary limonite district where they occur upon the hillsides and flat topped ridges up to an elevation of about 600 feet A. T.

A typical deposit of this gravel occurs in Sec. 23, T. 26N., R. 7E, at Hodges Ferry, Butler county. At this place it directly overlies a deposit of primary limonite which caps a hill about 100 feet above the flood plain of the St. Francois river. In the S. ½, Sec. 25, T. 27N., R. 4E. a deposit of Lafayette gravel caps a hill on the south bank of the Black river. Here again the formation directly overlies brown ore, but in this case the ore is of the pipe variety. Similar deposits of the Lafayette occur in the following localities:

Sec. 33 and 34, T. 28 N., R. 5 E.,	Wayne county.
Sec. 14 and 22, T. 27 N., R. 4 E.,	" "
Sec. 12, T. 27 N., R. 4 E.,	" "
E½ Sec. 23, T. 27 N., R. 6 E.,	" "
Sec. 9, T. 29 N., R. 7 E.,	" "
Sec. 23, T. 28 N., R. 5 E.,	" "

THE ORE DEPOSITS.

Topographic Relations: Unlike the secondary, the deposits of primary limonite have a definite and striking relation to the topography of the district. They invariably occur upon or near the crests of the hills and ridges of the inter-stream divides. East of the Black river, they occur chiefly upon the crests of secondary ridges and smaller spurs, while west of that river, they occur more frequently along the crests of the main divides. The deposits in any one locality appear to have approximately the same elevation, although those in the northern part of the district have a greater elevation than those near the Lowlands, due chiefly to differential elevation since Tertiary time.

Manner of Occurrence: The ore occurs in large and small boulders distributed irregularly through the cherty residuum of which it is, in part at least, a direct replacement. The boulders are irregular in shape, and vary in size from small fragments to masses weighing several tons. In some cases the ore occurs in a nearly solid ledge, which is roughly stratified and with which very little clay or waste is associated. The ore body may be irregularly inclined, intersecting the roughly bedded residuum at a low angle. Its position, with reference to the enclosing materials, is such as to indicate its introduction by circulating groundwater. At many places iron stained residuum was observed to grade laterally along its rough laminae into masses of solid ore, which preserves, to some extent, the laminated structures of the replaced materials. Many of the larger limonite boulders are coarsely cellular and do not show evidence of having replaced the residuum.

Form and Size: Very few deposits of this type of ore have been developed sufficiently to disclose their shape and size. Our present knowledge, however, would indicate that, as a rule, they have much greater lateral than vertical dimensions.

The largest continuous opening is at Puxico where operations have disclosed a nearly continuous ore body for fully 600 feet along the face of a hill. Many outcrops, covering from one to twenty acres, have been noted, and it is probable that, on development, some of these may be found to mark ore bodies as large as the surface showings.

Depth: The depth of the ore varies greatly, even within the same deposit. Prospecting has shown that, while some parts of a deposit may be only a foot or two thick, the remainder may be 20 to 30 feet. At the Puxico property, the bottom of the ore has not been reached at a depth of 50 feet.

Outcrops: All the known deposits of this type have been discovered through outcrops of one or more large, rough boulders of dark, porous, cherty limonite. Such outcrops are usually conspicuous and so characteristic as to identify the type of deposit.

The outcrops vary greatly in size, some of them covering many acres. They form no certain criterion upon which to judge the value of the ore body, since extensive outcrops, in some instances, have been found to be underlain by shallow, low grade ore. In other cases, pits sunk in the vicinity of a single outcropping boulder have disclosed important bodies of merchantable ore. Usually, however, the larger the outcrop, the better the prospect.

Overburden: The overburden seldom amounts to more than a few feet of surface soil and cherty clay. This is particularly true of the eastern portion of the district where outcrops are especially prominent. In the Flatwoods country, west of the Black river, the ore is, in some cases, pretty well concealed beneath five or six feet of soil and residual clay.

While the overburden is usually residual, cherty clay, in at least two instances it consists, in part, of water worn gravel of probable Tertiary age. At the Lilly Hollow mine, in Wayne county, about one foot of iron stained gravel occurs immediately above the ore bearing clay, and at the George tract No. 2, Butler county, three feet of gravel rest directly upon a six-foot ledge of cellular ore.

THE ORE.

Mineral Composition: The ore is chiefly limonite with minor quantities of goethite. The anhydrous oxides do not occur. Small quantities of oxide of manganese are quite uniformly distributed through the ore. It occurs locally in the form of wad, psilomelane, and pyrolusite, but in no case has it been found in sufficient quantities to constitute a manganese ore.

Fig. 1. OUTCROP OF CHERTY PRIMARY LIMONITE, ALLEN BANK, BUTLER COUNTY.

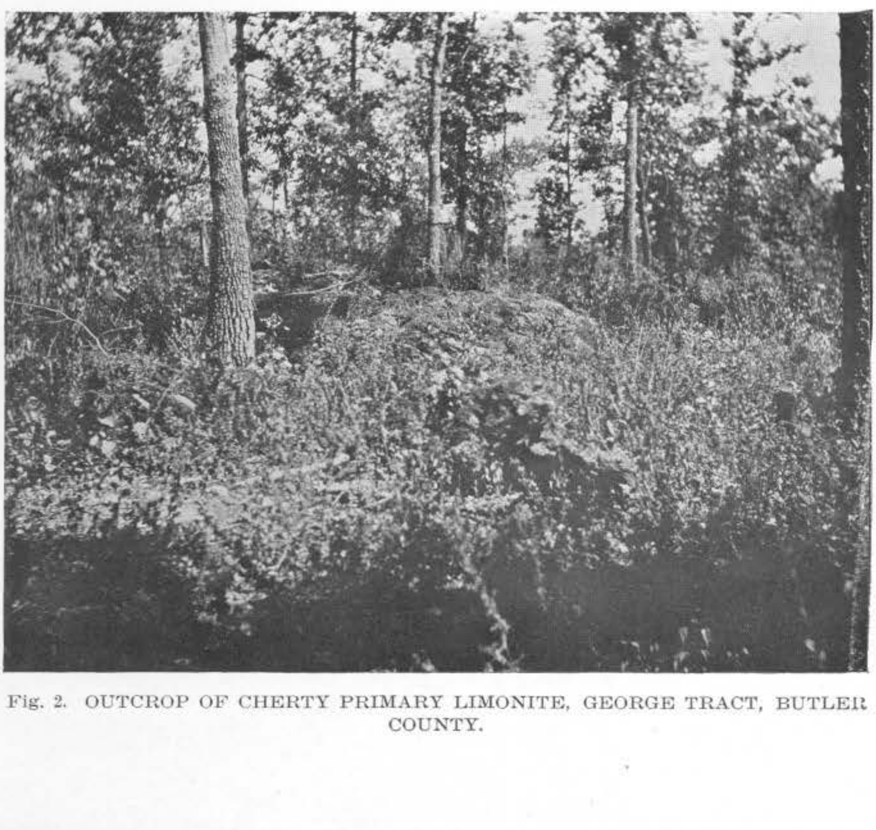


Fig. 2. OUTCROP OF CHERTY PRIMARY LIMONITE, GEORGE TRACT, BUTLER COUNTY.

Fig. 1. Finely cellular primary limonite. Southeast Dist., Picò mine. Reduction ½.

Fig. 2. Primary limonite replacing partly decomposed chert along joints and fractures. Southeast Dist. Reduction ⅓.

Fig. 3. Coarsely cellular primary limonite. Southeast Dist., Hooper mine. Reduction ½.

Fig. 4. Highly cherty and sandy primary limonite. Southeast Dist. Reduction ½.

The chief mineral impurity is silica, in the form of chert, sand, and irregular grains of crystalline quartz. Large and small fragments of chert, in all stages of decomposition, occur embedded in the ore. Where abundant, it may be, in large part, removed by crushing and washing. Sand occurs filling cavities and embedded in the ore. It is usually abundant in the outcrops but is not generally present in the deeper ore. With the exception of that filling cavities, it is so firmly cemented by limonite that it cannot be removed by crushing and washing. The irregular crystalline quartz grains are universally present in all the ore of this type, and form a distinguishing feature. They are so intimately associated with the ore that no amount of crushing and washing can effect their removal. More than either the chert or sand, they are responsible for the high silica of the primary limonite of the southeast district. See Figs. 3 and 4, Plate VI.

Clay, chiefly washed in by surface waters, fills cavities in the ore. It is no more abundant in the primary than in the seconary limonite and may be removed, in part, by washing.

The iron sulphides do not occur.

Physical Characters: The ore may be, in part, hard and exceedingly porous, in part, flinty and compact, and, in part, soft and earthy. The most characteristic phase is an extremely porous, hard, dark brown limonite, having a rough, cindery surface and enclosing angular fragments of light colored, hard chert and more or less sand. This phase of the ore is particularly characteristic of the outcrops. The openings vary in size from "pots" several inches in diameter to minute, irregular cells. They are usually lenticular in shape, and have a parallel arrangement which conforms to the rough lamination of the cherty residual material enclosing the ore. The larger openings generally have spherical walls less than an inch in thickness which are made up of concentric layers. The openings are usually from one to two inches in diameter with walls ½ to ¼ of an inch in thickness. Many of the openings have a dull interior surface and are partly filled with loose silicious material, while others are lined with a thin botryoidal growth of iridescent and velvety goethite. The latter when broken, are frequently found to contain water.

The amount of chert present varies from only an occasional fragment to where the ore becomes an iron chert breccia. The exceedingly cherty type occurs locally in large quantities and has been designated as "Peanut candy" ore. Gradations of this phase of the ore into cherty residual material is common. Figures 1 to 4, Plate VI, show the general character of the porous, cherty ore.

Another well defined phase is a very hard, dense, light brown limonite which breaks with a conchoidal, splintery fracture. It rarely contains chert or sand, but is highly silicious due to the presence of numerous very small irregular and quite evenly disseminated grains of quartz. This ore is so hard that it is difficult to scratch it with a knife. It is usually thinly laminated, occurring in well defined beds or layers overlying the porous, cellular ore. It is also massive, occurring as boulders and isolated masses scattered through the porous and softer ores. Aside from the iron-chert breccias, it is the lowest grade of the limonite ore. Gradations of this phase of the ore into soft, decomposed chert are common.

Still another well defined phase of the ore, though not so common as the above, is a soft, earthy, amorphous limonite which varies in color from an ashy gray to a dull bluish black, the shade depending upon the amount of manganese present. This ore is usually so soft as to be easily scratched with the finger nail. In both color and texture, it closely resembles wad, and locally, contains 3% or more of maganese. As a rule, it is free from chert and sand, but occasionally contains small druses of secondary quartz and chalcedony. Ore of this character is typically exposed in the Missouri Lumber and Mining Company's mine No. 2, Ripley county, where it forms an important part of the ore body. It is best developed in the deeper portions of the mine and grades upward into hard, cellular ore. Its downward transition is not shown by the present workings.

Of the above described phases of the ore, the exceedingly porous, cherty variety is by far the most characteristic, forming the major portion of most of the deposits. It frequently occurs alone but is usually accompanied by the hard, compact ore and only occasionally by the soft, earthy ore. When associated with the other phases, it occupies an intermediate position, the hard, compact ore lying above, and the soft, earthy, high manganese ore, beneath it.

Chemical Composition: The ore is a uniformly low grade limonite. The iron content of car load shipments ranges from 41% to 50% and averages about 45.50%. The range for silica is from 13.50% to excessive, while phosphorous varies from traces in the leached ore to 0.10%, but averages about 0.06%. Sulphur is uniformly low, rarely exceeding .10% and is never present in visible quantities as in the secondary limonite. Manganese is present in quantities ranging from 0.35% to 3.00%, being uniformly higher than in the secondary ore. Moisture varies from 1% to 5% and the loss by ignition is from 7% to 11.25%.

The following analyses, made by the St. Louis Blast Furnace Company, of car load shipments from all parts of the district, are fairly representative of what can be expected of this class of deposit, where the ore is not given special treatment:

TABLE NO. XVII.

No.	Mine.	Iron.	Silica.	Phos.	Mn.	Moisture.	Shipments Averaged.
1	Burton	47.51	15.31	.058	1.24	4.00	4
2	Chaonia Merc. and Iron Co.	42.54	20.12	.096	1.30	3.00	1
3	Deal No. 1	48.60	14.96	.067	.49	3.60	6
4	Hillis	47.96	14.30	.089	1.50	3.50	2
5	Hooper	44.71	18.70	.080	2.10	4.00	1
6	Lilly Hollow	46.39	14.92	.045	.42	5.00	1
7	Malin	42.58	19.15	.070	2.85	3.00	1
8	Myers	49.23	13.59	.059	.64	4.00	4
9	Pico	48.00	16.59	.041	.77	3.38	10
10	Woodenshoe	46.20	16.30	.090	1.20	3.00	1
11	Zippy	44.62	17.40	.054	2.00	3.00	1
	Average of 11 mines	46.21	16.48	.068	1.319	3.59	....

The following analyses are of shipments of primary limonite that has been washed, crushed, and jigged.

No.	Mine.	Iron.	Silica.	Phos.	Mn.	Moisture.	Shipments Averaged.
1	Orchard	47.23	17.08	.060	1.38	4.50	12
2	St. Francois No. 1	45.22	18.93	.056	.55	5.00	3

Of the several phases of the ore, the soft, earthy variety is generally the highest grade and contains the most manganese, while the harder, porous and dense ores are more silicious, due to inclusions of chert, sand, and finely divided quartz. The following analyses are of type samples of the three varieties taken from the big pit at the Missouri Lumber and Mining Company, Mine No. 2, Ripley county:*

Type of Ore.	Iron.	Silica.	Phos.	Sul.	Mn.	Combined Water.	Moisture.
Soft earthy	52.85	9.85	traces	.048	2.68	8.21	....
Hard porous	45.44	21.46	.038	.145	....	10.06	0.64
Hard compact	44.10	20.65	.038	.107	....	9.70	1.18

A comparison of the analyses of the washed and the unwashed ore shows that, other than the recovery of the smaller ore fragments, there

*Analyses by the Bureau of Geology and Mines.

is little to be gained by special treatment of this type of ore. Since in most primary deposits the ore occurs almost entirely in large masses or boulders, except for the small ore produced in the breaking and loading of the larger boulders, there is little that requires washing for its recovery. Experience has shown that the grade of the "peanut candy" ore can be materially improved by crushing and washing, and, except where this type of ore occurs in large quantities, the expense of the erection of a washer is not warranted.

THE SOUTHWEST DISTRICT.

Location and Extent: The known deposits of primary limonite in southwest Missouri are confined to an area approximately 12 miles wide and 24 miles long, including portions of western Greene and Christian counties, and the extreme southeast corner of Dade county. Eleven deposits of this type are described in this report. That other deposits have been partly developed is indicated by shipments received by the smelters from Ash Grove, Willard, Bois D'Arc, Palmetto, and Billings, and it is probable that the district will be found to be somewhat larger than defined above.

Production: The first production of primary limonite from this district, of which we have any record, was in 1903, during which year 729 tons were shipped from Ash Grove. During the following six years, mining was carried on almost continuously and at the end of 1910 the district had produced a total of 44,919 tons, exclusive of 4,382 tons of secondary limonite.

Topography: This district is characterized by a gently rolling topography, which is in strong contrast to the rugged features of the southeast district. Along the divides followed by the St. Louis and San Francisco railroad the land is comparatively level, but as one proceeds down the headwaters of the main streams to the northwest and southeast, the country becomes increasingly hilly. The break is most rapid toward the southeast, the valleys becoming increasingly narrow, steep sided, and deep until in the vicinity of James Fork one finds the rugged topgraphy so common to the southern slope of the Ozarks. To the northwest the fall is much more gentle and the changes more gradual, the valleys being comparatively wide and the surface features less pronounced. The highest portion of the district is that in the vicinity of Billings and Republic which stand respectively at elevations of 1366 and 1311 feet above tide. The lowest portions have an elevation of approximately 1050 feet.

Drainage and Water Supply: That portion of the district which lies southeast of the main line of the St. Louis and San Francisco railroad is drained by tributaries of the James river, while that on the opposite side of the railroad is drained by tributaries of the Sac river. Except in the case of Clear creek, the beds of these streams are dry during the greater part of the year.

Dug wells, which are sunk through the residuum to the underlying limestone, are the chief source of domestic water supply. By damming the small ravines with the impervious residual clays, reservoirs may be obtained in which a limited supply of surface water may be collected. Neither these nor the wells, however, afford sufficient water for the operation of log washers. It is probable that deep wells will provide the only adequate supply.

Geology: The district is underlain chiefly with the upper Burlington limestone which is covered with a blanket of from 25 to 50 feet of red clay containing numerous fragments of Burlington chert. Outcrops of the Burlington occur chiefly along the more rapidly cutting streams and in unusually deep gullies.

Unconformably upon the Burlington are many outliers of Pennsylvanian sandstone, shale, and occasionally chert conglomerate. The best exposures of Pennsylvanian sandstone and conglomerate occur in the vicinity of Billings, where they occupy pre-Pennsylvanian channels in the Burlington formation. These outliers are usually indicated by surface boulders of sandstone in the midst of residual materials, consisting entirely of Burlington chert and clay. The residuum is much thinner than that in the southeastern part of the State.

No gravels of Tertiary age have been recognized in this district, although they are known to occur in this part of the State.

THE ORE DEPOSITS.

Topographic Relations: On account of the gentle relief of this district, there is no apparent relation between the iron ore deposits and the topography. As a rule the deposits occur upon, or near, the interstreams divides. In the case of the Studley mine, the deposit is on the bank of a broad ravine about one mile west of and about 50 feet lower than the main divide of the Ozarks.

Manner of Occurence: The ore occurs in the form of boulders and fragments embedded in the residual cherty clay. It does not replace the enclosing material as in the case of the primary limonite of southeast Missouri, but, on the contrary, appears to have been deposited originally in its present form, in openings along the unconformable contact of the Burlington and Cherokee formations.

With a single exception, the ore occurs in the immediate vicinity of outliers of the Cherokee and in several instances, as in the case of the

Angus and Arnt mines, four miles southeast of Billings, the ore occurs directly upon what appears to have once been the contact of the Cherokee conglomerate and the Burlington limestone.

Form and Size: The deposits are irregular in outline but, as a rule, are longer in one dimension than in the other. Mining has not extended over thirty feet in depth and in no instance has the bottom of the ore been reached.

The Frisco mine, which has been worked by an open cut 960 feet long by 35 to 100 feet wide, is the best developed deposit in the district. Ore is reported in the bottom of the cut which has a depth of 30 feet. Developments at the Angus mine indicate that this ore body is also linear in form. This mine has been worked to a depth of 10 feet with good ore in the bottom.

Outcrops: The outcrops usually consist of small boulders and angular fragments of ore associated with cherty clay. In some instances the ore practically covers the surface although it has no apparent effect upon the contour of the surface. The Frisco, Angus, and Jackson mines were marked by outcrops of this type. While, as a rule, the ore body conforms to the area outlined by the outcrops, good deposits have been developed from outcrops which were small and unpromising, as evidenced by the Bayliss mine, northeast of Republic, and the Clutter mine, north of Willard.

THE ORE.

Mineral Composition: The ore is chiefly goethite with minor quantities of limonite, which is the reverse of the ore of the southeast district. The anhydrous oxides do not occur. Manganese is quite uniformly present in small quantities, although it has not been observed locally concentrated, as in the case of the primary limonite of the southeast district.

The chief impurities are silica and alumina, occurring mainly in the form of chert and clay. The chert occurs both as nodules and as angular fragments which are largely undecomposed. The sand and finely divided crystalline quartz, which are so characteristic of the southeast primary limonite, do not occur with the ore of this district. A large part of the silicious impurities can be removed by washing. Clay is present in small quantities. The sulphides of iron and their pseudomorphs do not occur, in which respect the ore differs from the secondary limonite. Crystals of zinc blende were found in the ore taken from a portion of the Frisco mine. Numerous casts of similar crystals indicate that part of the sulphide of zinc has been removed by leaching. This is the only known occurrence of sulphide in the deposits of this type.

Physical Characters: The ore occurs chiefly in the form of boulders, hollow "bombs," and as small fragments which have apparently resulted from the breaking down of the larger masses. The boulder ore consists either of a cellular mass of goethite and limonite containing little or no chert, or of masses of Burlington chert cemented by these minerals. The maximum thickness of the boulders of both types is apparently six feet. The ore at the Frisco and Arnt mines is chiefly of the conglomerate type while that at the Angus and Noble mines is of the non-cherty type. The conglomerate ore, for the most part, is too cherty to be mined without crushing and washing.

Geodes of hematite and goethite, locally known as "bombs," occur abundantly at the Angus mine and locally at the Frisco mine. They are usually not over ten inches in diameter although occasionally they have a diameter of 18 inches. The wall of the geode varies from a half an inch to two inches in thickness and consists of limonite lined with black, lustrous goethite. The limonite, which frequently encloses small fragments of chert, is amorphous except for a slight banding produced by concentric growth. The goethite exhibits concentric and radial structures, and is typically fibrous in cross-section. The goethite often attains a thickness of two inches and is always free from visible impurities. Occasionally it forms small stalactites from one-eighth to one-half inch in length.

In certain of the mines, particularly the Clutter, there is relatively little boulder ore, the deposits consisting mainly of fragments and slabs of goethite and limonite ranging from 2 to 18 inches in length. Very little of this ore would require washing. At other mines the amount of small "shot ore" is so abundant in the upper few feet that profitable operations can be carried on only by the installation of a log washer.

Chemical Composition: Average analyses of shipments from all parts of the district indicate that, in composition and value, the ore stands between the southeast primary and the secondary limonites. It, however, carries a higher percentage of phosphorous than any of the other Missouri types.

The iron content ranges from 43% to 55%, averaging 50.45% as compared to 55.27% for the pipe ore and 46.2% for the southeast primary ore. Silica ranges from 6 to 16%, averaging approximately 11%, in which particular the primary limonite of southeast Missouri runs at least 5% higher, while the better grades of the secondary ore run from 2 to 5% lower. Phosphorus ranges from 0.10% to 0.585%, averaging 0.204%, the average for the secondary ore being 0.085%. Manganese ranges from 0.30% to 1.67%, averaging 0.76%, as compared to an average of 0.14% in the secondary limonite and 1.32% in the primary deposits of the southeast district.

The following table of analyses is typical of from one to 18 shipments from each of nine mines, and indicates what may be expected from this type of deposit:*

TABLE NO. XVIII.

No.	Mine.	Iron.	Silica.	Phos.	Mn.	Moisture.	Number of analyses averaged.
1	Angus	50.60	13.04	0.102	0.50	3.87	8
2	Arnt	49.94	12.10	0.092	0.45	3.41	11
3	Clutter	47.65	13.40	0.450	1.67	4.00	1
4	Compton	47.03	11.00	0.103	0.86	....	1
5	Frisco	51.05	10.49	0.199	0.61	5.14	18
6	Jackson	51.03	10.97	0.279	0.51	5.00	11
7	Noble	51.71	8.53	0.238	0.86	4.00	3
8	Studley	59.82	11.46	0.172	0.66	6.00	2
9	Welsh	54.29	7.90	....	....	....	1
	Average of nine mines.	50.45	10.98	0.204	0.765	4.49	....

ORIGIN OF THE BROWN ORES.

SECONDARY LIMONITE.

The secondary limonite deposits have been derived directly through the oxidation and hydration of sulphides of iron, marcasite and pyrite which were originally deposited in openings in the once overlying limestones and sandstones, and have been left in their present position by the decomposition, solution, and removal of those rocks.

This conclusion is supported by several lines of evidence, chief among which is the fact that practically every deposit, so classified, exhibits indisputable evidence of its former sulphide character through the presence of crystalline pseudomorphs of either marcasite or pyrite. These pseudomorphs are present in all phases of the secondary limonite, there being very little ore in which the crystalline structures of one or both of these sulphide minerals cannot be detected. Pseudomorphs after marcasite predominate, indicating that this sulphide of iron constituted the major portion of the original deposits.

The occurrence, especially in the lower parts of the deposits, of unaltered sulphides, both in the form of pipes and boulders, also indicates the original composition of the ore. In all cases, the sulphide forms the central or more protected portion of a specimen.

*A part of the ore from the Frisco mine was washed.

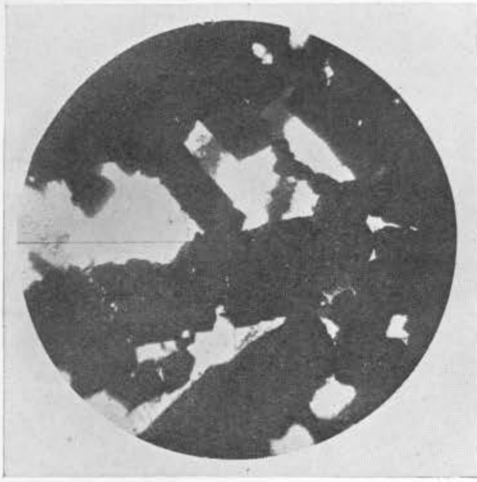


Fig. 1. Shepherd Mountain ore. The dark areas are hematite. The light areas are quartz. X. 50 diameters.

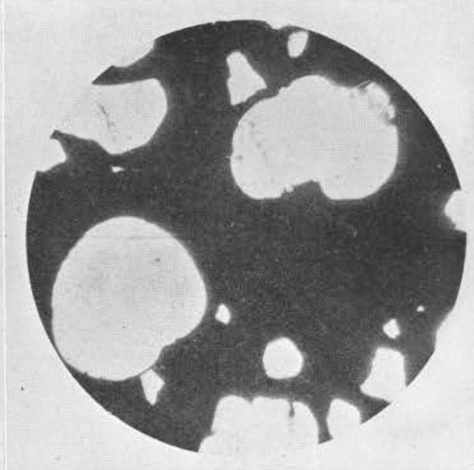


Fig. 2. Primary limonite containing grains of sand. X. 50 diameters.

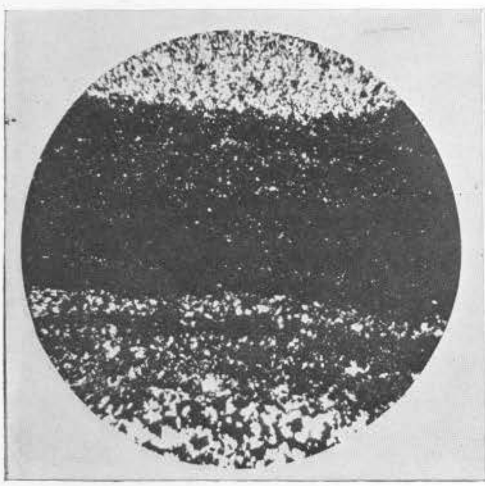


Fig. 3. Primary limonite replacing decomposed chert. X. 25 diameters.

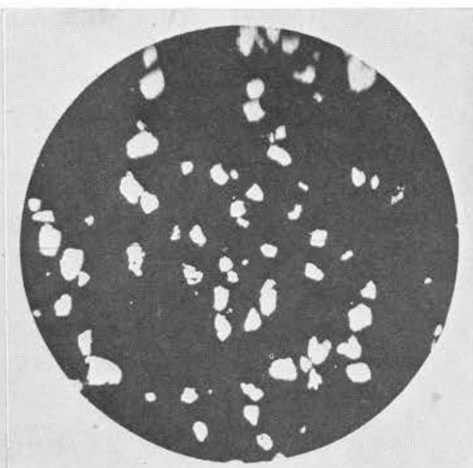


Fig. 4. Primary limonite containing unreplaced irregular grains of quartz. X. 50 diameters.

Except where apparently replacing a sandy limestone, the secondary ore contains no sand, and the clay present is usually of secondary origin, indicating that the ore was deposited originally from waters comparatively free from surface decomposition materials. The tabular and pipe ores were undoubtedly precipitated as sulphides in pre-existing openings resulting from solution along joints and bedding planes. While the sulphide, from which the massive boulder ore was derived, may have directly replaced the limestone, it is possible that it was deposited upon the bottom of caves which occurred at or near the level of ground water. This is indicated by the relative position of the pipe and boulder ores, the former usually constituting the upper portion of the ore body, the boulder ore occurring underneath. The ocherous ore is probably more largely the result of certain conditions of oxidation and hydration than any particular form of the original sulphide.

Alteration of the Sulphides: The alteration of the sulphides to limonite followed a change from reducing to oxidizing conditions. This change was brought about by a lowering of the water table, by increased uplift, or by the gradual reduction of the surface, due to erosion. Continued solution gradually removed the limestones in which the sulphides were deposited, leaving the limonite embedded in the residual cherts and clays.

Secondary Concentration: In addition to a first concentration as the sulphide, the deposits have undergone a secondary concentration due to the decomposition and partial removal of the limestones in which the ore was originally deposited. The degree of secondary concentration is greatest at the surface where much of the insoluble material has been removed by wash, but becomes increasingly less with depth. That there has been some concentration throughout the deposits is indicated by the slumping of the inclosing residual materials which, in some places, show only traces and, in others, none of the bedding of the original formation.

Age: There is very little field evidence upon which to base accurate deductions regarding the age of the deposits or the direct source of the iron. The fact that the sulphides were originally deposited in openings in the Cambrian formations, indicates that they are post-Cambrian in age, and the fact that in a number of instances these deposits are directly overlain by Tertiary gravels, indicates that they occupied their present position prior to Tertiary time.

PRIMARY LIMONITE OF THE SOUTHEAST DISTRICT.

The primary limonite of Southeast Missouri was deposited as the ferric hydrate in its present position without first having been segregated as the sulphide, as in the case of the secondary ore. It is, for the most part, a direct replacement of the cherty, residual materials in which it is embedded, and into which it often grades. The goethite, which is comparatively abundant, is not a replacement of other materials, but occurs lining cavities in the original ore. The fact that this ore, in its physical characteristics and chemical composition, differs radically from the secondary ore, indicates that it has had an entirely different origin. The total absence of iron sulphide or pseudomorphs after the sulphide is conclusive evidence that this ore was not deposited as iron sulphide in cavities in the limestone and subsequently oxidized to limonite as has been the case in the secondary deposits.

In their distribution, topographic relation, and physical character the primary deposits resemble bog ore in many respects. As already mentioned, they occur in a comparatively narrow zone which borders the Tertiary lowlands. Throughout the area occupied by the primary deposits are frequent deposits of Lafayette gravel, indicating that during Tertiary time the land surface was probably low, and that during at least a part of the period swamp conditions prevailed; conditions very favorable to the accumulation of bog ore. Certain of the deposits are directly overlain by Lafayette gravel, and in some places the gravel is cemented by limonite.

Topographically, the deposits, in any one portion of the field, occur at approximately the same elevation, being situated chiefly on the crests and upper slopes of the main and secondary ridges. In this respect they resemble certain bog ore deposits occurring in Iowa† and Wisconsin*, but differ from the secondary limonite deposits which occur at almost any topographic position. There is a notable difference in the elevation of the deposits in the northern and southern portions of the district, but such differences can be ascribed to differential elevation of the Ozarks since Tertiary time.

In addition to the above bog ore characteristics, the comparatively extensive areas over which these deposits frequently outcrop, as well as the similarity of certain phases of the ore to types that have been described elsewhere as bog ore, would tend to emphasize a like origin.

†Calvin, S., Iowa Geol. Survey, vol. 4, 1894, p. 101.

*Allen, R. C., Occurrence and origin of the brown iron ores of Spring Valley, Wis.: Mich. Academy of Sci., 11th rept. 1909, p. 100.

However, when the field relations and character of the better developed deposits are considered, it is evident that the larger part of the ore is not directly of bog origin.

The irregular shape and occasional dip of the ore bodies across the roughly stratified residual materials, as well as the variation in the depth of the ore in different portions of the same deposit, indicate that such ore bodies were not deposited under bog conditions but were concentrated by circulating ground water. The unequal permeability of the residual materials is shown by the unequal thickness of the ore, the deeper portions apparently being the result of more open channels.

The extensive replacement of the residual materials, as shown by certain phases of the ore as well as the gradational phases where replacement is not complete, and the frequent occurrence within the ore of comparatively large boulders and fragments of chert not differing from those found in the surrounding residuum, indicate that the ore is not the result of bog deposition.

From a consideration of the above field evidence it is concluded that the present ore bodies are largely the result of the replacement of the cherty residual materials by limonite derived through the leaching of the deposits originally deposited under bog conditions.

It is thought that during Tertiary time iron bearing solutions, entering the bogs bordering the lowlands, were oxidized and the iron precipitated as limonite mingled with fragmental chert and sand. That subsequently, with the elevation of the area, the amorphous limonite was taken into solution by the organic acids resulting from the decay of organic material. These solutions percolated downward through the residual material and redeposited the iron largely through the replacement of the cherty residuum.

As a rule, the upper portions of the present deposits are more or less sandy and contain numerous small fragments of chert. It is thought that in some cases this sandy, cherty ore may represent remnants of the original bog deposits. However, none of the ore has been found to carry fossils and its bog origin has not been definitely determined.

PRIMARY LIMONITE OF THE SOUTHWEST DISTRICT.

The primary ore of this district was deposited in its present form—goethite and limonite—by circulating ground waters in openings occurring either along the unconformable contact of the Cherokee and Burlington formations or within the Burlington itself.

The fact that in its physical characteristics and chemical composition this ore differs greatly from the other brown ores indicates that it has had a different origin. The marked absence of the sulphide of iron and its pseudomorphs, which are so characteristic of the secondary limonite, is conclusive evidence that the ore was not originally deposited as the sulphide. The relative abundance of goethite as compared to limonite, and the absence of the finely divided quartz which is so characteristic of the primary limonites of the southeast district, indicates that it has been deposited chiefly as a filling of cavities rather than as a replacement of decomposed chert. The fact that it is uniformly from 2 to 5 times higher in phosphorous, and averages 5% higher in iron than the primary ore of the southeast district, is also indicative of its having had a different origin.

The deposits do not resemble those of bog origin in any important particular, and there is no field evidence indicating that bog conditions have ever obtained here. The Lafayette gravels, while known to occur in Southwest Missouri, have not been observed within the iron bearing district.

While the ore was plainly deposited from descending ground water, there is very little field evidence upon which to base deductions regarding its source. There are, however, two possibilities; either the iron was derived through the leaching of earlier deposits of limonite which once overlay the present ore bodies, or it was derived from the concentration of the iron of some overlying formation.

As regards the first case there is no field evidence of the former presence of deposits of either primary or secondary limonite from which the iron might have been derived, indicating that some overlying formation is the more probable source. The numerous remnants of the Cherokee within the district indicate its former presence over the entire area. The Cherokee, consisting chiefly of shale, sandstone, and chert conglomerate with occasional coal seams, contains also an abundance of iron in the form of the sulphide and carbonate which would constitute an abundant source for the iron. With but few exceptions, the deposits are closely associated with outliers of the Cherokee and in several instances occur directly along what appears to have been the contact of the Burlington with the Cherokee. Since the Burlington itself is not generally characterized by openings, it would appear that the ore was deposited chiefly in openings in the Cherokee near the contact of that formation with the Burlington.

The chief difficulty with the above hypothesis is that it does not account for the localization of the ore bodies. The Cherokee formation is known to have been equally well developed beyond the iron bearing district, so also are the structures which appear to have governed the deposition of the ore, and until more detailed investigations are made, the origin of these deposits must remain an open question.

VALUE OF MISSOURI BROWN ORES.

The value of the Missouri brown ores, from the standpoint of the smelter, is readily ascertained by comparing them with the brown ores being mined in other parts of the United States. Alabama is at present the largest producer of this kind of ore, and shipments from that state should offer a fair basis for comparison.

In the following table are shown average analyses of washed brown ore shipped during December, 1908, from six of the largest of the brown ore mines in the Birmingham district of Alabama.*

TABLE NO. XIX.

No.	Mine.	Iron.	Silica.	Alumina.	Mn.	Phos.	Moisture.
1	Tannehill	43.31	17.75	5.02	....	....	....
2	Houston	47.47	12.90	4.45	....	....	....
3	Standiford	41.92	15.67	3.98	0.64	0.59	6.60
4	Martaban	44.47	12.38	4.22	1.19	0.93	6.91
5	East Giles	45.90	11.20	4.10	0.59	0.46	6.20
6	Champion	47.19	12.50	2.44	0.72	0.26	7.10
7	Average	45.04	13.73	4.03	0.785	0.56	6.70

(No. 7 is an average of analyses Nos. 1 to 6 inclusive.)

In the following table are shown average analyses of shipments of washed ore from a number of the largest brown ore mines in Missouri:

TABLE NO. XX.

No.	Mine.	Iron.	Silica.	Mn.	Phos.	Moisture.	Shipments averaged.
1	Orchard	47.23	17.08	1.38	0.060	4.50	12
2	St. Francois No. 1	45.22	18.93	0.55	0.056	5.00	3
3	Frisco	51.05	10.49	0.61	0.199	5.14	18
4	Luke	52.65	11.60	0.11	0.080	4.00	26
5	Sawyer	50.31	13.37	0.38	0.069	....	13
6	Kingsbury	54.29	8.22	0.12	0.166	3.50	17
7	Carson	53.83	9.85	0.12	0.115	5.30	33
8	Average	50.65	12.79	0.47	0.106	4.57	....

Nos. 1 and 2 are of primary limonite of Southeast Missouri.
No. 3 is of primary limonite of Southwest Missouri.
Nos. 4 to 7 are of secondary limonite.
No. 8 is an average of the analyses Nos. 1 to 7 inclusive.

*Burchard, E. F., Brown ores of the Birmingham district, Ala.: U. S. Geol. Survey Bull. No. 400, p. 169.

According to the above tables, the average iron content of the Missouri ore is from 2 to 7% higher and averages 4.5% higher than that in the Alabama ore. With the exception of the southeast primary limonite, the Missouri ores range from 1% higher to 3% lower and average about 1% lower in silica than the Alabama ore. The phosphorus content of the Missouri ore is uniformly very much lower and averages less than one-fifth of that in the Alabama ore. While the Missouri secondary limonite is low in manganese, the Missouri primary limonite carries on an average 1.30% of this element (see page 71) which is nearly twice the average shown by the Alabama ore.

The Missouri secondary limonite is equal to any high grade limonite on the market. So also is the primary limonite (goethite) of the Southwest district. The primary limonite of the Southeast district, although the lowest grade ore, has about the same composition as that being mined so extensively in the Birmingham district.

MINING AND CONCENTRATING METHODS.

The shallow nature of the brown ore deposits makes mining operations comparatively simple. The deposits are usually entered by means of an open cut from which the ore is trammed in wheel-barrows or mine cars. Where the ore body occurs in the valley and the opening takes the form of a pit, the ore may be hoisted by means of a derrick or other simple hoisting equipment. In no case has mining extended below ground water level, and the small amount of surface water is removed by hand pumps or by bailing.

Mining is usually done by hand, the ground being loosened by picking and blasting. Gravel or sand screens are seldom used because of the abundance of chert which cannot be separated from the ore by this means. The finer particles of ore and clay are hauled out as waste unless the property is equipped with a washer. Frequently this dirt contains a large proportion of the ore. Many of the deposits are too small to support expensive equipment, although in the case of the larger ore bodies steam shovels can be used profitably, if the ore be treated at a washer.

Ten washing-plants have been erected in the limonite districts. They are located as follows: two each at Greenville, Wayne county, and West Plains, Howell county; one each at Williamsville and Taskee, Wayne county, Keener, Butler county, Orchard, Carter county, Puxico, Stoddard county, and Billings, Christian county. A majority of these washers are in serviceable condition, and have been operated intermittently during the past two years.

Fig. 1. KEENER BROWN ORE WASHER, AT THE LUKE MINE, BUTLER COUNTY. OLD TYPE.

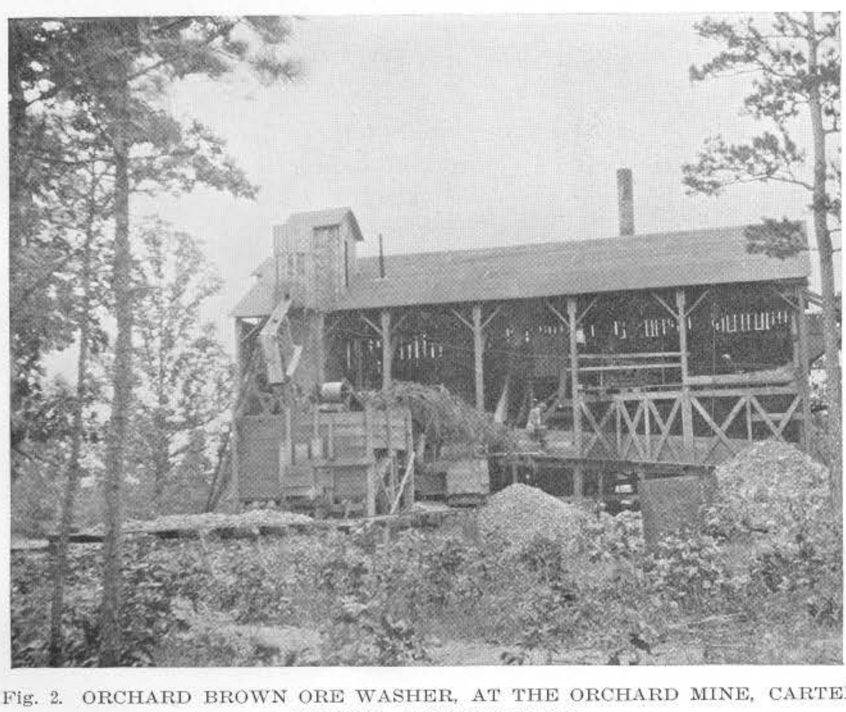


Fig. 2. ORCHARD BROWN ORE WASHER, AT THE ORCHARD MINE, CARTER COUNTY. MODERN TYPE.

The first washers erected in Missouri consisted of a single log to which the ore was fed from a platform. In some cases hand jigs were used to separate the chert from the fine ore. The more recent plants usually include receiving bins, distributing trommel, two logs, sizing screens, crushers, jigs and picking belts. The Orchard washer, a 50-ton plant, built in 1910, is typical of the later construction. The equipment in this plant consists of receiving bins, horizontal grizzly, two 26-foot logs, one 5-foot screen (opening 1¾ in.), crusher, one 12-foot screen, three two-compartment jigs and a picking belt. Water is obtained from a well 247 feet deep which has a capacity of 100 gallons per minute. By a system of ponding this is sufficient water for the plant.*

*For a detailed description of methods of treating brown ores the reader is referred to an article by Geismer, H. S., Bull. Am. Inst. Mining Eng. No. 56, 1911, p. 642.

CHAPTER VI.

THE HEMATITES OF THE FILLED SINKS.

INTRODUCTION.

"The hematites of the filled sinks" are so called because of their invariable relation to some kind of filled sink structure, in which particular they are altogether different from other iron ore deposits in this State, and so far as known, from all other iron ore deposits in the United States. The term "filled sinks" is used to distinguish the ore bearing sink from the ordinary drainage sink, while the general term "hematite" is used to embrace the several types of that mineral which may figure prominently in any particular deposit.

In the earlier Missouri reports, these deposits have been variously referred to as "Specular ores in Sandstone" (Iron Ores of Missouri, 1872, Schmidt), "Central Missouri Specular Ores" (Missouri Iron Ores, 1874, Schmidt), and "Specular ore of the Sandstone Region" (Iron Ores of Missouri, 1892, Nason). It will be noted that in each case the specular character of the ore is emphasized although this type of ore usually constitutes a relatively small part of the deposits and, in certain instances, has hardly been detected. The ore is mainly red hematite with important quantities of limonite but may include almost any oxide of iron from hard blue specular hematite to soft yellow ocher.

The restrictive use of the term "Sandstone Region" is now rendered meaningless by the present knowledge that the particular sandstone formation referred to occurs over a much larger part of the State than that characterized by this type of ore deposit. The term "in sandstone" is also not literally true, since some of the deposits are intimately associated with limestone, and it is believed that the presence of sandstone was not necessary to the concentration of the ore.

The term "filled sink," on the other hand, is applied to a constant structural feature, peculiar to these deposits, and one that has been an essential factor in their location. For these reasons one seems warranted in substituting this structural and somewhat genetic classification for those which have been outgrown. The structural features of the filled sinks must ever be reckoned with in prospecting, developing, or mining these deposits.

THE FILLED SINK (CENTRAL) DISTRICT.

Location: The ore bearing sinks occur over an area of approximately 4000 square miles extending from the head-waters of the Current and Black rivers, in southern Dent county, northward over the Central Ozark divide to within a few miles of the Missouri river. The district is virtually surrounded by deposits of other types of iron ores and for this reason was, in 1872, fittingly referred to by Adolph Schmidt as the Central ore region.*

By far the greater number of the known sink deposits occur in the area drained by the upper Meramec river in Phelps, Crawford, and Dent counties, although outlying deposits occur in Franklin, Washington, Iron, Reynolds, Shannon, Texas, Pulaski, Miller, and Maries counties. The best known and most extensively worked deposits are in the first three counties named, although Franklin county has recently become an important producer.

Topography: The district has, in general, the surface features of a moderately dissected plateau pitching gently to the north. The highest portion is along the southern border in Dent and the adjoining counties, where the upland has an elevation of about 1250 feet A. T. To the north it falls gradually to 1000 feet in the vicinity of Cuba, and to approximately 850 feet in Franklin and Gasconade counties. The southern and higher portion of the district forms a part of the Central Ozark divide. Here the country is rolling rather than hilly, the valleys being relatively shallow, the intermediate divides seldom rising more than 100 feet above drainage level. Ordinarily, the stream channels of this upland area are dry, being flooded only during excessive rains.

The area drained by the Bourbeuse river, and its tributaries, is rolling to hilly. The valleys are comparatively wide and are separated by long stretches of flat topped ridges which mark the former plateau. The roughest parts include a narrow belt along each side of the river.

The remainder of the district is decidedly hilly, the roughest area being that drained by the Meramec and Gasconade rivers. In the

*Schmidt, A., Iron ores of Missouri: Mo. Geol. Survey, 1872, p. 48.

immediate vicinity of the main channels of these streams, the hills are frequently over 300 feet in height. The tributaries to the Meramec and Gasconade rivers have dissected the plateau so thoroughly that this area now consists mainly of narrow valleys and sharp ridges with very little smooth upland.

Drainage: A greater part of the district is drained by the Meramec river and its tributary, the Bourbeuse. Both streams cross it in a northeasterly direction uniting just beyond its border. They head in the uplands on the south, and flow through deep meandering valleys.

The western portion of the district is drained in part by the Gasconade river and in part by tributaries of the Osage. Like the Meramec and Bourbeuse, these streams also meander through deep valleys.

The upland areas of the district are generally characterized by relatively wide and shallow valleys of steep gradient which are dry except during and immediately following heavy rains. Springs having their source in underground channels are abundant throughout the Ozarks, especially in the region of the sink deposits. Some of the springs are of great size, in certain instances supplying virtually all of the water of good sized streams. The well known Meramec Spring in Phelps county just about doubles the volume of the Meramec river where its waters joint the latter.

Large caverns and caves in the limestone are very common throughout the Ozark region. They usually have high, vaulted rooms connected by low, flat channels. Where solution extends upward to within a short distance of the surface, the roofs of the larger caverns become too weak to support the overburden and caving results. The large sink holes so prevalent throughout the Ozark region have probably been formed in this manner.

Frequently the drainage into these sinks carries in clay which chokes the underground outlet. When this happens the water collects, forming small ponds. More often, however, the sinks remain open and through them the surface waters are drained into underground channels. The solvent action of ground-water has been the important factor in the formation of not only the surface sinks, but also the "filled sinks" in which the iron ores occur. Most of the surface sinks appear to have been formed during the present period of erosion, while the iron bearing or filled sinks appear to have been formed during an earlier geologic period.

Geology: The Filled sink district is underlain chiefly by the Gasconade, Roubidoux and Jefferson City formations. Near the eastern border there are a few isolated knobs of porphyry and granite, and along Crooked creek, in the southeastern part of Crawford county, there is a small area underlain by the Bonneterre, Davis, and Potosi formations. The Proctor limestone outcrops over a small area along the Osage river in Miller county. These formations are not known to be ore bearing nor have they any definite relation to the occurrence or distribution of the sink deposits.

The Gasconade is the oldest formation in the district having any considerable surface distribution or a direct bearing on the occurrence of the iron ore. It outcrops throughout the southern and western portions of the district, where it occupies the deep valleys of most of the larger streams.

The Roubidoux formation is even more widely distributed in the Central ore district than the Gasconade. The hills and ridges of the major portion of the district are capped by this formation, which forms a large proportion of the valley of the Bourbeuse river where it occupies a position similar to that of the Gasconade in the valley of the Meramec.

The Roubidoux weathers more evenly than the Gasconade and produces more gentle topographic forms. The ridges capped by it are usually somewhat flat topped and bluffs are not so common along the streams of which it forms the bed. The contact of the Roubidoux with the Gasconade is usually marked by an abrupt change in surface slope. This contact is the most important geologic feature of the district since it is at, or near it, that most of the ore bearing sinks occur.

The Jefferson City formation appears to be confined almost entirely to that part of the district north of the St. Louis and San Francisco railroad, and to the north and west of the Bourbeuse river. Here, it caps most of the inter-stream divides extending south to the immediate vicinity of Rolla and Dixon. Nowhere is the formation known to be directly associated with the sink deposits.

The thickness and number of the Ordovician formations originally deposited within the area can only be conjectured. The series outcrops but a short distance to the northeast with an aggregate thickness of over 400 feet, but, with the exception of the St. Peter sandstone, the lowest member of the Ordovician, there is no direct evidence that any of these ever extended over the Central ore district. Outliers of what are thought to be St. Peter sandstone occur unconformably above the Jefferson City, Roubidoux, and Gasconade formations.

What is true of the Ordovician applies also to the Silurian, Devonian, and Mississippian series, most of which are well represented in St. Louis county and along the Mississippi river.

Occasional outliers of typical Burlington limestone have been found throughout the northern portion of the district and Burlington chert is of frequent occurrence in the residual materials. It is very probable that this formation, at one time, covered the entire district. If other Mississippian formations were deposited in this district, they were, so far as known, entirely removed prior to Pennsylvanian time.

The Pennsylvanian is the youngest formation known to have been deposited within the district. It occurs as many small outliers resting unconformably upon the Jefferson City, Roubidoux, and the Gasconade formations. The Pennsylvanian consists of shale, sandstone, and conglomerate, with occasional seams of coal and thin layers of earthy, red hematite. It occurs as a relatively thin veneer upon the higher hills and ridges, and as pockets filling sink depressions and stream channels formed by pre-Pennsylvanian drainage.

A number of the better known areas of Pennsylvanian are shown on the accompanying geologic map. There are a considerable number of others actually known in the district. The size of those represented on the map has been greatly exaggerated in order that they might be recognized. The outliers are perhaps most numerous along the divides occupied by the St. Louis and San Francisco and the Chicago, Rock Island and Pacific railroads. Numerous cuts along these roads have exposed sandstone and variously colored shale of probable Pennsylvanian age.

From the foregoing it would appear that the Pennsylvanian originally covered the entire Central ore district and that it was deposited at a time when the district presented a rather rough topography, characterized by numerous sinks in the Roubidoux and Gasconade formations. Because of the superposition and softness of the Pennsylvanian rocks, they were more generally eroded than the underlying Cambrian, for which reason they have been almost completely removed.

The fact that outliers of the Pennsylvanian are much more numerous and better preserved in the northern than in the southern part of the district, would indicate that the formation was either relatively thicker to the north or that greater elevation to the south has hastened erosion.

There is a closs relation between the distribution of the Pennsylvanian outliers and the ore bearing sinks, and the possible influence of the Pennsylvanian upon the source of the iron ores will be considered more in detail in the latter part of this chapter.

Relation of the Deposits to the Gasconade-Roubidoux Contact: As already mentioned, the hematite deposits of this district are usually associated with well defined sinks which occur chiefly at or near the contact between the lower Roubidoux sandstone and the Gasconade dolomite. The occurrence of the sinks at this horizon is so universal that the location of the ore deposits corresponds closely with it.

In the extreme southeastern portion of the district the contact is found at an elevation of approximately 1200 feet. Due to the gentle dip of the formations to the north, it falls to an elevation of from 900 to 950 feet in the vicinity of Cuba. From Rolla eastward along the divide occupied by the St. Louis and San Francisco railroad, it passes beneath the surface, reappearing locally to the north where the larger streams have cut deepest into the underlying formations. The contact finally disappears beneath the divide followed by the Chicago, Rock Island and Pacific railroad. This divide marks the northern boundary of the district.

With few exceptions the sink deposits are confined to the basins of the Meramec, Gasconade, and Osage rivers, throughout which areas the contact is well above drainage level. On the other hand, there are comparatively few deposits in the northern portion of the area lying between the St. Louis and San Francisco and the Chicago, Rock Island and Pacific railroads east of the Gasconade river.

THE ORE DEPOSITS.

Filled Sinks: The origin of the filled sinks is thought to be very similar to that of the large surface sinks; i. e. solution of the dolomite and subsequent caving of the overlying sandstone. In the case of the filled sink, it is thought that the caving did not extend to the surface, but that the opening was arched over by undisturbed sandstone or limestone. The present position of the filled sinks at the surface is the result of subsequent erosion.

The filled sinks may be grouped under two general heads: (1) those in which the enclosing formation is mainly sandstone, and (2) those in which the wall rock is part sandstone and in part limestone. The former type is much the more common and usually possesses the more regular outlines. A perfect example of this type of sink is the old Simmons Mountain bank now worked out and fully exposed. It is roughly circular in outline and is enclosed by a wall of sandstone which dips toward a common center. Sinks in which the wall rock is in part sandstone and in part limestone are generally more irregular in shape. Usually the limestone lies nearly horizontal and forms a long wall toward which the sandstone pitches and beyond which the ore does not extend. The DeCamp mine in Phelps county is an important example of this type of sink.

Rim Rock: The dipping sandstone, which so frequently accompanies the ore where it outcrops and which has been aptly referred to by Schmidt as "rim rock," is an important surface feature of the filled sink. In a large number, perhaps in most cases, the outcropping ore is confined to a somewhat circular area enclosed by a rim of steeply dipping Roubidoux sandstone. Those deposits which have been marked by the strongest outcrop of ore have generally shown the best developed rim rock, the extent to which both the ore and the rim rock are exposed depending largely on the extent to which erosion has removed the surrounding formations. Fig 2, Plate IX, is a photograph of the rim rock shown at the Griffith mine.

The rim is commonly in the form of a rough ellipse, about twice as long as wide, and, though usually somewhat broken, frequently encircles the ore outcrop. The dip of the sandstone may be at almost any angle from the horizontal but it is usually between 5° and 30°, toward the ore body. The rim of dipping sandstone, wherever developed, has, in all cases, marked the limits of the ore bearing sink. In some cases the boundary of the sink is indicated by a line of scattered sandstone fragments, or in part by a well defined rim and in part by broken blocks of sandstone. Where residual materials are abundant, there may be no indication of a rim rock at the surface.

The Christy bank in Sec. 12, T. 38 N., R. 2 W., in northeastern Crawford county, is perhaps the best example of a heavy outcrop enclosed by a well defined rim rock. Here, a rim of dipping sandstone encircles an area fully 1000 feet long and 400 feet wide. Over the east end of this area soft red hematite outcrops almost continuously, while large and small boulders of blue specular ore extend beyond its southern limits into a ravine and for some distance up the opposite hillside. The relation between the rim rock and the outcrop is well shown in Figs 18 and 19.

Wall Rock: Since the iron ore was precipitated in underground openings, the ore bodies are either completely or partially enclosed by wall rock or decomposed residual materials derived from the breaking down of the wall rock.

The walls are usually sandstone, although they may be limestone or chert. The hard sandstone is commonly ferruginous while the soft is light colored. It usually pitches toward the ore body and where the inclination is as much as 30° it may form a roughly cone shaped basin within which the ore rests. In many instances the sandstone of the side wall lies nearly horizontal, in which case the contact with the ore is apt to be nearly vertical, as though conforming to

Fig. 1. INCLINE, PIT NO. I., GRIFFITH MINE, SHOWING DIPPING SANDSTONE AND CHERT.

Fig. 2. DIPPING SANDSTONE RIM ROCK, GRIFFITH MINE.

vertical joints in the formation. The pitching sandstone upon which the ore rests consists of that portion of the Roubidoux which caved prior to the deposition of the iron.

Where limestone forms the side wall, it usually lies horizontal or pitches but slightly toward the ore body and is generally in nearly vertical contact with the ore.

In most cases, the floor of the sink consists of broken sandstone, clay, and chert, usually much confused. In Cherry Valley No. 1 mine, it consists of nearly flat lying quartzitic sandstone, while at Copper Hill, south of Sullivan, the ore is known to extend down to the Gasconade limestone.

The cap rock or overburden consists, for the most part, of somewhat confused but alternating layers of sandstone, residual clay, ocher, and ferruginous chert. At the Leslie mine it consists of a light colored, silicious limestone which dips toward the ore body from all sides. (See detailed description, page 244.) The materials forming the overburden are generally more or less stratified and co-extensive with those forming the side walls.

As a rule, the overburden is so thin that the ore may be mined by the open pit method. The depth to which open pit work may be carried on depends, however, upon the regularity of the deposit, and the relation of the dip of the ore to the surface contour. In a few instances only has an unusually thick overburden required underground mining.

Contact of Ore and Wall Rock: The character of the contact between the ore and the wall rock depends somewhat upon the nature of the wall rock. Where the wall rock consists of sandstones there is usually a sharp and more or less regular contact. Locally the ore may extend several feet into the wall between sandstone beds, but there is little evidence of extensive replacement of the sandstone by the ore.

Where the wall rock is limestone, the separation is equally as sharp. The ore and limestone contact is generally marked by a thin seam of light colored clay which has apparently resulted from the decomposition of the limestone. There are, however, instances of local transition into a highly calcareous ore. In the Leslie mine the clay separating the ore and the wall rock varies from one-half inch to several feet in thickness, and completely encloses the ore body, quite effectively excluding ground water to a depth of 30 feet below drainage level.

Size and Shape of the Ore Bodies: The deposits vary greatly in form, depending primarily upon the shape of the sinks to which they are confined. While most of them are regular in outline, others are exceedingly irregular. The more regular are bowl and canoe shaped, resembling an elongated, inverted cone, with nearly circular outlines; some are crescent shaped with narrow bottom and wide top, the crescent sometimes bending upon itself until its ends almost meet; while others are rather flat, pitching deposits with top and bottom of nearly equal width. The more irregular ore bodies usually consist of smaller deposits connected by irregular stringers and bunches of ore so enclosed by sandstone, chert, and clay as to make mining difficult. Of these various forms, the elongated, inverted cone is the most common, and naturally the most easily mined. Splendid examples of the inverted cone are the old Scotia, Cherry Valley No. 1 and No. 2, Simmons Mountain, and Meramec mines. The crescent form is well exhibited at the Hawkins, DeCamp, and Clark banks, the pitching deposit by the Marsh and Leslie banks, while the Craig is a good example of the extremely irregular type.

The quantity of ore in the deposit varies from a few hundred to more than half a million tons. Good examples of the larger ore bodies are the two Cherry Valley mines, which together had produced to Jan. 1st, 1911, a total of 736,800 tons, and give promise of reaching a total output of more than one million tons before exhausted. Of these, No. 2 is the larger having already produced approximately 500,000 tons.

The larger and more regularly shaped ore bodies are usually characterized by a single well defined dip. This is nicely exhibited in the Leslie, Marsh, and Cherry Valley No. 1 mines. Where the ore body is irregular and is composed of several parts scattered about the flanks of the enclosing sink, the ore may pitch in several directions, although ordinarily toward a common center. In the case of extremely irregular ore bodies, like that of the Craig mine, there appears to be no well defined structure. The pitch of any given deposit has been governed entirely by the structure of the sink in which it was formed.

Topographic Relations: The ore bodies occur on the crest of the hills and ridges, marking the highest points within the district; in ravines, in part at least, below present groundwater level; and at all intermediate horizons. Commonly they lie directly across the present drainage channels to which they apparently have no definite relation, and of which they are probably entirely independent.

There also appears to be no definite relation between the dip of an ore body and the surface contour. The dip is just as apt to be into the hill as with it, indicating that the present topography is very much younger than the deposits and has had no influence upon their formation.

Outcrops: The size of the outcrops of ore is a very irregular feature. Many of the larger deposits, so far developed, were marked by splendid showings of surface ore, in some cases several thousand tons being in sight. Such was the case at Cherry Valley No. 1 and at Simmons Mountain. On the other hand, large deposits such as the Leslie and DeCamp have had comparatively little or no surface showings.

Most of the larger outcrops consisted of hard specular ore, which appears to have quite commonly formed the upper portion of the deposits. However, several very important ore bodies have been marked by small outcrops of red and brown ore.

Where particularly large, and of hard ore, the outcrop usually occupies the crest of a hill and protrudes above the general level of the surface. Where it consists of the softer red and brown ores, it is usually small and has no apparent effect upon the topography.

While the outcrop normally occurs within the rim, it frequently extends beyond the area thus enclosed, in which case it is made up of boulders of specular ore that have been transported to their present position through gravity.

The size and nature of the outcrop depends, in part, upon the depth of the ore body and, in part, upon the extent to which the overburden has been removed. While it is probable that the present advanced stage of erosion has exposed the upper portion of many of the ore bodies, there may be, in the less denuded portions of the district, many deposits like those already mentioned, where the outcrop is in no way a criterion of the size of the deposit.

THE ORE.

Mineral Composition: The ores are chiefly soft, red hematites, with subordinate amounts of blue, specular hematite and soft, brown and yellow limonite, all of which are, for the most part, the alteration products of iron sulphide.

The chief mineral impurities are quartz, calcite, dolomite, and marcasite. There are also small amounts of the oxide of manganese, the sulphide and carbonate of copper, and the sulphides of lead and zinc.

Quartz occurs as crystals lining cavities in the ore, occasionally as a fine cellular net work, and as sand. Apparently it is largely an original constituent, having been deposited with the sulphides. The silica content of ores smelted since 1897 ranged from 7.00% to 20.00% averaging about 10.83%.

Calcite is most abundant in those deposits having limestone as a part of the wall rock, while it is rarely present in those enclosed by sandstone. It occurs chiefly as secondary calcite filling small joints but it is also an original constituent of certain highly calcareous ores which grade into limestone. The more calcareous ores frequently contain 15% calcium carbonate.

The larger cavities in the ore frequently contain crystals of dolomite.

Marcasite is an important accessory in certain of the deposits and its presence as an original constituent in all of them is well shown by the many pseudomorphs after the sulphides. It is usually found near the bottom of the ore body in isolated boulders incased in a hard shell of limonite. In certain deposits, however, particularly those at or near groundwater level, the sulphide has been found to occur in large quantities underlying the entire ore body. In most cases the line of demarkation between oxide and sulphide is well defined. For this reason the presence of the sulphide seldom gives much trouble in mining, and determinations of sulphur in analyses of shipments are seldom made. In a number of instances the output of marcasite has constituted an important part of the production, and in many of the abandoned mines there are, no doubt, deposits of iron sulphide of commercial value.

Manganese occurs quite uniformly disseminated through the ore in quantities varying from 0.10 to 0.15% but local concentrations are unusual.

The sulphide and carbonate of copper occur most frequently in deposits containing unaltered marcasite. In a few cases the percentage of copper in the ore has caused the abandonment of the mine, and in several instances the ore has been mined and smelted for copper.* The sulphides of lead and zinc are of very infrequent occurrence.

Waste Materials: In addition to the foregoing impurities, there are usually associated with the ore more or less chert, clay, and sandstone.

Chert occurs in stringers or layers embedded in the ore, or less frequently in isolated nodules or boulders in the vicinity of the wall rock.

Clay fills joints and fissures in the ore, and frequently constitutes a large part of the waste to be handled.

Sandstone occurs in isolated boulders embedded in the ore near the margin of the deposit.

*For further information as to the occurrence and value of the ores of copper, see Bain and Ulrich, Copper Deposits of Missouri: U. S. G. S. Bulletin, No. 276, p. 47.

As a rule, the materials classed as waste may be readily removed by hand and in no instances has the ore required washing.

Physical Characters: The specular hematite has a steel blue color and a metallic luster. It usually has a fine grained texture, with numerous small irregular cavities, which are very uniformly distributed. The cavities are lined with small tabular crystals of iridescent hematite, together with a few small crystals of vitreous quartz. The larger cavities are a foot or more in diameter, and are usually lined with large crystals of limpid amethystine quartz, the faces of which are studded with small rosettes of iridescent hematite and an occasional cluster of golden dolomite crystals.

The specular hematite generally shows pseudomorphs after marcasite but not so frequently as the red and brown ores. It is sometimes stalactitic but more often exhibits the radiated, feather, and botryoidal structure. In several instances it has been found to be magnetic, and, according to Schmidt*, quite generally shows some polarity.

The red hematite varies greatly in physical character even within the same deposit. The most common varieties are; (1) soft granular ore, (2) soft paint ore and, (3) hard calcareous ore. The granular is the commonest phase in most of the deposits. It is mainly soft and porous, but has a great variety of texture like those of the sulphide.

The soft paint ore occurs in many of the deposits but seldom in large quantities. It is a nearly pure, fine grained, red to purple hematite, having a greasy feel. Sulphide pseudomorphs are not so frequent in this ore as in the granular ores.

The hard calcareous ore has a coarsely crystalline texture resembling that of siderite or of coarsely crystalline limestone into which it frequently grades. It occurs only where limestone forms a part of the wall rock. This relation is well developed at the DeCamp and Copper Hill mines. None of the red ores are magnetic.

The hydrous or brown ore consists chiefly of the soft granular and ocherous forms, but there are, in some places, important quantities of hard, boulder limonite, similar to the secondary boulder limonite of the southern district. The brown ores, like the red, show abundant sulphide pseudomorphs and are not magnetic.

Mention should be made of a soft black hematite, occurring in the clay seams near the margin of the deposits. This ore is similar in all respects to the soft black ore at Iron Mountain and Pilot Knob,

*Schmidt, A., Iron ores of Missouri: Mo. Geol. Survey, 1872, pp. 63-84.

and, like these, is the result of the disintegration of the hard blue ore.

While a number of the deposits have produced large quantities of hard, blue, specular hematite, the softer red and brown varieties usually predominate. The specular ore occurs in bunches and as isolated boulders embedded in the softer ores. In no instance has a sink deposit been found that consists exclusively of specular ore, as is the case at Iron Mountain and Pilot Knob.

On the other hand, deposits have been found which are almost exclusively red hematite, and others which are exclusively brown ore. The Leslie mine, which is being operated at the present time, contains red hematite exclusively, and it is reported that several other abandoned mines, notably the Plank and Winkler, were of a similar character. The Griffith mine, in its present stage of development, has produced brown ore exclusively, although it is probable that with increased depth red hematite will be encountered.

In the light of the above facts, the term "specular ore deposits," which has hitherto been generally applied to these ores bodies, is, in a large measure, a misnomer. Its adoption was chiefly due to the fact that most of the earlier developed deposits were marked by outcrops of specular ore. Added to this was the belief that the softer red and brown ores had resulted from the breaking down and hydration of the specular ore, which was thought to have originally constituted the major portion of all the deposits.

Chemical Composition: These iron ores are, on an average, medium to low grade, non-bessemer hematites. The iron content of recent shipments, from all parts of the district, ranges from 44.49% to 59.01% and averages about 54.00%. The specular ore is generally the highest in iron, while the brown ore is lowest. Silica ranges from 7.03% to 20.01% and averages 10.83%. The phosphorous content varies, but averages about 0.107%. The specular ores are lowest in this respect, while the soft red and brown ores are relatively higher. Sulphur, though abundant in many of the deposits, is so well segregated as to be easily avoided in mining. With the exception of the Leslie, ore shipments have been uniformly low in sulphur, seldom running over 0.03%.

The partial analyses in the following table are of shipments from twelve of the more recently producing mines, and are fairly representative of the district:

TABLE NO. XXI.

No.	Mine.	Iron.	Silica.	Phos.	Sul.	Mn.	Alumina.	Lime.	Loss on Ignition.	Moisture.	Number Anal. averaged.	Kind of Ore.
1	Leslie	44.49	5.17	0.075	0.274	0.05	2.15	7.94	......	5.31	24	Red limey hematite.
2	DeCamp	58.10	6.78	0.105	0.035	0.13	0.86	7.23	3.19	7.06	13	Blue and red "
3	Cherry Valley No. 1, Underground	57.98	9.37	......	......	......	1.61	......	......	......	6	Red and brown.
4	Cherry Valley, No. 2, ore from dumps	51.17	20.01	......	......	......	......	......	......	......	10	Brown.
5	Griffith	53.70	12.14	......	0.030	......	......	......	......	12.02	5	"
6	Marsh	57.24	6.77	......	0.030	......	......	......	......	......	5	" and red.
7	Plank	53.01	12.54	0.119	......	0.12	......	......	......	7.66	9	Red hematite.
8	Winkler	52.37	13.02	0.111	......	0.11	......	......	......	8.45	5	" "
9	Copper Hill	53.61	9.00	0.125	......	0.15	......	......	......	......	1	Red limey ore.
10	Stephens-Woodside	58.40	7.43	0.112	......	......	......	......	......	12.30	1	
11	Cooper	54.54	8.05	0.101	......	......	......	......	......	11.00	3	
12	James & Mozelle	52.44	11.20	......	......	......	......	......	......	......	1	

The following complete analyses of specular and red hematite appeared in the Tenth U. S. Census, Vol. XV, page 592. They represent the grade of the ore produced by some of the old deposits, at a time when the then unmerchantable brown ores were not included in shipments:

No.	Mine.	Kind of Ore.	Iron.	Silica.	Phos.	Sul.	Magnesia.	Lime.	Alumina.	Comb. H_2O.
1	Cherry Valley	Blue specular	65.96	3.06	.022	.159	0.07	.28	1.27	0.98
2	Riverside	Blue specular	63.90	7.15	.029	.020	0.09	.34	0.81	0.15
3	Riverside	Red hematite	64.31	2.57	.063	.180	0.06	.13	1.36	3.46

No. 1—From all parts of bottom of pit No. 1, and 10 feet up sides;
No. 2—From 300 tons of ore from main part of pit;
No. 3—From face of ore.

ORIGIN OF THE ORES.

EARLIER THEORIES.

Dr. A. Schmidt*, who in 1872 first studied these deposits, believed the ores to have been deposited originally as specular hematite, either replacing the existing rock or in hollows in the then existing surface, and that the soft red hematite and limonite were the result of the alteration of the specular hematite.

*Schmidt, A., Iron ores of Missouri: Mo. Geol. Survey, 1872, p. 127.

Pumpelly** regarded the iron as having been derived from the weathering of the overlying 1st (Joachim) and 2nd (Jefferson City) magnesium limestones, and the depressions in which it was deposited to be due to the collapse of solution cavities in the 3rd (Gasconade) magnesium limestone.

Nason***, who in 1892 was the next to give the subject attention, concludes that the iron was derived from the leaching and erosion of the overlying Cambrian sandstones; that it was originally deposited as the sulphide in solution channels in the Gasconade dolomite, whose waters had become choked or impounded by the falling of the Roubidoux sandstone of the roof; and that subsequently, through the heat generated by its decomposition, the sulphide was metamorphosed to specular hematite, which was later transformed to the soft red and brown ores.

PRESENT THEORY.

General Statement: The results of the present investigations, in so far as essential principles are concerned, are largely in accord with the conclusions of Nason, differing mainly in the matter of details concerning the probable source of the iron, the time and conditions governing its deposition, and the results of the process of metamorphism.

Briefly stated, the several events in the history of the formation of the deposits are believed to have been as follows:

(1) That the Pennsylvanian sediments once overlay the entire Central Ore District.

(2) That the deposition of the iron took place subsequent to the deposition of the Pennsylvanian sediments and after these had been cut through by post-Pennsylvanian erosion; thereby allowing surface drainage to enter the underground circulation.

(3) That the iron was derived largely through the leaching, by meteoric waters, of the iron carbonates and sulphides in the overlying Pennsylvanian sediments, though it may have been derived, in part, from the overlying and immediately adjacent Cambrian formations.

(4) That the iron was originally precipitated in place, in the form of the sulphide, mainly as marcasite, by descending waters.

(5) That the localities most favorable to the deposition of the sulphide were various sink structures, generally resulting from the depression of the Roubidoux sandstone into solution cavities in the

**Pumpelly, R., Iron ores of the U. S.: Tenth Census of the U. S., vol. XV, p. 12.
***Nason, F. L., Iron ores of Missouri: Mo. Geol. Survey, vol. 2, 1892, pp. 138-146.

Gasconade dolomite, producing caves at or near ground water level in which descending iron bearing solutions might become impounded.

(6) That subsequently, under conditions favorable to oxidation and hydration, produced by a relative depression of ground water level, the iron sulphide was altered, in part, to specular ore, in part to the soft, red hematites, and in part to limonite.

(7) That almost continuous erosion since Pennsylvanian time has greatly reduced the surface of the Central ore district and thereby exposed most of the ore bearing sinks.

Presence of the Pennsylvanian: The former presence of the Pennsylvanian over a large part of the Central ore district is conclusively shown by numerous outliers of sandstone and shale capping the main divides and filling pre-Pennsylvanian sinks at lower elevations.

Adjacent to the St. Louis and San Francisco railroad, these outliers are common, increasing in number to the northward. South of the railroad, outliers are less frequent, but are well developed at several places near the southern limit of the district. Conspicuous among these are the deposits of coal and fire clay in the vicinity of Cooks Station, Crawford county, and in Sec. 11, T.39, R. 2W., near the Washington county line. The latter contains a seam of coal 40 feet thick which appears to be in place. In the vicinity of Cooks Station the Pennsylvanian contains 8 to 10 feet of coal which is much disturbed and presents more nearly the appearance of having settled into a post-Pennsylvanian sink, through the solution of the underlying strata. In either case the Pennsylvanian is so well developed that it is safe to presume that it originally extended much farther south and east, probably beyond the limits of the Central ore district. In any event, it has been pretty well established that the Pennsylvanian was formerly well developed over that part of the district in which the iron bearing sinks are most abundant.

Nason appears to have been fully satisfied as to this, but evidently believed that the Pennsylvanian had been largely removed before the primary concentration of the ore. Considering the long period of erosion to which many of the deposits have been subjected, and the fact that many remnants of the Pennsylvanian are still to be seen within the district, it hardly seems probable that the formation of the sulphide deposits was as late as this deduction would signify.

The Simmons Mountain deposit illustrates the extensive erosion which has probably taken place since the first concentration of the iron. This mine is situated on the top of a prominent hill and shows a well developed rim rock. The ore, which extends to a depth of 100 feet, was originally deposited as the sulphide, probably at or below the level of ground water. The location of the sink at that time must therefore have been at or below drainage level and low with respect to the surface relief. Due to extensive erosion of the formations since this primary deposition, the water table has been gradually lowered and the surrounding formations have been eroded until, at present, the ore body occupies one of the highest points in the area. Other similar examples occur throughout the Central ore district.

It is certain, therefore, that the district has been subject to extensive erosion since the deposition of the sulphides, and with the present occurrence of numerous outliers of the Pennsylvanian, it is but natural to suppose that the farther back we go into the history of the present period of erosion, the more of these sediments would be found, and that during the earliest life of the ore bodies there were, in all probability, extensive areas of the Pennsylvanian sediments capping the uplands throughout the ore bearing district.

Source of the Iron: Nason seems also to have been fully satisfied that it is to the Pennsylvanian sediments that one would naturally look for the source of the iron, but, presuming that the ores were deposited since the removal of the major portion of the Pennsylvanian, he declares in favor of the existing Cambrian and Ordovician sandstone instead.

That the Pennsylvanian formations may be considered an ample source for all the iron concentrated in the district, is shown by the fact that wherever found these sediments are characterized by an abundance of iron bearing minerals.

In a succeeding chapter bedded red hematites, occurring in these formations, at other points throughout the State, are described. The coal seams and many of the shales of the series contain abundant sulphides of iron, while more or less unaltered iron carbonate is also known to occur throughout the lower Pennsylvanian of northern Missouri.

What is characteristic of the Pennsylvanian outside of the district may be supposed to have been characteristic of that originally deposited within the district, and this supposition is warranted by the fact that the Pennsylvanian outliers are readily recognized by frequent red to purple bands of highly iron stained shales, some of which have been found to approach an iron ore.

While the Cambrian sandstones and limestones contain a small percentage of iron, chiefly in the form of the oxide, they are not thought to be comparable with the Pennsylvanian as a source of the iron.

Nason observed that the sandstones in the immediate vicinity of the iron bearing sinks were less ferruginous than the average for the formation, and concludes that the iron was obtained from the area in which the leaching is shown and from the overlying beds of the Cambrian.

In the larger ore bodies, such as the deposits at Cherry Valley, the concentration of a million tons of ore would require the solvent action over a large area. Field evidence does not indicate such conditions. That geologic conditions must, in part at least, have been different from those of today is indicated by the fact that although solution and decomposition of the Cambrian is in progress at present, we have no evidence that there are deposits being formed at any place within the area of the filled sinks.

Since the deposits are mainly due to purely local structure, they necessarily have had a local source. It is therefore all the more urgent that that source, to have been ample, must have been unusually rich. It is believed that the Pennsylvanian was the only formation that could have acted as the original source of the iron necessary for the concentration into ore bodies of the size now existing in the district.

Form in which Deposited: The evidence in support of the supposition that the iron was originally deposited as the sulphide and later altered to hematite and limonite may be correlated under two heads:

(1) The sulphides of iron and other metals are commonly associated with the iron ores. These sulphides occur in the more protected portions of the ore body, and frequently unaltered marcasite underlies the entire deposit. This is especially true of the deposits which lie near ground water level where alteration is not so apt to be complete. In some cases the sulphide occurs in large lense shaped masses within the ore, and boulders of hard ore are occasionally found to contain a sulphide core. In the deeper parts of the deposits and associated with the iron sulphide, the sulphides of copper, zinc, and lead have been found in small amounts. Carbonates of copper, evidently the oxidized product of similar sulphides, frequently occur associated with the ore. This is especially true where the sulphides of copper are encountered in depth.

(2) The oxide ores, in nearly all phases, preserve the crystal forms of marcasite. This is particularly the case with the softer red and brown ores, which often consist of a nearly solid mass of marcasite pseudomorphs. In the hard, specular ore these forms are usually less pronounced, but excepting in some dense, fine grained hematite and the tabular crystals of hematite lining cavities, they are generally present. In general, the original sulphide character of the deposits is so pronounced that one can find no well founded reason for a difference of opinion on this point.

There is, however, a disagreement as to the method of the formation of the soft red and brown ores. While both Schmidt and Nason have held that the ore was once entirely of the specular variety, and has been, and is at present, in the process of being transformed to the soft red and brown ores, recent investigations have led to the conclusion that the specular ore has not broken down to the soft anhydrous and hydrous ores, but that the soft red and brown ores, as well as the specular ore, for the most part, are the direct result of the alteration of the sulphide.

The field evidence leading to this conclusion may be summarized under the following heads:

(1) The soft red and brown ores uniformly carry more sulphur and exhibit more, and generally better preserved, sulphide pseudomorphs than does the specular ore. This would not be the case where the soft ores farther removed from the sulphides.

(2) The sulphides are found in the actual process of alteration to the soft ores, particularly to the brown ore, in both the sinks and the secondary limonite deposits of the southern part of the State.

(3) In the extensively worked deposits of specular hematite at Iron Mountain, Pilot Knob, and Shepherd Mountain, the alteration of specular ore to soft red and brown ore does not occur, although it has been so reported. The alteration which does take place is the softening and leaching of the specular ore, resulting in the soft black ore which forms so important a part of those deposits. Nowhere is there any evidence of hydration—not even to the extent of iron staining—except at Shepherd Mountain, at which place the stains may be traced directly to the oxidation of iron sulphide. The specular ore of the sink deposits has also suffered leaching and softening in certain places, but the product in each case observed, was a soft black ore not unlike that of Iron Mountain and Pilot Knob.

The results of recent laboratory experiments corroborate the field evidence above cited. These experiments show that, under ordinary conditions, the anhydrous hematites are the more stable of the oxides of iron, and that the tendency, under normal conditions of weathering, is more toward the dehydration of the hydrous ores, instead of toward the hydration of the anhydrous.

Structures Governing Deposition: That the point of deposition of the sulphides was governed by some sort of sink structure is established beyond doubt by the exposed structure in many of the mines that have been completely worked out. The conditions under which these structures have been formed, however, are not so readily established. Their repeated occurrence at horizons just above or near the contact of the

Roubidoux sandstone with the Gasconade limestone, suggests that most of the ore bearing sinks have been produced by the collapse of the sandstone into large caves in the underlying limestone. This would create a chamber, the walls of which might be either vertical or inclined, while the beds forming them might be either horizontal or inclined and the floor would naturally consist of broken, confused material of the same character. Such a chamber would usually occur near the sandstone-limestone contact; never far below it, but still possibly a considerable distance above it.

Where the sinks occur above the contact, it is thought that while the caving of the sandstone probably started at the contact with the underlying limestone, it extended somewhat farther vertically, resulting in the complete filling of the limestone cavity, above which was formed a basin entirely enclosed by sandstone.

However, certain of the deposits appear to be essentially replacements of the more calcareous of the associated rocks. This is well exhibited at the Leslie and DeCamp mines where limestones form a part of the wall rock. At both mines, stringers of fresh and decomposed chert occur embedded in the ore in such a way as to indicate that the ore occupies the position of what was formerly a cherty limestone. That the limestone was replaced by iron sulphide, which was later altered to the oxide, is indicated by the highly pseudomorphous character of the ore.

From what is known of the extensive erosion within the district, it is evident that the deposits were originally much more deeply buried than at present. This is indicated by the depth at which many of the ore deposits are found at present, and by the character and relations of the materials forming the overburden. The often solid, and semi-stratified character of the overburden, bears evidence of its having been but little disturbed, in which case it must have arched the formations or cavities that have since been replaced or filled by the ore. It is thought, however, that only those sinks having an overhead communication with the surface, through which surface iron bearing solutions might enter, were destined to be a depository for the ore.

Alteration of the Sulphides: It is evident that the initial stage in the process of the alteration of the sulphides was their elevation above ground water level where they were subject to oxidizing influences, but the exact conditions under which they were metamorphosed in part to limonite, in part to soft, red hematite, and in part to hard, blue, specular hematite, have not been clearly established. It is thought that to obtain results differing so widely from those obtained in the formation of the secondary limonite, the conditions of alteration in the two cases must have differed materially.

Under ordinary laboratory conditions, marcasite oxidizes to ferrous sulphate, sulphuric acid, and free sulphur. With the oxidation of the ferrous sulphate to ferric sulphate and the hydrolysis of the latter, an amorphous, hydrous oxide is obtained having the yellowish color of limonite. When exposed in small quantities to ordinary oxidizing conditions within the zone of weathering, direct alteration to limonite usually results.

The exact conditions essential to the precipitation of the iron salts as the hydrous oxide are not known, but the occurrence of small crystals of specular hematite lining cavities in the ore indicates that it is possible to obtain the oxide direct from solution. The occurrence of the specular hematite exhibiting abundant pseudomorphs after the sulphides, indicates that it is also possible to have these oxides formed through the oxidation of marcasite.

Nason has suggested that high temperature, due to the heat generated through the oxidation of the sulphide, was essential to the deposition in this form of oxide, and cites the silicification of the surrounding rocks and the presence of vitreous quartz in the ore as evidence of heated solutions. The present investigation, however, failed to disclose any evidence of the action of heat; the silicification, referred to by Nason, having taken place during the deposition of the sulphides and not during the period of their alteration.

Considering the difference in the occurrence of the sulphides which have been altered to the secondary limonites and the sulphides deposited in the sinks, it would appear that the different results of oxidation may be attributed in large part to the control of the attending structures upon the rapidity of flow and chemical composition of the solutions. Many of the sink deposits are found to be surrounded by a relatively impervious layer of clay which effectively prevents a vigorous circulation of ground water. This indicates that the oxidizing solutions must have moved relatively slow which would favor, within a limited space, differential action such as has been described.

The oxidation of large masses of sulphides, such as occurred in the sinks, might also be expected to be attended with results differing from those resulting from the oxidation of the relatively small masses of sulphide which characterized the secondary deposits. It is interesting to note, in this connection, that in the secondary limonite deposits, the anhydrous ores do not occur except locally and in very small quantities in a few of those deposits where the sulphides have occurred in mass under conditions approaching more nearly those occuring in the sinks.

While the main process of ore formation has undoubtedly been that of oxidation and hydration of the sulphide in place, there has also been some limestone, clay, sandstone, and possibly chert replacement. This action appears to have taken place during the deposition of the sulphides. The process, in all cases, is confined chiefly to the outer limits of the deposits, particularly at the contact of the ore with the wall rock, the character of which determines the nature and extent of the replacement.

Limestone appears to have been particularly susceptible to replacement by ore, and where it forms a part of the wall rock, a crystalline, limey, red hematite is usually encountered.

Certain of the soft, greasy, red and purple paint ores are found directly replacing and intimately mixed with soft, green clays, enclosing nodules of green chert which also shows partial replacement. That sandstone has been replaced, to a small degree at least, is suggested by the manner in which a soft, granular, red hematite, without pseudomorph characters, is found to occasionally extend into the foot and side walls along the bedding plane at the expense of the adjacent sandstone beds.

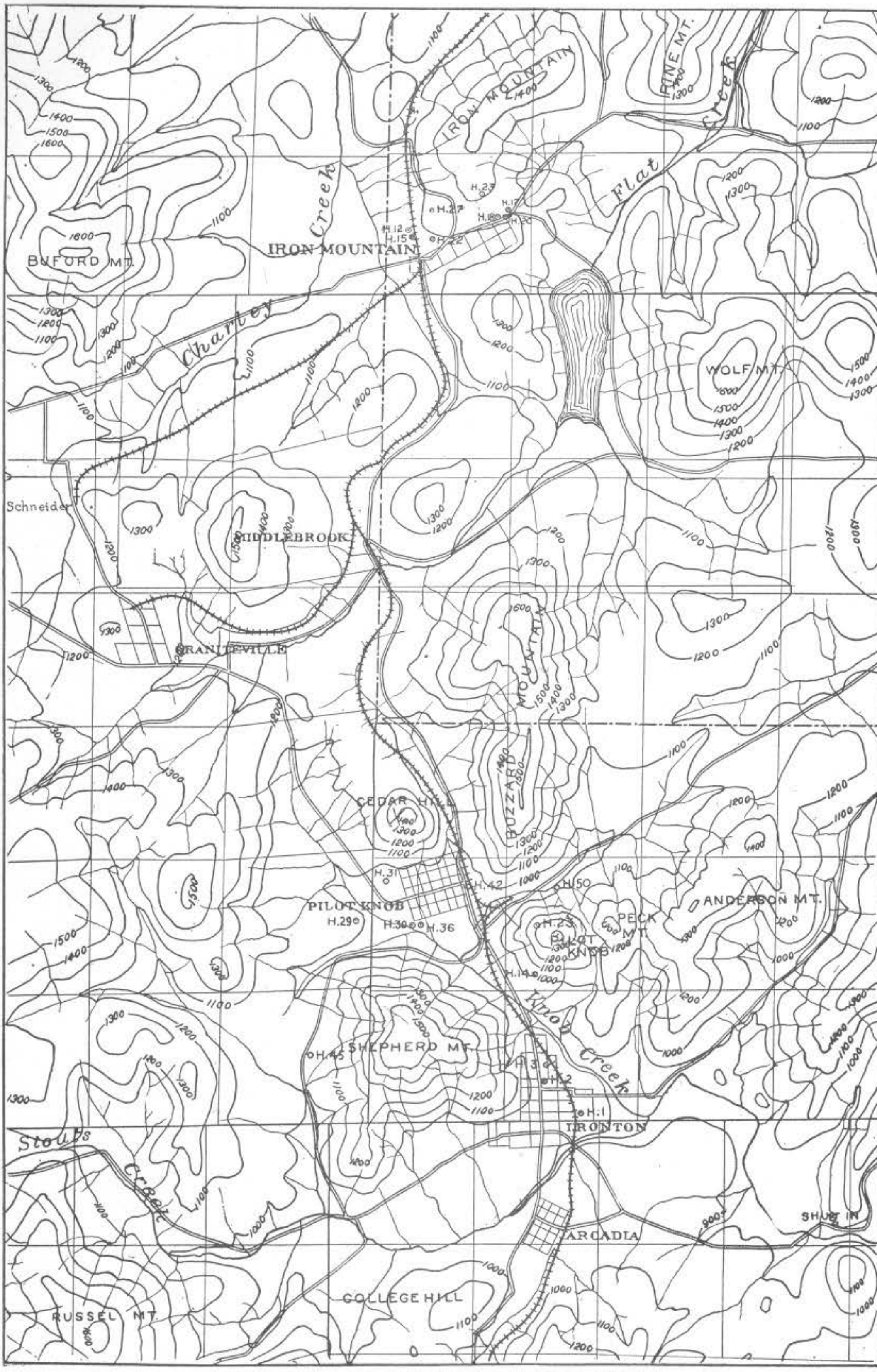
BEARING OF THE THEORY OF ORIGIN UPON FURTHER EXPLORATION.

According to the above theory, the ore deposits of commercial value are restricted largely to the area in which the Roubidoux sandstone is exposed and in which pre-Pennsylvanian sinks have been formed in the Gasconade and Roubidoux formations. While this area has not been mapped in detail, its outlines are fairly well known. The principal deposits have been confined to the central portion of the district, although it is probable, that deposits similar to the Leslie mine in Franklin county and the Red Ore Bank in Reynolds county may be found near the margins of the district. Since the deposits occur chiefly at or near the contact of the Gasconade and Roubidoux formations, prospecting should be restricted to the areas underlain by the latter. That portion of the district underlain by the Jefferson City or the Gasconade offers little encouragement for prospecting. Where the sink has been formed chiefly in the Gasconade formation, the deposit may be completely surrounded by limestone. Usually, however, some portion of the Roubidoux sandstone remains, indicating sink structures.

Since the deposits bear no definite relation to the topography there is no particular topographic position to be sought as an indication of their presence. The important surface indications are the dipping sandstone rim rock and the ore outcrop. The rim rock indicates sink structure and, even in the absence of outcrop, is considered the most favorable point for prospecting. The ore bodies are restricted to individual sinks, no two of which are known to be connected. Each deposit is a local concentration the form of which depends upon the outlines of the sink.

The size and general nature of the deposit cannot be judged by the outcrop which usually consists of blue specular hematite. While specular ore may predominate at the surface, the deeper ore may consist largely of red and brown hematite. The size of the deposit cannot be estimated by the outcrop alone. Some deposits do not outcrop, and in other cases strong outcrops, when prospected, have been found to be only the remnants of an eroded deposit. Due to the extensive erosion since the formation of the deposit, the surface ore may have migrated beyond the limits of the sink and, in part, indicate a false location of the ore body. Care should be taken that the sink structure be located and prospecting be restricted to within its limits. Detailed geologic mapping in Phelps county has shown the filled sinks to be of comparatively frequent occurrence and these structural features are probably much more common than has been generally supposed.

IRON MOUNTAIN-PILOT KNOB DISTRICT.



Scale, 1 inch = 1⅕ miles. Contour interval = 100 feet.

CHAPTER VII.

SPECULAR HEMATITE IN PORPHYRY.

GENERAL GEOLOGIC RELATIONS.

The commercial deposits of specular hematites of the St. Francois Mountain district are, in all cases, directly associated with the porphyry. Although the porphyry occurs throughout several counties, ore has been mined in large quantities at two localities only; Iron Mountain in St. Francois county, and Pilot Knob in Iron county. At Iron Mountain the ore occurs as irregular veins in the porphyry, and at Pilot Knob as a bedded deposit in porphyry. At both localities important quantities of boulder ore occur upon the surface and locally conglomerate ores, derived through the weathering of the original deposits, are found between the solid porphyry and the overlying Cambrian sediments.

Shepherd Mountain, near Pilot Knob, has produced important quantities of ore which occurs as veins in the porphyry. Cedar Hill and Russell Mountain have also produced some ore which occurs as seams in the porphyry in much the same relation as the ore at Pilot Knob.

Plate X is a topographic map of the Iron Mountain-Pilot Knob district.

The valley areas of the St. Francois mountains are occupied by sediments consisting chiefly of limestone and sandstone, and iron-ore-porphyry conglomerate. With the exception of the iron-ore-porphyry conglomerate, which is, in part at least, pre-Cambrian, all of the sediments so far recognized in this area are of Cambrian age, chiefly middle Cambrian.

In the northern and eastern parts of the district the LaMotte sandstone is well developed and is overlain by the full succession of formations up to and including the Potosi. Farther south, especially in the vicinity of Iron Mountain and Pilot Knob, the LaMotte is very poorly developed and in places entirely absent, the Bonneterre limestone lying directly upon the granite and porphyry, very little or no sandstone intervening. It is at the two last named localities that the iron-ore-porphyry conglomerate is known to occur. Still farther south in the vicinity of Des Arc, it is doubtful if any of the middle Cambrian formations exist, for in the vicinity of Leeper and Kerrigan, Roubidoux sandstone caps the ridges, while the Gasconade limestone fills the lowest valleys and lies in direct contact with the igneous rocks.

As already stated, about three-fourths of the igneous rocks of the St. Francois mountains consist of porphyry which is more generally exposed in the western than in the eastern portion of the district. The porphyry covers an area of about 300 square miles, and, weathering more slowly than the granite, gives rise to most of the higher mountains. Usually it is decidedly massive with no other structure than irregular lines of fracture, but locally it has a roughly bedded appearance, due to nearly parallel partings caused by flowage while the rock was still in a viscous state.

The various deposits of iron ore associated with the porphyry differ radically in physical characteristics and mode of occurrence. In the following pages each will be described and the possible source of future ore supplies indicated.

IRON MOUNTAIN.

Iron Mountain is the largest iron ore deposit in Missouri, and must, in large part, be credited for the reputation of this State as an iron ore producer. It has an accredited output of about 3½ million tons, exceeding its nearest rival, Pilot Knob, by about 2 million tons.

Iron Mountain proper, located in the N. ½ Sec. 31, T. 35 N., R. 4 E., is a low, conical hill projecting south from a larger and higher porphyry mountain on the north. It originally stood about 230 feet above the surrounding valley, its base covering an area of approximately 300 acres. To the southwest it slopes off gradually, forming what is known as Little Mountain. Figure 1, Plate XI, is a detailed topographic sketch of Big and Little Mountains, showing the present state of development.

The property was first opened in 1845, and, except for the year 1907, has been in continuous operation up to the present time. The largest annual production was 269,480 tons for the year 1872. During recent years the annual output has varied from 7,000 to 60,000 tons.

OCCURRENCE OF THE ORE.

The workable ore of Iron Mountain occurs at three distinct geologic horizons; including, (1) boulder ore embedded in the surface clay; (2) undisturbed vein ore extending to a considerable depth in the solid porphyry; and (3) conglomerate ore occurring in beds between the porphyry and the overlying Cambrian sediments. The accompanying cross-section through Big and Little Mountains shows the position of the several ore horizons and their relation to both the sedimentary and igneous rocks. See Fig. 2, Plate XI.

Boulder Ore: The boulder ore consists of large and small boulders of specular hematite embedded in variously colored red and yellow clays. The boulders were most abundant and largest near the crest of the mountain, becoming less frequent and smaller lower on the slopes. So completely did the ore bearing clays cover the surface that no rock of any kind was exposed, and this led to the belief that the entire Mountain was composed of similar materials. The boulder ore was the first to be worked, and only after it had been very largely removed, was the true nature of the deposit revealed. Upon the removal of this ore from the upper portion of the mountain, it was found to be underlain by a great vein of solid ore from which smaller veins radiate into the surrounding rocks. Later, by means of drilling, the conglomerate ore, lying between the porphyry and the Cambrian sediments, was discovered.

Vein Ore: The solid vein ore, which must be regarded as the parent mass from which both the boulder and conglomerate ores were derived, was best developed at Big Mountain. The rocks of the upper portion of the mountain exhibit everywhere the effects of extreme alteration. The main vein was 60 feet wide and was enclosed by decomposed porphyry containing a perfect network of smaller veins. It formed an inverted "U" enclosing a "horse" of porphyry which contained many irregular veins and masses of ore. The limbs of the arch were from 12 to 18 feet thick and extended downward into the solid porphyry to a depth of 150 feet, below which they became too narrow and too badly mixed with porphyry to be mined profitably. All that remains today to indicate the distribution, size, and shape of the larger veins are the numerous deep cuts which extend through the decomposed porphyry well down into the solid porphyry. See Fig. 2, Plate XI.

There is still considerable ore in the faces of the old openings. It occurs, for the most part, in nearly horizontal sheets or layers conforming in a general way to the rough flow-bedding of the porphyry. Occasionally they enlarge to irregular masses having considerable thickness; see Fig. 1. These seams vary in thickness, frequently pinching out to reappear within a few feet. At the time the property was visited, this ore was being mined at a number of points in both Big and Little Mountains. The ore frequently surrounds large and small masses of porphyry, indicating the replacement of the latter. (Fig. 3.) Locally it occurs in nearly vertical veins which exhibit comb structure, indicating fissure filling.

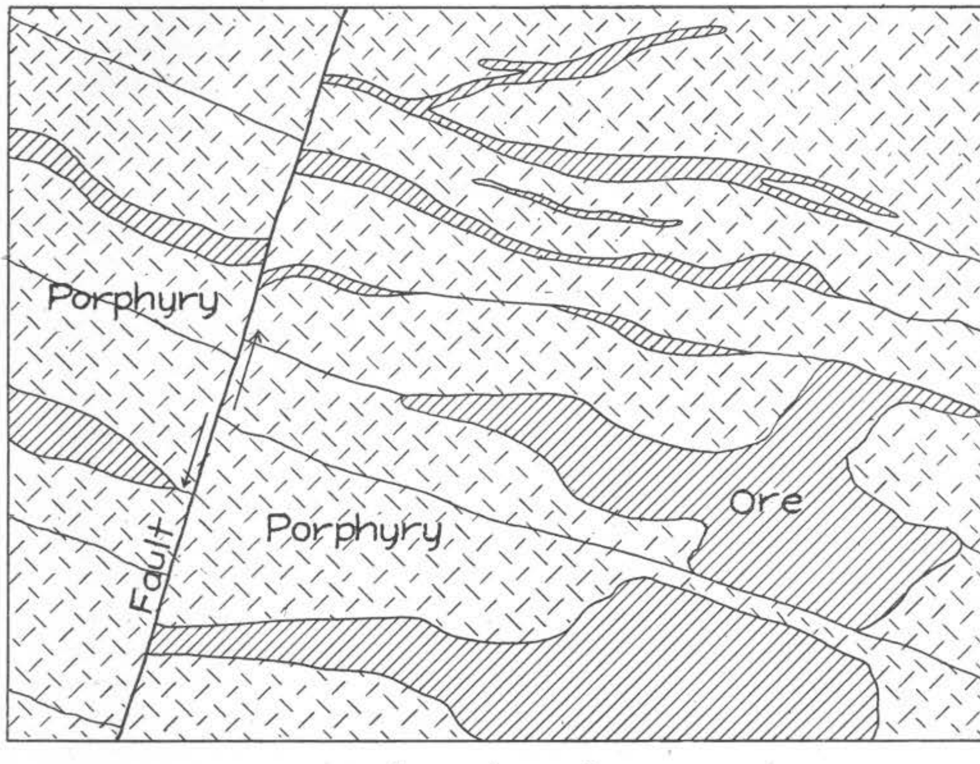


Fig. 2. Sketch of a portion of the north face of Big Mountain cut.

Occupying the position of the open cut at Little Mountain, there occurred a 30 to 40 foot vein of solid ore which dipped about 40° to the southwest and extended a distance of 360 feet down the slope and 420 feet along the strike. The ore rested upon a foot wall of brecciated porphyry which contained many small veins of ore carrying considerable tremolite. It was immediately overlain by an 8 to 10 foot bed of conglomerate ore which was in turn covered by the Cambrian limestone. Crossing the west end of the pit, in a northeast-southwest direction, is a nearly vertical dike of greenstone, varying from one to two feet in width. The greenstone cuts both the vein ore and the porphyry but not the conglomerate ore nor the Cambrian sediments. It is not so highly decomposed as the surrounding porphyry.

At present all that remains to indicate the shape and size of the main vein at Little Mountain is the deep cut which, at the time the property was visited, was flooded with water.

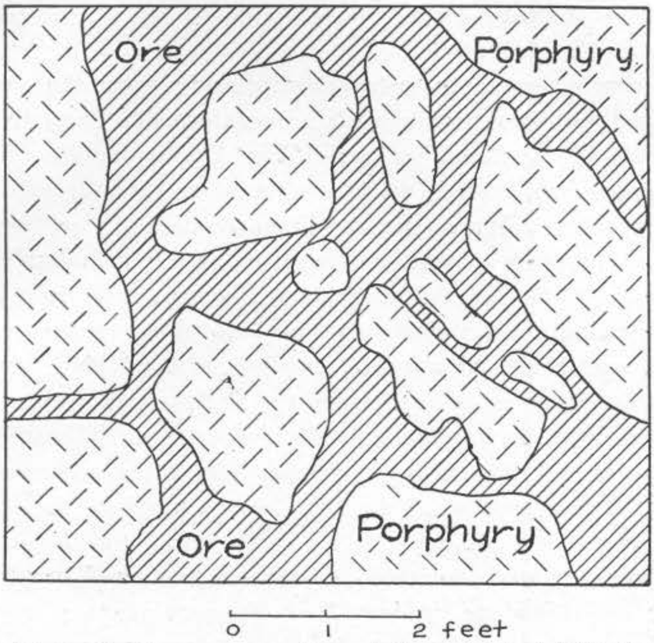


Fig. 3. Sketch showing the occurrence of ore at the east end of Little Mountain cut.

Conglomerate Ore: The conglomerate ore was the last to be discovered, and the last to be mined extensively. It occurs upon the east

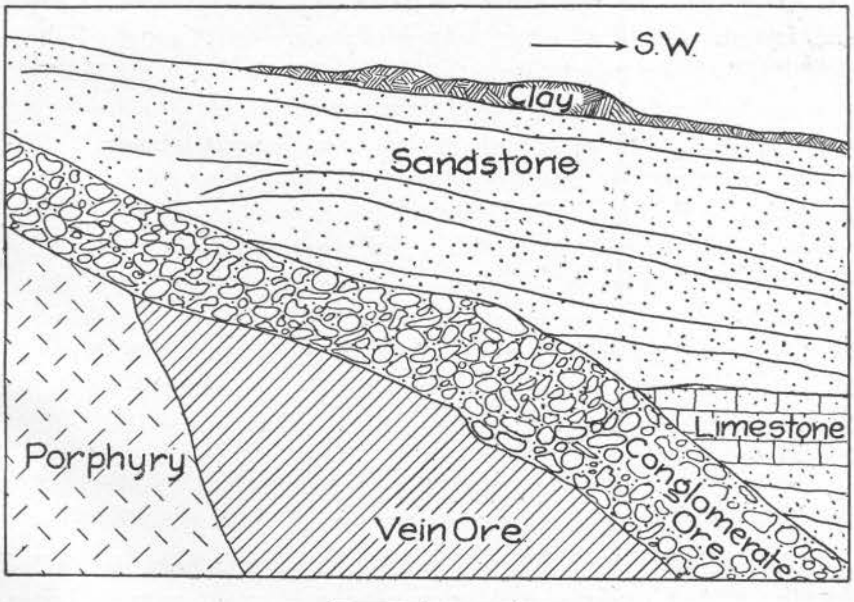


Fig. 4. Sketch showing the occurrence of the conglomerate ore at the east end of Little Mountain cut.

and southeast slopes of Big Mountain and upon the south and northeast slopes of Little Mountain. It has been worked by both open pit and underground methods at the places indicated on the accompanying contour map, Fig. 2, Plate XI.

The conglomerate ore rests unconformably upon the underlying vein ore and porphyry, and is overlain unconformably by sandstone and limestone of middle Cambrian age. (Fig. 4.) It consists of angular to sub-angular boulders and pebbles of specular hematite embedded in hard, gray arkose. Where exposed to weathering, the ore has become soft and bluish-black to dark red in color, and is then locally known as "black ore." The enclosing arkose weathers soft and light yellow in color, resembling a soft yellow sandstone. In places the ore was found to consist exclusively of angular boulders of hard blue hematite so firmly matted together as to resemble the undisturbed vein ore.

The ore boulders were undoubtedly derived from the weathering of the vein ore, and the enclosing arkose from the weathering of the porphyry. The general angular nature of the boulders, the absence of well rounded grains of sand in the material filling the interstices, together with its unconformable relation to the overlying Cambrian sandstone and limestone, indicate that the conglomerate ore is more largely the result of pre-Cambrian surface disintegration than of shore action during Cambrian time.

At Big Mountain the conglomerate ore has been worked for a distance of about 1200 feet along the strike and for a distance of about 1700 feet along the dip. The thickness of the ore varied greatly in both directions but particularly along the strike. This is due to the fact that it is confined chiefly to ravine-like depressions in the surface of the porphyry, and is cut out laterally by the rise in the underlying rock. The ore has a maximum thickness of 45 feet at a point about half way down the incline, at the lower end of which, it tapers to about seven feet. It is reported that the outlines of the present workings mark the limits of the workable conglomerate deposits. Only a few of the larger pillars have been removed, however, and it is evident that, in those remaining, there is still a considerable tonnage of available ore. At Little Mountain the conglomerate ore consists of a single bed 6 to 8 feet thick which has been worked for a distance of about 500 feet along the strike and 200 feet along the dip.

NATURE OF THE ORE.

Physical Characters: Iron Mountain vein ore is hard, crystalline hematite with a uniform steel gray color, and bright metallic luster, by which it may be distinguished from either the Pilot Knob or Shepherd Mountain ore. In texture, it is very dense with a mediumly coarse but close grained, massive crystalline structure, which, under the miscroscope, appears crystalline to lamellar. Cavities lined with drusy crystals of hematite occur but rarely, in which particular it is very different from the specular ore of the Central Ozark region.

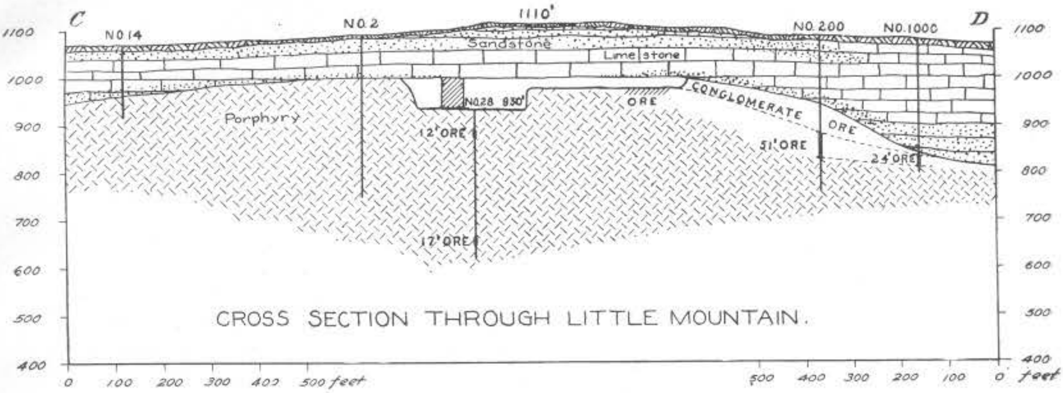


Fig. 5. Showing the southeast extension of conglomerate and vein ore.

All of the ore is slightly magnetic, some of it strongly so, due to irregular admixtures of magnetite. Locally, martite occurs abundantly in small octrahedral crystals embedded in a groundmass of hematite.

The mineral impurities are quartz, amphibole, and apatite. Iron sulphide does not occur. Quartz is not a common constituent of the larger veins, but occurs locally near the porphyry contacts and in the smaller veins where it fills small fissures and small irregular cavities in the ore. It is usually coarsely crystalline and sometimes forms drusy aggregates several inches in diameter.

Amphibole, in the form of tremolite, (calcium-magnesium silicate) is very common in the smaller veins. Near the porhpyry contacts it often becomes so abundant as to completely replace the ore.

Apatite, (calcium phosphate) is comparatively abundant. While it rarely occurred in the larger and thicker veins, it is a very common impurity in many of the smaller veins, particularly near the contact of the ore with the porphry. It occurs as hexagonal, flesh colored crystals which range up to three inches in length. The crystals are usually arranged approximately parallel with their longer axis nearly perpendicular to the wall rock, though they also occur in radial clusters. Where exposed to the leaching action of surface waters, the apatite has generally been removed from the ore.

Chemical Composition: The ore is a medium to high grade, specular hematite in which the iron ranges from 55% to 67%. Silica varies inversely as the iron, up to about 12%. Phosphorous is present in amounts up to 0.3%, depending upon the source of the ore. The vein ore in the porphyry, especially that filling the small fissures is, in general, much higher in phosphorus than the boulder and conglomerate ores. The latter, though originally derived from the vein ore, have been thoroughly leached of their phosphorus, and are uniformly within the bessemer limit. Sulphur is invariably low, the ore being almost free frm that element.

The following table, which is taken from the report of 1892, represents average analyses of the various ores shipped from Iron Mountain during the year ending March 31st, 1892:

TABLE NO. XXII.

No.	Iron.	Silica.	Phos.	Kind of Ore.*	Number analyses averaged.	Number tons represented.
1	65.68	3.91	0.026	Surface jigged	14	2,188
2	66.51	3.80	0.020	Surface lump	15	2,378
3	62.19	6.60	0.028	Soft jigged, Shaft No. 1	20	9,969
4	63.79	4.92	0.093	Soft jigged from inclines Nos. 1 and 2	11	7,579
5	63.08	6.11	0.060	Soft jigged, Shaft No. 1 and incline No. 1	4	2,450
6	65.13	4.47	0.034	Soft lump ore, shaft No. 1	25	7,536
7	62.50	6.40	0.038	Soft jigged ore, shaft No. 1	34	14,018
8	62.81	6.46	0.063	Soft jigged ore, shaft No. 1, incline No. 1	3	921
9	63.68	4.87	0.070	Soft jigged ore, incline No. 2	27	7,008
10	61.45	7.12	0.105	Furnace jigged ore	39	3,291
11	55.22	11.68	0.026	No. 2 Bluff ore, shaft No. 2	14	3,327
12	63.00	5.86	0.389	No. 2 Bluff ore from upper S. E. mine	4	693
13	59.64	8.69	0.226	No. 2 Bluff ore from west and upper S. E. mine	8	3,177
14	66.80	2.51	0.058	Soft lump ore, incline No. 3	4	....
15	65.75	4.08	0.095	Soft lump ore, incline No. 2	1	90
16	64.12	5.44	0.013	Special ore, shaft No. 2	8	1,624

ORE RESERVES.

Among the possible sources of a future ore supply at Iron Mountain may be considered the surface boulder ore in clay, of which a considerable tonnage still exists upon the lower slopes of the mountain. Re-

*Surface lump and surface jigged ores are those obtained from the surface clays. Soft ore is from the conglomerate beds. Bluff ore is from the solid veins in porphyry.

Shaft No. 1 is in the conglomerate ore deposit on the east side of Big Mountain. Shaft No. 2 is on the west side of Little Mountain. Incline No. 1 is in the conglomerate ore on the northeast side of Big Mountain. Incline No. 2 connects with Shaft No. 1. Incline No. 3 is in the conglomerate ore at Little Mountain.

cently, the area in which this ore occurs has been systematically prospected, and preparations have been made to mine it by hydraulic methods.

The numerous pillars of conglomerate ore, still effectively supporting the roof of the underground workings at both Big and Little Mountains, may be considered another important source of ore. These pillars vary from 7 to 45 feet in height, and their number and size, as shown on the accompanying topographic map, indicate that they represent a considerable reserve. There is a possibility of the lateral extension of the old underground workings, for these were abandoned at a time when only comparatively rich ore was mined. In addition to the above, new developments of conglomerate ore in the vicinity of Little Mountain indicate a considerable reserve on that portion of the property. Test pits have shown the outcrop of this conglomerate to lie immediately below the surface clays both to the east and to the northwest of the Little Mountain cut, while drill holes Nos. 100 and 200, put down to the southeast of Little Mountain, show respectively 18 and 77 feet of conglomerate ore between the sandstone and the porphyry, indicating that the limits of this ore horizon have not been fully determined.

There is also a considerable tonnage of ore to be obtained from the old dumps. Such ore may be recovered in part by hand picking and in part by crushing and jigging.

At the present time ore is being mined from the smaller veins found in the porphyry bluffs at both Big and Little Mountains. Such veins are particularly abundant in the broken porphyry forming the walls of the pits from which the larger veins were removed. Though small, exceedingly irregular in shape, pinching and swelling suddenly, and generally of short duration, they usually reappear at intervals so frequent that they can be mined at a profit. The possibility of ore being derived from this source is indicated by the results of diamond drilling in the foot wall of the big pit at Little Mountain. Each of the three holes, Nos. 28-A, 28-B, and 27-A, the locations of which are shown upon the topographic map and general cross-section, cut considerable ore. These holes were drilled by the old Iron Mountain Company, and in the original records are described as follows:

Hole No. 27-A (Iron Mountain).

On north bluff of Little Mountain; drilled vertically; elevation of collar 1084 feet:

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		2		2		No. 2 ore.
2		4		2		Porphyry.
4		6	6	2	6	No. 2 ore.
6	6	32		25	6	Porphyry.
32		34		2		Ore and porphyry.
34		46		12		Porphyry.
46		48		2		No. 2 ore.
48		59		11		Porphyry.
59		60		1		No. 3 ore.
60		96		36		Porphyry.
96		99		3		No. 3 ore.
99		106		7		Porphyry.
106		111		5		Ore and porphyry.
111		224		113		Porphyry mixed with ore.
224		229		5		No. 3 ore.
229		237		8		Porphyry.
237		238		1		No. 3 ore.
238		239		1		Porphyry.
239		240		1		No. 2 ore.
240		244		4		Mixed ore and porphyry.
244		275		31		Porphyry.
275		277		2		Mixed ore and porphyry.
277		298		21		Porphyry.
298		303		5		Mixed.
303		306		3		Porphyry.
306		307		1		No. 3 ore.
307		312		5		Mixed.
312		315		3		No. 2 ore.
315		331		16		Porphyry.
331		332	6	1	6	Porphyry and ore.
332	6	350		17	6	Porphyry.
350		351		1		No. 2 ore.
351		356		5		Porphyry.
356		357		1		No. 2 ore.
357		362		5		Porphyry.
362		363		1		Porphyry and ore.
363		365		2		Porphyry.
365		366		1		Porphyry and ore (half and half).
366		373		7		Porphyry.
373		374		1		Porphyry.
374		398		24		Porphyry.
398		403		5		No. 2 ore mixed with hornblende.
403		413		10		Hard clay from dike.
413		423	6	10	6	No. 2 ore mixed with hornblende.
423	6	424	6	1		Porphyry.
424	6	425		0	6	No. 2 ore.
425		432		7		Porphyry.
432		434		2		No. 2 ore.
434		443		9		Porphyry.
443		465		22		No. 2 ore.
465		594		129		Porphyry and ore.

Hole No. 28-A (Iron Mountain).

Bottom of pit at Little Mountain; drilled vertically; elevation of collar 930 feet:

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		4		4		Porphyry.
4		5	6	1	6	No. 1 ore.
5	6	40		34	6	Porphyry.
40		52		12		No. 1 ore.
52		55		3		Ore and porphyry.
55		62	6	7	6	Porphyry.
62	6	63		0	6	No. 1 ore.
63		171	6	108	6	Porphyry.
171	6	172		0	6	No. 1 ore.
172		266		94		Porphyry.
266		272		6		No. 1 ore.
272		273		1		Porphyry.
273		277	6	4	6	No. 1 ore.
277	6	278		0	6	Porphyry, red.
278		280		2		No. 2 ore.
280		280	6	0	6	Porphyry.
280	6	282		1	6	No. 2 ore.
282		305		23		Ore and porphyry mixed.
305		305	6	C	6	No. 1 ore.
305	6	306		0	6	Porphyry.
306		307		1		No. 2 ore.
307		308		1		No. 1 ore.
308		316		8		Porphyry.

Hole No. 28-B (Iron Mountain).

Bottom of pit at Little Mountain; inclined 45° northeast towards No. 27-A; elevation of collar 930 feet:

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		7	6	7	6	Porphyry.
7	6	9	6	2		No. 1 ore.
9	6	11	6	2		Porphyry.
11	6	12		0	6	No. 1 ore.
12		14		2		Porphyry.
14		21	6	7	6	No. 1 ore.
21	6	24		2	6	Porphyry.
24		24	6	0	6	No. 1 ore.
24	6	26	6	2		Porphyry.
26	6	28	6	2		No. 1 ore.
28	6	32		3	6	Porphyry.
32		33		1		No. 1 ore.
33		35		2		No. 2 ore.
35		38		3		Porphyry.
38		39	6	1	6	No. 2 ore.
39	6	42		2	6	Porphyry.
42		155		113		Mixed ore and porphyry.

Hole No. 28-B (Iron Mountain)—Continued.

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
155		156		1		No. 1 ore.
156		217		61		Porphyry.
217		231		14		Hard clay from dike.
231		248		17		Porphyry.
248		250		2		No. 2 ore.
250		338		88		Porphyry.
338		341		3		No. 2 ore.
341		350		9		Porphyry.
350		357		7		No. 1 ore.
357		373		16		Hard clay dike E. and W.
373		382		9		No. 2 ore.
382		384		2		Hard clay dike.
384		388		4		No. 1 ore.
388		394		6		No. 2 ore.
394		396		2		No. 3 ore.
396		398		2		Porphyry.
398		400		2		No. 2 ore.
400		402		2		Porphyry.
402		404		2		No. 2 ore.
404		408		4		Porphyry.
408		408	6	0	6	No. 2 ore.
408	6	410		1	6	Porphyry.
410		411		1		No. 1 ore.
411		420		9		Porphyry.
420		421		1		No. 2 ore.
421		434		13		Porphyry.

Fig. 1, Plate XII, shows the above holes platted to scale.

In addition to the above a 15-foot ledge of solid bluff ore has been disclosed by recent developments at the foot of the underground incline at the east end of Little Mountain.

Three diamond drill holes, numbered 100, 200, and 1000, drilled in the vicinity of the old office building during the summer of 1910, showed the following results:

Hole No. 100 (Iron Mountain)

Elevation of collar approximately 1070 feet.

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		12		12		Clay.
12		70		58		Sandstone.
70		139		69		Limestone.
139		180		41		Shale and clay.
180		226		46		Soft conglomerate.
226		244		18		Ore and conglomerate.
244		275		31		Porphyry with occasional seams of ore.

HOLE NO. 100 (Iron Mountain)—Continued.

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
275		278		3		Porphyry.
278		352		74		Porphyry with small seams of ore (5-inch max.).
352		357		5		Ore.
357		361	10	4	10	Porphyry.
361	10	368	10	7		Ore, 50%.
368	10	376		7	2	Porphyry.
376		379	5	3	5	Ore and 11-inch porphyry mixed.
379	5	380	7	1	2	Porphyry.
380	7	382	7	2		No. 2 ore.
382	7	385	7	3		Porphyry.
385	7	392		6	5	Porphyry and ore mixed.
392		399		7		Porphyry.

Hole No. 200 (Iron Mountain).

Elevation of collar approximately 1085 feet.

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		21		21		Clay.
21		30	6	9	6	Blue limestone.
36		75		44	6	Sandstone.
75		121		46		Limestone.
121		123		2		Conglomerate.
123		131	6	8	6	Sandstone.
131	6	132	6	1		Sandstone and ore, equal parts.
132	6	134	6	2		Sandstone.
134	6	137	6	3		Ore and conglomerate, equal parts.
137	6	138	6	1		Conglomerate.
138	6	139		0	6	Sand.
139		141	5	2	5	Ore and conglomerate, equal parts.
141	5	143	5	2		No. 1 ore.
143	5	151	10	8	5	Ore and conglomerate.
151	10	216	4	64	6	One-third boulder ore and two-thirds conglomerate, mixed.
216	4	225		8	8	Ore, 61% Fe (Bluff ore).
225		231		6		Ore, 57% Fe (Bluff ore).
231		234		3		Ore, 55% Fe (Bluff ore).
234		237		3		Ore, 47% Fe (Bluff ore).
237		240		3		Ore, 59% Fe (Bluff ore).
240		243		3		Ore, 45% Fe (Bluff ore).
243		247		4		Ore, 66% Fe (Bluff ore).
247		267		20		Ore, 61.5% Fe (Bluff ore).
267		274		7		Porphyry.
274		278		4		Ore and porphyry mixed.
278		320		42		Ore and porphyry mixed.
320		332		12		Porphyry (barren).

The above iron determinations are from analyses of the whole of the core for each division.

Hole No. 1000 (Iron Mountain).

Elevation of collar approximately 1080 feet.

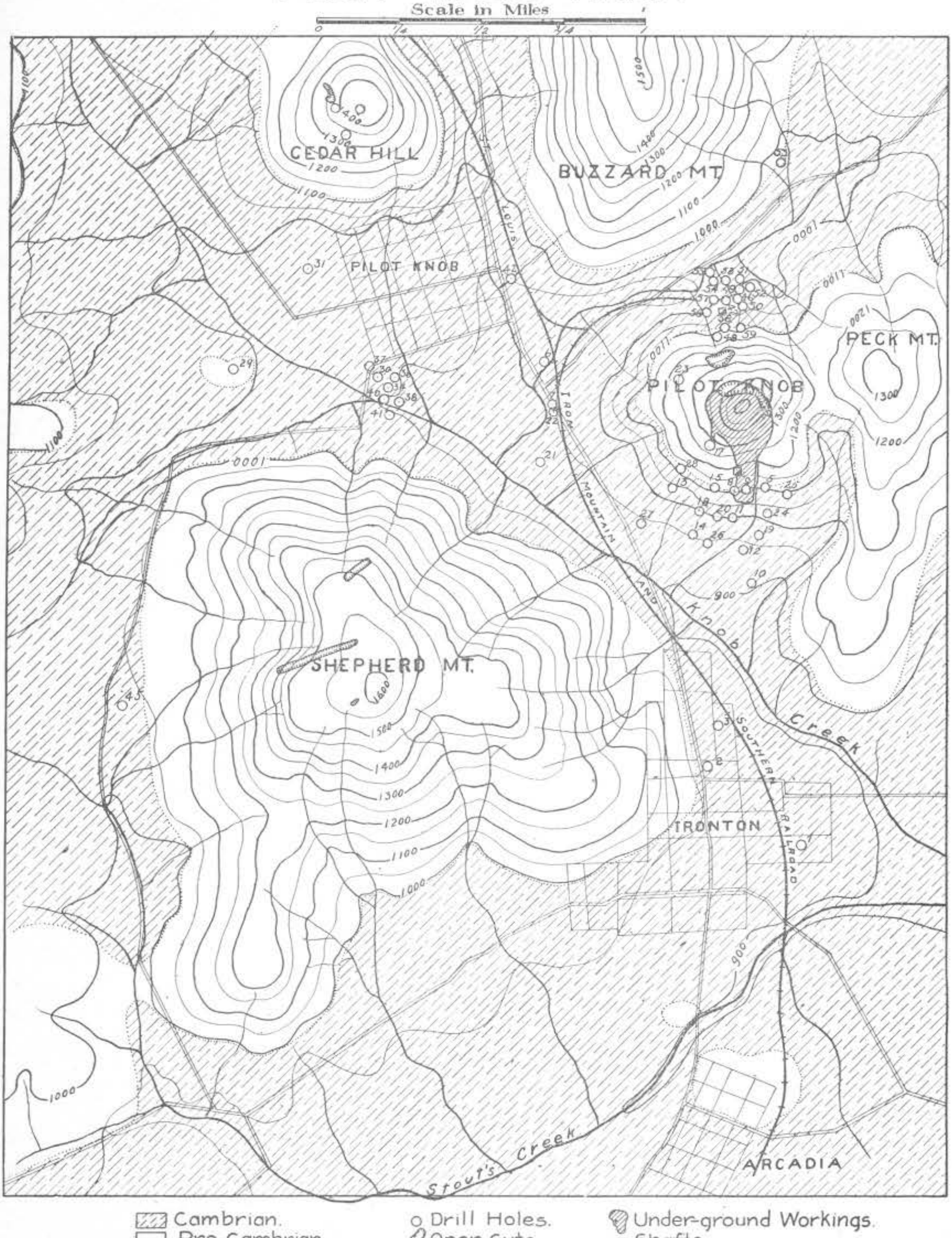
From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		17		17		Clay.
17		138		121		Limestone.
138		185		47		Limestone and conglomerate.
185		242		57		Chocolate and pink sand.
242		245		3		Sand and ore mixed.
245		248	6	3	6	Sandstone conglomerate.
248	6	250		1	6	Ore, 56% Fe (estimated).
250		252		2		Ore, 52% Fe (estimated).
252		255		3		Ore, 50% Fe (estimated).
255		260		5		Ore, 49% Fe (estimated).
260		264	6	4	6	Ore, 45% Fe (estimated).
264	6	266		1	6	No core.
266		271		5		Ore, 45% Fe (estimated).
271		272		1		Ore, 53% Fe (estimated).
272		284		12		Conglomerate and broken porphyry.

In the accompanying Fig. 2, Plate XII, these holes have been platted to scale.

The three holes, above described, indicate a considerable thickness of conglomerate ore although they do not form a sufficient basis for a tonnage estimate. It will be noted that the 50 feet and 8 inches of solid vein ore encountered in hole No. 200 occurs very much in the same manner as that mined from the Little Mountain pit, in that it lies directly between the conglomerate ore and the solid porphyry. This similarity of position suggests that the two occurrences may be parts of the same ore body. Their relation, however, can be determined only by drilling the intermediate area. The abrupt ending of the ore in the big vein at Little Mountain, the unexpected appearance of the bluff ore at the bottom of No. 3 incline, together with the presence of broken ground along the line of the southwest edge of the Little Mountain workings, points to the possible influence of faulting in the distribution of the ore. The flooded condition of the mine at the time it was visited did not permit of direct observations on this point.

The connecting ridge between Big and Little Mountains has been generally regarded as barren of ore, but it is worthy of note that it has been only partially prospected. The only drilling on record is that of holes No. 29-A, 29-B, and 29-C drilled from a point about 300 feet north of the Little Mountain pit. These holes showed no workable ore but they can not be said to have effectively tested the large area in question.

PILOT KNOB AREA



GEOLOGIC MAP OF PILOT KNOB AND VICINITY. CONTOUR INTERVAL = 50 FEET.

PILOT KNOB.

Pilot Knob is located in the S. ½, Sec. 29, T. 34 N., R. 4 E., about five miles south and slightly east of Iron Mountain. It ranks second in the production of iron ore, having an accredited output of approximately 1,580,000 tons. According to Prof. W. B. Potter, "it was first entered in 1835" but active mining did not begin until as late as 1848, at which time the first Pilot Knob furnace was built. From that date the property was worked almost continuously until 1890, when the old mine was abandoned as worked out. Between 1890 and 1893 some ore was shipped from the old dumps and an unsuccessful attempt was made to wash the soft, conglomerate ore occurring on the north flank of the mountain. With the failure of this washing project the property was abandoned until the latter part of 1910 when it was leased by the Puxico Iron Company. Early in February of the following spring, the cut in the conglomerate ore was reopened and active mining operations are again under way.

Before attempting to describe the present condition of the property and the possible ore reserves, the essential geologic features of the area and the general nature of the original ore bodies will be outlined. Plate I shows the geology and topography of the Pilot Knob area.

GEOLOGY.

Pilot Knob is a nearly circular, cone-shaped, porphyry mountain of the type so generally characteristic of the St. Francois district. Except for a low, narrow neck of porphyry connecting it with a range of mountains on the east, it stands alone, nearly surrounded by Cambrian sediments. It has a basal diameter of three-quarters of a mile and rises about 600 feet above the surrounding valley, attaining an elevation of approximately 1500 feet above tide. Fig. 1, Plate XVIII is a general view of Pilot Knob taken from near the crest of Cedar Hill.

To the north, across a narrow valley is Buzzard Mountain, on the northwest is Cedar Hill, on the southwest is Shepherd Mountain, and on the east and southeast are other mountains all of which are composed of compact, reddish brown porphyry which does not differ essentially from that constituting the lower portion of Pilot Knob.

The accompanying Plate XIV, which is a north and south cross-section, shows the geologic structure and distribution, also the occurrence of the various ore horizons at Pilot Knob. It will be noted that geologically these horizons are in part similar to those described at Iron Mountain; viz.: (1) capping the crest and southern slope of the mountain is the original iron bearing formation at the base of which occurred the great ore bed now represented by the abandoned workings of the old mine; (2) lying between the solid porphyry and the Cambrian sediments and extending up the northern slope of the mountain, are beds of conglomerate ore; and (3) overlying both limestone and porphyry is surface boulder ore embedded in residual clay.

THE IRON BEARING FORMATION.

The original iron bearing formation is best exposed in the big cut near the crest of the mountain where it has a maximum thickness of about 140 feet. Occupying the southern slope, the formation dips at angles varying from 15 to 45°, in a general southwesterly direction, to and beneath the Cambrian limestone. It consists of a variety of porphyritic and iron bearing beds, representing all stages of gradation from a high grade, thinly laminated, specular hematite on the one hand, to a coarse, porphyry breccia or massive, red porphyry on the other.

The formation consists of four distinct lithologic divisions between which there are zones of transition. These divisions, in descending order, are:

(1) Ferruginous porphyry breccia (formerly called conglomerate) approximately 100 feet thick.
(2) Upper ore bed, 10 to 20 feet thick.
(3) Lower ore bed, 6 to 30 feet thick.
(4) Foot-wall porphyry.

The Foot Wall: The underlying or foot-wall porphyry outcrops in a rim along the north and east sides of the hill but is best exposed by two cuts which enter the old mine from the east, disclosing a section of 40 feet.

At a point about 70 feet below the lower bed of ore on the north slope, there is a massive outcrop of roughly bedded porphyry which weathers to a rough, spherulitic surface and is described by Haworth as a devitrified pearlite.

Interbedded with the massive porphyry at a point 20 feet below the lower ore level, there is a six inch layer of fine grained, banded rhyolite which exhibits slaty structures similar to those found in the main ore bed. This bed contains no visible hematite. Aside from the above, there is no essential difference in the character of the rocks of the footwall, the remainder consisting of dark brown to red quartz porphyry (rhyolite) which, in places, is somewhat brecciated. For the

Fig. 1. Porphyry breccia, Pilot Knob. Showing fragmental nature, bedding and jointing.

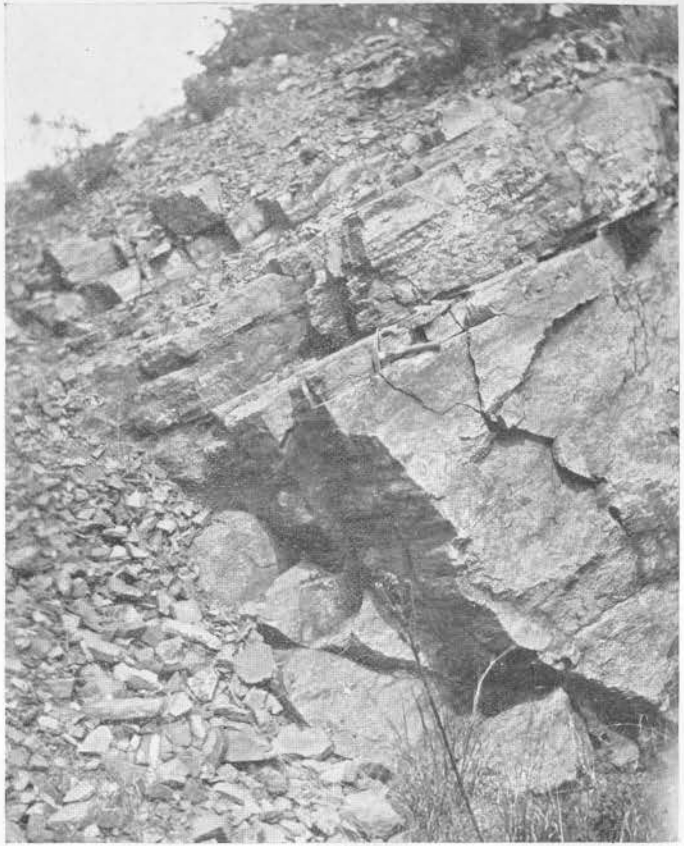


Fig. 2. Foot wall contact, east side Pilot Knob. Showing conformity of bedding.

most part, it is massive in character with a rough bedding, due to flowage, which becomes more pronounced toward the iron ore contact. In a number of instances, this bedding is well developed down the dip but dies out and disappears in the massive porphyry toward the outcrop. The contact with the overlying ore bed is not abrupt, but grades upward by means of 2 to 3 feet of alternating thin beds of banded iron bearing rock and porphyry breccia. Plate XV, Fig. II is a photograph of the foot wall, in which the position of the hammer marks the point of transition from the massive porphyry to the overlying finer grained iron bearing beds. Overlying the massive porphyry, is a five-inch bed of fine grained, banded ore which becomes finer grained and more distinctly banded down the dip but toward the outcrop, grades into massive and but slightly ferruginous brecciated porphyry. Above it is a 14-inch bed of somewhat brecciated, ferruginous porphyry containing irregular stringers of fine grained iron bearing rock. At a number of places in the big cut, this rock contains many small inclusions of white barium sulphate which gives it a flecked appearance. Where exposed to weathering, the barite has been leached, leaving small irregular surface cavities. The breccia grades rapidly upward into thinly stratified and, in places, distinctly ripple marked iron ore which constitutes the main ore bed.

This vertical gradation is shown at other points in the big cut. Where the ore has been removed down to the transition bed, the foot wall is often very irregular. In this transition from a massive, igneous rock to one bearing many of the characteristics of a sediment, there is complete conformity as to bedding, and a total absence of sand or other water worn detrital material, either in the iron formation or between it and the underlying porphyry.

The Lower Ore Bed: The lower or great ore bed was worked out in 1889, and its position is now occupied by the abandoned workings of the old mine. Only an occasional pillar of ore was left standing, two of which may be seen at Tunnel No. 2, and a third in the face of the big pit.

The ore consists of a very hard, compact, specular hematite of a bluish steel gray color. It is exceedingly fine grained and characterized by a thin lamination or bedded structure which gives it the capacity to part readily into thin flags. It also breaks into polygonal blocks due to innumerable, nearly vertical joints. At several points in the big cut and in Tunnel No. 1, the lower portion of the ore bed is distinctly ripple marked, and at one place bears well defined rain prints.

The mineral impurities consist of quartz, feldspar, and barite. Quartz and feldspar occur in minute, irregular grains, very evenly disseminated through the ore, and are probably original constituents. Barite occurs cementing joints and bedding planes in the ore and as small crystals lining cavities in the associated rocks. It is light pink in color and certainly of secondary origin. Pyrite and apatite do not occur in visible quantities, and the ore is uniformly low in both sulphur and phosphorus.

In the vicinity of Tunnel No. 1 the ore had a maximum thickness of 30 feet, from which point it became thinner both along the strike and dip. As shown in Plate XIII the mine has a maximum east and west diameter of about 900 feet and a north and south diameter of 1500 feet. The workable ore was limited on the north and northeast, by the outcrop, and on the east, south, and west, in part by thinning but chiefly by grading into porphyry breccia. The face of the incline at the lower end of the mine, showed a considerable thickness of iron bearing material, but with the exception of 18 inches near the foot-wall, the ore was too lean to pay. At No. 2 tunnel, the ore had a thickness of about 10 feet and may be seen grading laterally through a ferruginous, porphyry breccia into a massive, dark red porphyry of a normal character, the complete change taking place within a horizontal distance of about 100 feet.

The "Clay Seam": The division between the upper and lower ore beds is well marked in the upper part of the mine by what has been called the "clay seam." This seam is a shearing zone which varies from one to three feet in thickness. In the face of the big cut where it is best exposed it consists of the following materials:

1 inch—Soft, light colored, talcose material.

2 inches—Fine grained, thinly banded, chocolate colored rock.

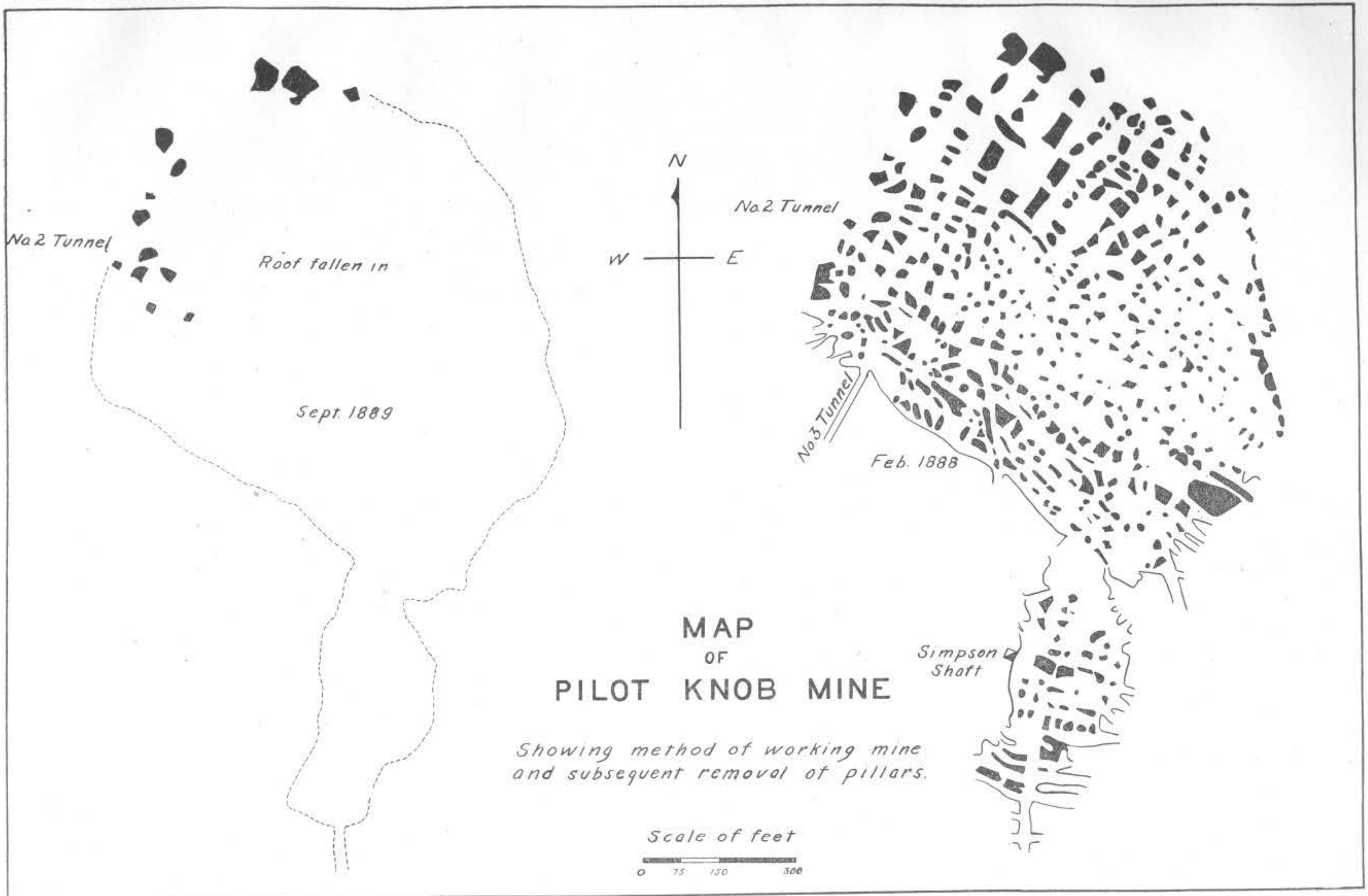
2 inches—Gray, talcose material which is thinly laminated and shows "S" shaped lines of shear crossing the laminae.

8 inches—Somewhat altered, ashy gray rock occurring in a single bed; not noticeably banded.

4 inches—Soft, gray, talcose material which is thinly laminated with shearing structures like those above.

2 inches—Soft, thinly banded rock lying directly upon the main ore bed.

Thirty feet north of where the above section was made the seam is about three feet thick. It thickens by encroaching upon the thin beds of the overlying, banded ore which, in places, is also reduced to a soft, gray, talcose material. Usually both above and below this



SHOWING OUTLINES OF THE WORKABLE ORE BODY AND THE AREA WHICH HAS SUBSEQUENTLY CAVED. FROM DRAWINGS BY W. B. POTTER.

seam there is a zone of gradation into the ore. This zone varies from 6 to 10 inches in thickness. Wherever softened, the rock has the shearing structure which slopes with the dip.

The seam probably represents the decomposition of a stratified tuff along a shearing zone. The horizon bears evidence of having been a water channel, which probably accounts for the decomposition. At No. 2 tunnel crystalline quartz occurs in layers as though lining cavities in the seam. At this place the seam pinches out and disappears along the strike and is lost in the massive porphyry. The following are analyses of the soft, loose material and the harder, talcose layers:

Substance.	Soft, clayey material.	Hard, talcose material.
SiO_2	50.21	46.27
Al_2O_3	25.77	28.86
Fe_2O_3	11.85	9.96
MgO	0.87	1.09
CaO	None	None
Na_2O	0.76	1.47
K_2O	3.93	6.14
H_2O+	4.54	3.42
H_2O-	0.15	0.06
Sul	None	None
Total	98.08	97.27

The similarity of the softer and harder materials is well shown by the above analyses. The softer material has no doubt been derived through the partial decomposition of the harder. At no place has the horizon been found to be ore bearing.

The Upper Ore Bed: The upper ore bed, as exposed in the big cut, has a thickness of from 20 to 30 feet. The lower portion of the bed is only slightly lower grade than the upper portion of the main ore bed, but grades upward into a massive, ferruginous breccia. The rapidity of the upward transition varies from place to place. At No. 2 tunnel the upper ore bed is entirely absent, the ferruginous breccia lying directly above the "clay seam." This ore is best developed near the eastern end of the big cut where, in places, it is abnormally thick. Similar ore outcrops near the crest of the hill at a point approximately 90 feet above the main workings. There appears, however, to be coarse breccia between this outcrop and the underground workings. Apparently the banded ore may occur locally anywhere in the coarser, ferruginous breccia.

The ore of this bed, as exposed in the face of the big cut (see

Plate XVII, Fig. 2), is a thinly banded, fine grained, bluish gray hematite, ranging from 45% to 50% iron and from 15% to 20% silica. Its highly silicious character is due to the presence of thin seams of porphyry breccia and to disseminations of minute, irregular grains of quartz and feldspar. The uniform distribution of the silicious materials along lines parallel to the bedding gives the ore its banded appearance. Many of the bedding planes, which are well developed in this ore, exhibit regular undulations resembling ripple marks for which they may well be taken in the presence of the unquestionable ripple marks in the lower ore bed. The thin seams of breccia become thicker and more frequent in the upper portions of this horizon, resulting in a gradual and irregular upward transition into a ferruginous porphyry breccia.

The Porphyry Breccia: The porphyry breccia is typically exposed in the face of the big cut where it has a maximum thickness of about 100 feet. Its thickness varies from place to place due to the irregular upward extension of the banded ore.

The most characteristic phase of the breccia consists of angular to sub-angular fragments of light colored porphyry and felsite embedded in a fine grained, dark colored, silicious hematite matrix. The weathered surface shows the fragmental inclusions more plainly than fresh fractures. The fragments vary in size from minute, feldspathic crystals up to boulders 12 inches in diameter. They consist entirely of porphyritic materials with no pebbles of iron ore such as characterize the conglomerates at Iron Mountain, the iron being confined entirely to the matrix. The included fragments are themselves often brecciated, and are usually bounded by irregular, ragged outlines. Many of them show the effect of magmatic corrosion while others are broken or drawn out into distorted and thinly tapering masses. Long, lath-shaped crystals of feldspar are not uncommon in the finer phases of the rock. Where flowage lines are best developed the included fragments occur with their diameters nearly parallel to the bedding, the lines of flowage passing around them exactly as may be observed in the breccia at Cedar Hill and other parts of the district, where their igneous origin has not been questioned. Where the rock is more massive, the fragments occur with their greater diameters tilted at all angles to the bedding and to each other, there being a total absence of the sorting effect of water. The breccia appears to grade vertically and laterally through blue and brown, slightly brecciated, ferruginous porphyry into normal red porphyry. The evidence of a change of this character is had in the outcropping porphyry upon the south slope in the vicinity of the Simpson and the old air shafts. Near the latter, much of the porphyry is of the normal red type. That the breccia also

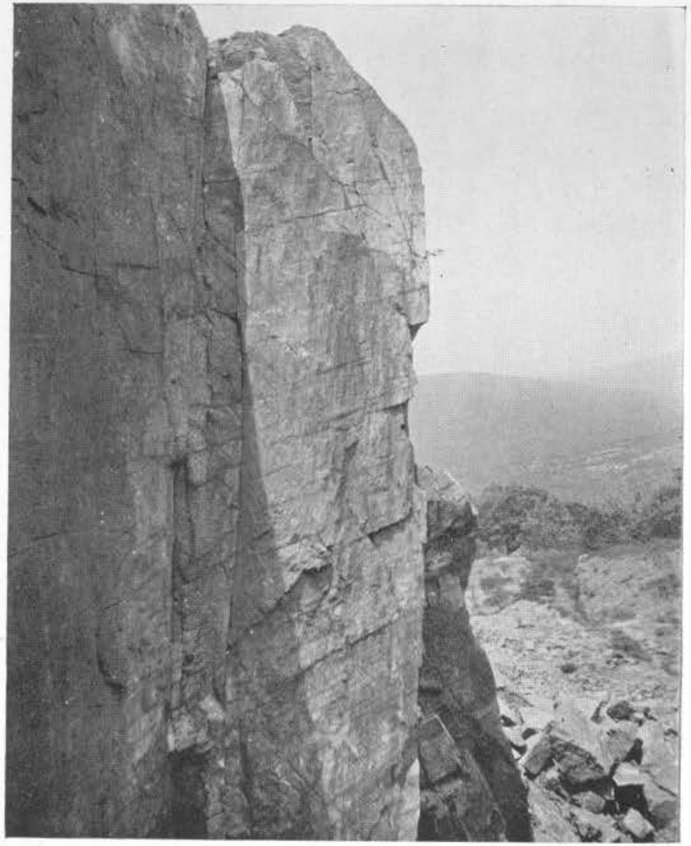


Fig. 1. Bluff of Pilot Knob breccia showing columnar jointing, bedding, and inclined joints.

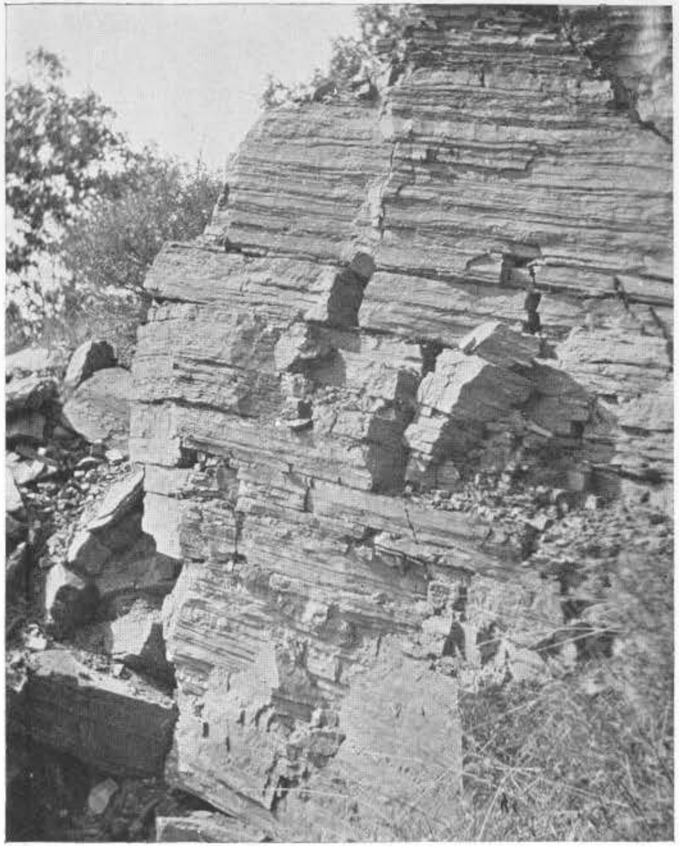


Fig. 2. Upper ore bed, Pilot Knob. Weathered face, showing banded slaty structure.

grades laterally into normal and but slightly brecciated porphyry, has been shown by the numerous drill holes to the east, south, and west of the old workings. Fig. 1, Plate XV, shows the fragmental nature of the breccia.

Structure: As already mentioned, the iron bearing beds dip in a general southwesterly direction to and beneath the Cambrian limestone, the only point of outcrop being that near the crest of the Knob. The formation has the form of a pitching trough, as is indicated by the following measurements taken at intervals of about 200 feet along the foot wall from the extreme west end to the extreme southeast end of the big cut.

Dip	15°,	direction	due south.	Taken at the west end of the cut.
"	19°,	"	S. 15° W.	
"	21°,	"	S. 25° W.	
"	27°,	"	S. 27° W.	Taken near the middle of the cut.
"	21°,	"	S. 45° W.	
"	22°,	"	S. 45° W.	
"	17°,	"	S. 55° W.	Taken at the southeast end of the cut.

The direction of the pitch is nearly parallel to the longer axis of the ore body. Below the open cut, the dip of the formation is reported to have varied considerably from place to place, becoming increasingly steeper toward the lower end of the mine where it was approximately 45° to the southwest.

Jointing: The jointing, mentioned as characteristic of the ore, affects the entire iron bearing formation but does not extend below the foot-wall contact. It is best developed in the finer grained iron bearing beds; is less frequent in the overlying and surrounding breccias; and, where these grade into the porphyry, is no more pronounced than in the porphyry of other parts of the district.

Both vertical and inclined joints are prominent. The former appear to be the best developed and produce the strongest effect upon the weathered forms. There is no definite system of vertical joints, and the varying strikes produce rectangular, pentagonal, and hexagonal blocks or columns. The inclined joints are less frequent and cut the vertical at all angles up to 45°. In a general way they have a strike parallel to that of the formation. Fig. 1, Plate XVII is a photograph of the upper portion of a bluff of Pilot Knob breccia showing the columnar jointing referred to; also the inclined joints and the bedding. A portion of the foot wall is shown near the lower right hand corner.

Conglomerate Ore: The conglomerate ore occurs only upon the north slope of Pilot Knob, where it is directly overhung by the bluff-like outcrop of the original iron formation of which it is a pre-Cambrian talus accumulation. It consists of a firmly matted mass of ore and porphyry boulders derived from the weathering of the entire iron bearing formation. Through leaching, the ore has become nearly black in color and so softened that, when disturbed, it crumbles readily into a soft powder or into thin platy blocks due to the laminated and jointed nature of the original ore. The associated porphyry boulders are usually softer than the ore and in some places have been completely altered to a talcose clay. In mining, this material may be readily separated from the ore by hand picking but not by washing, the latter method accomplishing little more than a through mixing of all the materials and the loss of much of the finer and better grade ore.

The lateral extent and thickness of this deposit is not definitely known, but test pitting and drilling have shown the formation to underlie an area of approximately 400,000 square feet, and in places to have a thickness of nearly 200 feet. At a point just above where it outcrops from beneath the Cambrian limestone, the conglomerate ore has been entered by a cut approximately 300 feet wide. It has a maximum face of about 90 feet which, with the exception of 15 feet of barren material at the top, consists of ore and porphyry. A 40 foot pit, located just below the cut, was sunk in similar ore. Fig. 2, Plate XVIII is a view of the cut in the soft, conglomerate ore.

Since the conglomerate is made up of a mixture of the various materials comprising the iron formation, it requires very careful sorting in mining. Under the present method of hand picking, the average of seven cars (264 tons), shipped during the month of March, 1911, ran: 56.03% iron, 10.15% silica, 4.37% alumina, and 0.021% Phos. The leaching to which the ore has been subjected has removed a part of the silica. This is indicated by the fact that the average silica content of the 56% hard ore from the old mine, was about 7% higher than that for the 56% soft conglomerate ore*.

Boulder Ore: The surface boulder ore, like the conglomerate ore, is known to occur in commercial quantities only upon the northern slope where it covers an area somewhat larger than that underlain by the conglomerate ore. Like the latter, it is derived from the weathering of the main seam but consists of boulders of ore and porphyry embedded in the surface clays.

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*Average of hard ore from main seam shipped during six months in 1885 was 58.11% iron, 17.02% silica, 0.013% Phos., 2.59% alumina, 0.077% Sul., 0.150% lime, and 0.015% magnesia. Taken from Nason, F. L., Iron ores of Missouri: Missouri Geol. Survey, vol. 2, 1892, p. 46.

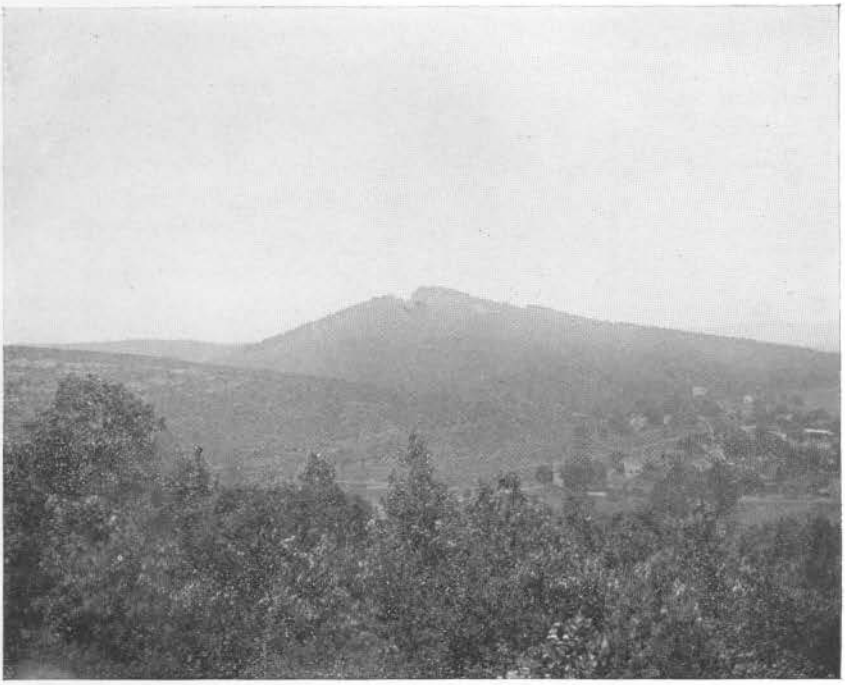

Fig. 1. VIEW OF PILOT KNOB FROM TOP OF CEDAR HILL.

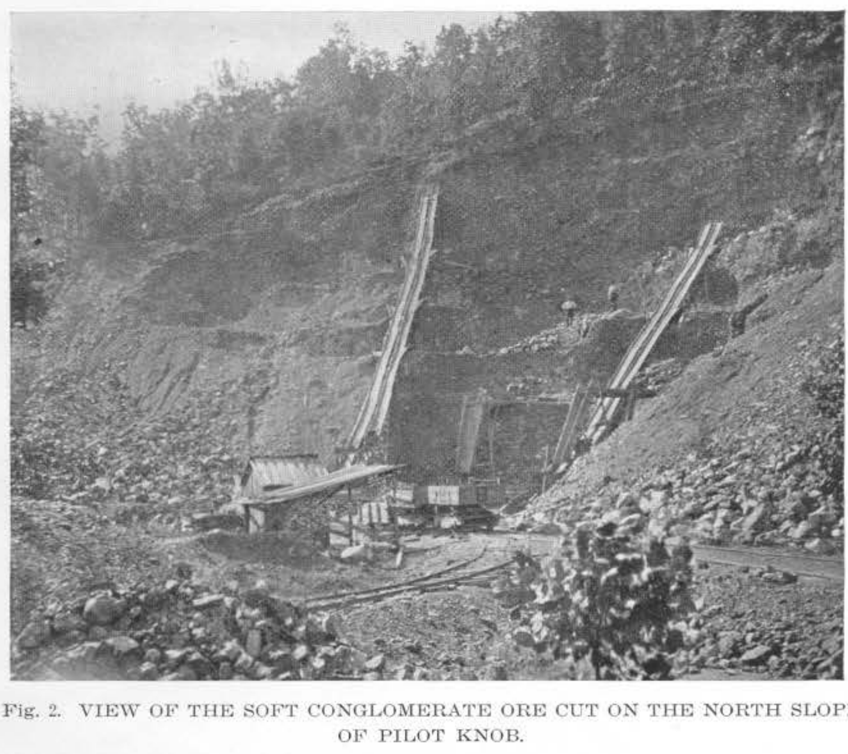

Fig. 2. VIEW OF THE SOFT CONGLOMERATE ORE CUT ON THE NORTH SLOPE OF PILOT KNOB.

Up to the present time no attempt has been made to mine this ore. The following partial analyses** are of the surface boulder ore:

Number.	Iron.	Silica.	Alumina.
1	46.00%	30.38%	....
2	52.60	19.17	....
3	49.60	23.20	3.76%

No. 1 includes every variety of float ore taken over an area of 1,000 square feet and represents the product that could be obtained by hydraulic mining without picking. No. 2 was taken in the same manner as No. 1 but included only such ore as had a fair appearance, and represents what could be obtained by both washing and picking. No. 3 represents an average sample of several tons of hand picked ore, in which the picking was not very carefully done.

Vein Ore: In addition to the deposits described above, comparatively small veins of hematite have been encountered upon the northwest side of Pilot Knob. The most important of these is located a short distance above the company's office. The vein has a northeast-southwest strike and is apparently vertical. The ore, which is massive, resembles in texture and manner of occurrence more nearly that of Iron Mountain than the associated deposits of the iron bearing formation at Pilot Knob.

An endeavor was made to mine this ore but the vein appears to have been thin and very irregular and apparently offers no encouragement as a profitable source of ore.

ORE RESERVES.

The surface boulder and conglomerate ores constitute the most important ore reserves at Pilot Knob. Since these deposits have been formed through the weathering and breaking down of the main iron bearing formation along the outcrop on the north and northeast, they may be expected to conform closely in their distribution to these slopes of the mountain. Prospecting and development have been restricted to the north slope. Surface boulders are numerous along the northeast slope and from the relation of these to the surface exposure of the main ore bed it is possible that additional deposits may occur to the east of the present workings. There is sufficient ore in sight on the north

**Nos. 1 and 2 were sampled and analyzed by W. M. Chauvenet; No. 3 was sampled by the Puxico Iron Company and analyzed by the St. Louis Blast Furnace Company.

slope of the mountain to support active mining operations for many years.

It is hardly probable that any important quantity of good ore remains in the old workings, for before the mine was abandoned, all but a very few of the pillars were drawn, permitting the roof to fall. (Plate XVI.)

To test the ground immediately beyond the mine, the Pilot Knob Company, in 1887-88, drilled a number of holes with generally discouraging results. As shown on the accompanying map, Plate XIII, these holes were placed at a distance of from 300 to 600 feet apart, and so located as to intersect any considerable extension of the ore to the south or west.

Plate XIX shows a series of east-west sections passing through holes drilled south and west of the mine workings. The ore bearing horizon seems to extend to the southward but is not of sufficient thickness to prove of commercial value.

Among the best showings are three feet of 51.8% ore at a depth of about 600 feet in hole No. 14 and three feet eight inches of 46% ore at a depth of about 486 feet in hole No. 12. The maximum thickness is 52 feet of 21% ore at a depth of about 400 feet in hole No. 19.

The above results would indicate that there is virtually no commercial ore beyond the limits of the old workings. While a number of the drill holes show ore, the results are important chiefly for the light they throw on what might be the results of further drilling to the south.

A thorough study of the outcrops on Pilot Knob disclosed no evidence of the occurrence of a second and parallel bed of ore beneath the main workings. In order to test this, the Pilot Knob company drilled 17 holes at various points in the bottom of the old mine. A number of these were from 30 to 60 feet in depth, several 100 feet, and one 326 feet, all of which showed the underlying porphyry to be characteristically barren of ore. However, in the leaner banded beds, which form the roof of the old mine, and in the irregular local ore bodies described as characteristic of the coarser breccias well toward the crest of the Knob, there is a large tonnage of low grade banded ore which will eventually become available and must not be lost sight of.

The banded ore, as previously noted, varies greatly in thickness and in its iron content, grading irregularly upward and laterally into ferruginous porphyry breccia. An average sample taken over a vertical exposure of 20 feet in the face of the big cut ran 49.30% iron, 16.46% silica, 0.203% Sul., and 0.068% Phos. The caved condition of the old mine will make the recovery of this ore difficult.

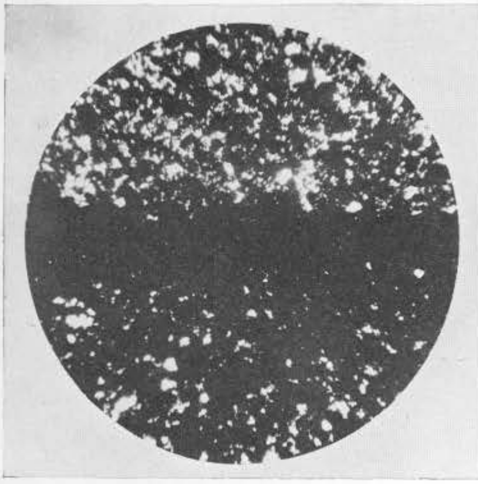

Fig. 1. Banded ore, Pilot Knob. The dark areas are hematite. The light areas are quartz and decomposed feldspar. X. 50 diameters.

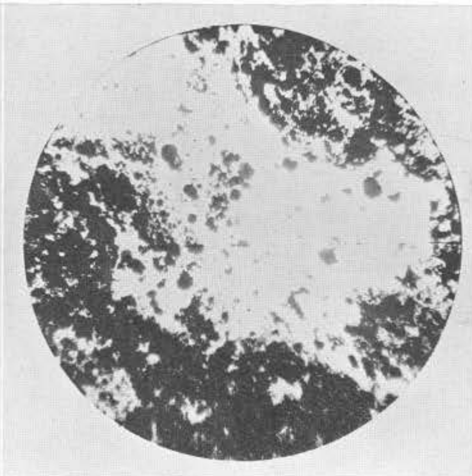

Fig. 2. Ferruginous porphyry breccia, Pilot Knob. The dark areas are hematite. The light areas are feldspar containing inclusions of quartz and martite. X. 50 diameters.

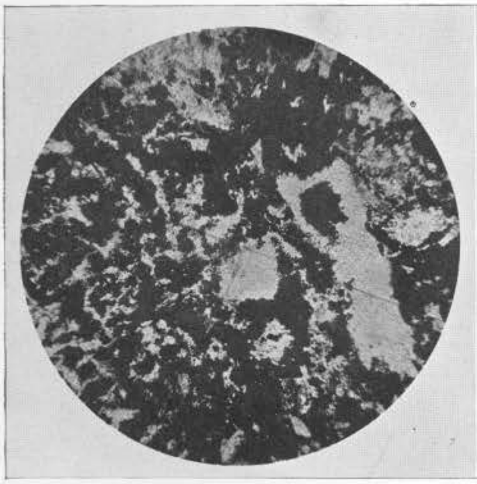

Fig. 3. Ferruginous breccia, Pilot Knob. The dark background is fine grained hematite. The light areas are mainly decomposed feldspar with some quartz. X. 50 diameters.

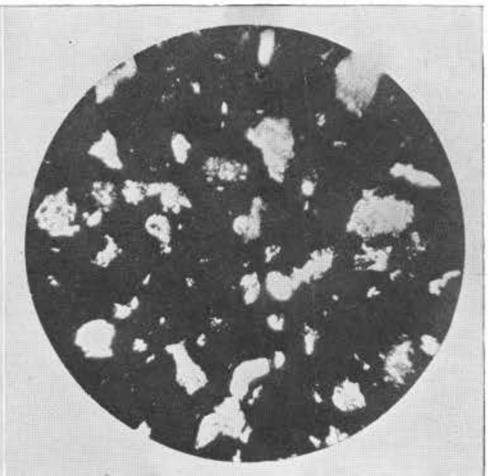

Fig. 4. Cedar Hill ore. The dark area is hematite. The light areas are chiefly feldspar with some quartz. X. 50 diameters.

In an endeavor to keep up the grade of the ore mined from the main seam, a large quantity of the more silicious ore was thrown upon the dumps where it is mixed with other waste materials. This ore, though high in silica, is uniformly low in phosphorus and sulphur, and in order to meet a demand for high silicon pig iron, for certain bessemer purpose, there were shipped during the year 1889 some 30,000 tons which ran from 40 to 50% metallic iron. From the appearance of many of the dumps there is still a considerable quantity of this grade of ore to be had.

The future production of Pilot Knob, however, will probably be restricted largely to the conglomerate and boulder ores occurring on the north face of the mountain.

SHEPHERD MOUNTAIN.

Shepherd Mountain is located in the N. W. 1/4, Sec. 31, T. 34 N., R. 4 E., about 1 1/4 miles southwest of Pilot Knob. In point of production, it stands third among the deposits of specular ore in porphyry, having an accredited output of 75,000 tons.

The available records indicate that this was the first iron ore deposit to be opened in Missouri, the property having been worked as early as 1815. Although the veins were not worked out with depth, and the results of diamond drilling undertaken in 1888 shows an ore body of considerable size near the north base of the mountain, no mining has been done here since the Civil War.

Shepherd Mountain, as shown on the accompanying topographic sketch (Plate XIII), has the form of an irregular cone, and consists entirely of porphyry. It rises to an elevation of about 700 feet above the surrounding valley, attaining an altitude of a little over 1600 feet above tide. It covers an area of about two square miles and, like its neighbor Pilot Knob, is nearly surrounded by Bonneterre limestone. The Bonneterre has a thickness of from 250 to 300 feet and grades downward into a few feet of conglomeratic material. It extends up to about the 1000 foot contour, above which, all the rocks exposed are of the normal porphyritic type.

The porphyry is usually of a brown to red color. In places it is beautifully banded and flow structures are common. The breccias which are so well developed at Pilot Knob are not known to occur.

OCCURRENCE OF THE ORE.

The ore is known to occur at three points; (1) in nearly vertical fissure veins near the top of the mountain, (2) in comparatively flat veins or seams in the porphyry near the north base of the mountain, and (3) as residual boulders upon the surface of the mountain directly below the outcropping vein ore. Deposits of conglomerate ore, like those between the limestone and the porphyry at Iron Mountain and Pilot Knob, are not known to occur at Shepherd Mountain, although it would seem probable that such deposits, on a small scale at least, might occur at points immediately below the outcrop of the main vein. To what extent vein ore may occur with depth at other points upon the mountain is not known, for no drilling or development work of any kind has been done outside of the areas mentioned.

Three veins, having a general northeast-southwest strike, occur near the top of the mountain. Their relation to the porphyry is shown in the accompanying Fig. 5, while their general location is shown on Plate XIII.

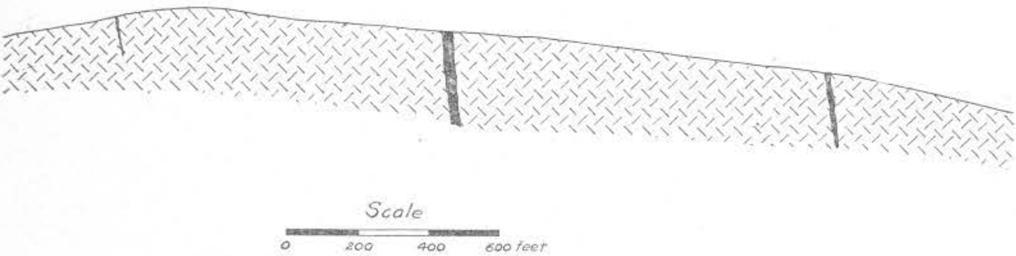

Fig. 6. North and south cross section through Shepherd Mountain.

The southern vein is small, irregular in shape, and occurs in hard porphyry. It has been exposed by shallow pits for a distance of about 50 feet but at no place gives promise of a valuable deposit of ore.

The middle or main vein originally outcropped near the crest of the mountain, and has been worked by an open cut which extends for a distance of 1300 feet down the southwest slope. The vein has a dip of about 5° to the northwest, giving it a well defined foot wall and hanging wall. It is reported to vary in width from a few feet to 20 feet, pinching and swelling both along the strike and with depth. The ore is exposed at one place only, where it is much broken by bands of porphyry. The contact between the ore and porphyry is generally sharp, there being little or no impregnation of the wall rock. The foot wall is, for the most part, solid porphyry while the hanging wall is thoroughly decomposed, in some places, for a distance of 20 feet from the contact. Most of the ore mined on Shepherd Mountain was taken from this cut.

The northern vein, which outcropped on the northeast slope of the mountain, strikes N. 50° E. and dips 2° to 3° to the northwest. It has been worked for a distance of 450 feet by an open cut which has a maxi-

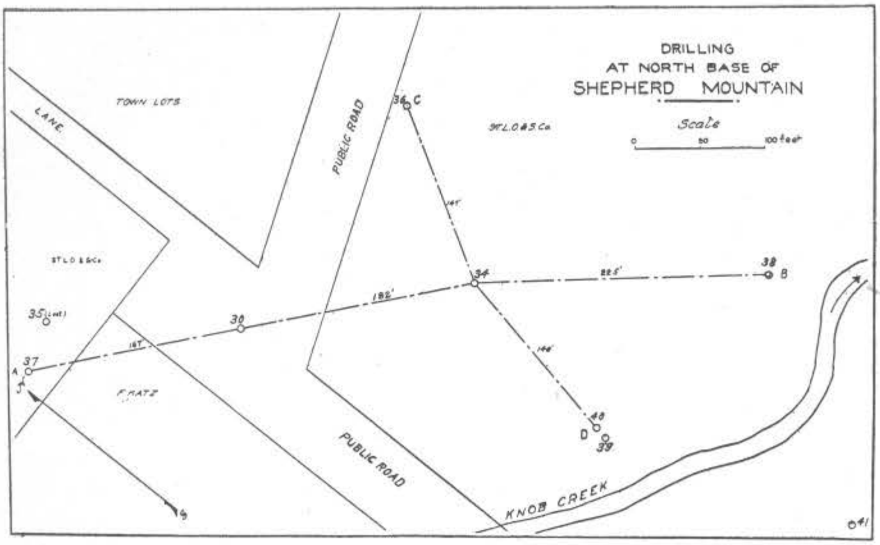

Fig. 1. SKETCH SHOWING DRILLING AT NORTH BASE OF SHEPHERD MOUNTAIN. COMPILED FROM DRAWINGS BY W. B. POTTER.

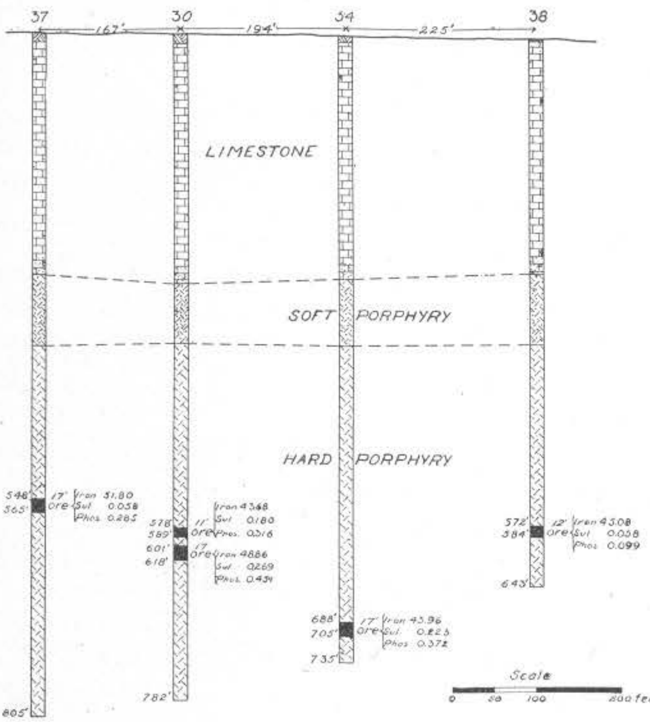

Fig. 2. Section along line A-B of Fig. 1. Compiled from drawings by W. B. Potter.

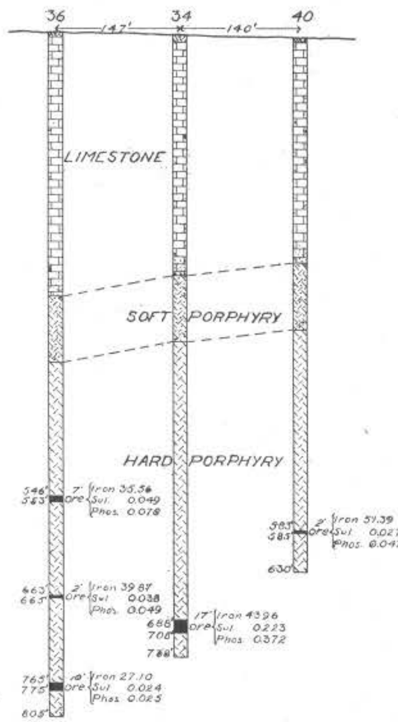

Fig. 3. Section along line C-D of Fig. 1.

mum width of 30 feet and a maximum depth of 50 feet. At present the ore is exposed at two points near the middle and upper end of the workings. At the upper exposure, the vein has a width of about four feet. The ore contains stringers of porphyry and appears to pinch out in that direction. Near the middle of the workings, the vein is 10 feet wide, and consists of nearly solid ore. In general the width of the ore appears to have been about 10 feet. Although its lower limits have not been determined, it is reported to pinch with depth. This vein is reported to have been abandoned because of the high percentage of sulphur in the ore.

The deposit at the north base of the mountain was discovered in 1888 by diamond drilling. Eight holes were put down, six of which show ore. The distribution of the drill holes is shown on the accompanying topographic sketch, Plate XXI. Those showing ore are shown on the same Plate, Fig. 2. The cross-section shows the thickness of the materials penetrated, the relative position of the more important ore horizons, and the grade of the ore. In each case, after passing through from 270 to 310 feet of Bonneterre limestone, which became sandy and conglomeratic near its base, the drill entered soft, decomposed porphyry which graded downward into hard, fresh porphyry, containing seams of iron ore. These seams vary from a few inches to 17 feet in thickness and occur at depths ranging from 546 to 775 feet.

NATURE OF THE ORE.

The ore as exposed in the open cuts near the crest of the mountain, consists chiefly of dull blue to black specular hematite with which is mixed more or less magnetite so that it is commonly magnetic, much of it strongly so. In texture, it is, for the most part, very coarsely crystalline but is, in part, finely crystalline to granular. Much of it is thinly lamellar to micaceous with single faces an inch or more across. Where the ore was associated with the decomposed porphyry, it is reported to have been soft like the conglomerate ore at Iron Mountain and Pilot Knob.

The coarsely crystalline texture and magnetic properties of the ore are characteristics by which it may be readily distinguished from other Missouri ores.

The chief mineral impurities are quartz, kaolin, and pyrite. Quartz occurs as small crystals lining cavities and as small, irregular aggregates scattered through the ore. Kaolin occurs in thin films and patches, and is usually some shade of pink, red, or green. It grades into a light flesh colored porphyry of which it is probably a decomposition product.

Pyrite is not generally present, but is abundant in some of the ore. It occurs as crystals lining cavities and embedded in the ore. The quartz, pyrite, and ore appear to be contemporaneous deposits.

In chemical composition the ore is a bessemer grade of hematite which both Schmidt and Nason accord first rank among the Missouri ores. Shipment analyses are not available, but the following complete and partial analyses are representative of the ore produced at this property:

TABLE NO. XXIII.

	1	2	3	4	5	6
Iron	65.63%	64.31%	66.52%	67.69%	66.63%	61.48%
Phosphorus	0.013	0.017	0.011	0.014	0.017	0.010
Silica	3.19	6.76	5.15	....	....	5.65
Sulphur	0.077	0.00	0.00	0.00	0.00	0.560
Ferric iron	91.69	88.56	94.84	96.70	....	....
Ferrous iron	1.77	2.97	1.80	....	....	....
Alumina	1.37	1.55	....	....	....	....
Lime	0.43	0.35	....	....	....	....
Magnesia	0.10	0.04	....	....	....	....
Manganese	trace	0.00	....	....	....	0.37
Copper	trace	trace	....	....	....	....
Phosphoric acid	0.029	0.039	0.025	0.032	0.038	....
Potassium	0.11	....	....	....	....	....
Sodium	0.05	....	....	....	....	....
Carbon dioxide	0.09	....	....	....	....	....
Carbon	0.01	....	....	....	....	....
Combined water	1.00	....	....	....	....	....

Analysis No. 1, Tenth Census Rept., vol. XV, p. 591; ore from north cut.
Analyses Nos. 2 to 5 inclusive; Missouri Geol. Survey Rept., 1872, p. 62.
No. 2, average sample of slightly magnetic ore from lower part of middle vein, about 80 feet below the outcrop.
No. 3, average sample of magnetic ore from upper portion of middle vein.
No. 4, soft, friable, slightly magnetic ore from lower part of middle vein.
No. 5, hard, black, strongly magnetic ore from north vein.
No. 6, average sample of stock pile of sulphurous ore at north cut.

The ore drilled at the north base of the mountain is nearly black in color and strongly magnetic and in some cases soft and partly decomposed. It is high in sulphur, due to the presence of pyrite, and in this respect resembles more particularly the ore occurring in the north vein described above.

Analyses of average samples taken every six inches through the larger seams show iron ranging from 27.10% to 51.8%, sulphur, from 0.027% to 0.269%, and phosphorous, from 0.025% to 0.451%.

The ore varies considerably in composition in different parts of the same seam. Samples taken from hole No. 30 at depths ranging from 600 to 617 feet show the following analyses:

Depth.	Iron.	Silica.	Phos.	Sulphur.
600 to 609	47.45	28.80	....	....
600 to 605	55.55	....	0.086	....
617	64.72	....	....	3.74

From hole No. 34 the following analyses were made at the depth indicated:

Depth.	Iron.	Silica.	Phos.	Sulphur.
680	36.72	41.82	0.139	0.364
688	43.54	30.64	0.466	0.193
692	53.41	18.39	0.188	0.419
704	39.48	36.26	0.169	0.408

ORE RESERVES.

From the appearance of the old cuts, it is evident that the veins pinched and swelled to such an extent as to make mining difficult. It is probable that they were not followed to their limits and that there is still some ore to be had at greater depths.

When the deposit was first opened, considerable boulder ore was obtained from the surface clay directly below the large cut on the west side of the mountain. The possibility of a future ore supply from this source is, however, very small. The surface of the mountain is exceedingly rough, and the residuum is generally thin and barren. Near the foot of the mountain the residuum is thicker but test pits and drill holes, in all cases, have failed to show it to be ore bearing. The principal source of a future ore supply appears to lie in the deposit drilled at the north base of the mountain.

The ore encountered in holes No. 36 and No. 40 was either too thin or too low grade to be worked. Holes Nos. 30, 34, 37, and 38, located about 195 feet apart, show an average of 18½ feet of ore, which runs 47.02% iron, 0.176% sulphur, and 0.29% phosphorus. Assuming that the ore horizons shown in the several holes are co-extensive, grading laterally into each other, and that the two horizons in hole No. 30 join to form the single horizon in holes No. 34 and No. 37, and figuring that each hole successfully prospects an area 195 feet square, the ore body would contain 2,813,850 cubic feet, or approximately 300,000 tons. It is, however, possible that the ore in each hole may represent independent veins, relatively thin but dipping at high angles like those cutting the top of the mountain. If such should prove to be the case, the above estimate would not hold. In the absence of banding or bedded structure in this ore, it is not possible to detect the pitch of the veins except by close drilling and painstaking analysis of the records. Only when the manner of occurrence is definitely determined, can more specific deductions be made. Although the drill records indicate a deposit of considerable size, the depth at which the ore occurs probably precludes its development at the present time.

As shown in Plate XXI, the drilling covers a comparatively small area and the extent of the ore body has not been fully outlined.

CEDAR HILL MINE.

This mine, located about one mile northwest of Pilot Knob, is situated near the crest of the west slope of Cedar Hill, Sec. 30, T. 34 N., R. 4 E. It was opened in 1872 and during a short period of operation produced about 25,000 tons of ore.

The surface geology at Cedar Hill is similar to that of the porphyry hills in general, except that in the vicinity of the mine, the red porphyry gives place to one of a decided bluish tint. In the immediate vicinity of the ore the porphyry is distinctly brecciated.

According to Schmidt, the ore occurred in two roughly parallel veins, one to four feet in width, which outcropped for a distance of about 100 feet in a northwest-southeast direction.

Developments consist of an irregularly shaped pit about 150 feet long by 75 feet wide, nearly enclosing a horse of brecciated porphyry. At the time it was visited, the mine was flooded so that only the upper portion of the pit could be seen. It is reported that at the south end of the mine an incline has been driven 50 feet or more on the dip of the ore which is approximately 20°, S. 45° W.

According to Prof. W. B. Potter, the ore body is not marked by persistence in direction, uniformity in dimension, or clear separation from the porphyry, but from the large body worked out, it appears to taper away in all directions, so that at present only small bunches and irregular streaks of ore are visible in the face.

Three diamond drill holes which were put down upon the hill at points indicated by the map, (Plate XIII), showed no ore. Drill hole No. 31 in the valley at the foot of Cedar Hill, according to the drillers hand book, showed the following record:

From		To		Thickness.		Formation.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.	
0		17		17		Clay.
17		55	7	38	7	Limestone.
55	7	75	7	20		Decomposed, shaley limestone.
75	7	139	2	63	7	Lime and sand.
139	2	333	6	194	4	Porphyry.
333	6	412		78	6	Porphyry (Water at 336 feet, 6 inches).
412		420	10	8	10	Specks of ore in porphyry.
420	10	423	10	3		Ore.
423	10	450		26	2	Specks of ore in porphyry.
450		454	3	4	3	Mixed ore.
454	3	501	10	47	7	Porphyry (hard).
501	10	506	2	4	4	Mixed ore.
506	2	563		56	10	Porphyry.

In physical characteristics and manner of occurrence, the ore at Cedar Hill is essentially like that at Pilot Knob. There is the same brecciated porphyry in the foot wall, the same irregular gradational contact between the ore and the foot wall, and the same fine grain, thin lamination, and close jointing in the ore. Also the same absence of all magnetism and such minerals as amphibole, apatite, and secondary quartz, as in the Pilot Knob deposit. Barium sulphate occurs cementing joints. Near the north end of the cut, there is a nearly vertical twelve-inch dike of red, jaspery ore which cuts directly across the strike of the ore seams as if intruded into the enclosing porphyry breccia.

An average sample of Cedar Hill ore taken by Raphael Pumpelly from all parts of the mine showed on analysis, 65.47% iron, 5.62% insoluble matter, 0.039% Phos., and 0.000 Sul.

RUSSELL MOUNTAIN MINE.

This mine, located four miles west of Ironton, is situated on the upper northeast slope of Russell Mountain in the S. W. 1/4, Sec. 3, T. 33 N, R. 3 E., Iron Co. It was opened during the early 70's, and is reported to have produced about 3000 tons of ore. The ore occurs in a single irregular seam which strikes nearly east and west with the slope of the hill and dips 30° or more to the south. The thickness of the seam could not be observed but is reported to be approximately six feet.

Developments consist of a series of shallow, open cuts which extend about 400 feet along the strike of the seam and vary from 15 to 20 feet in width. From these cuts several short inclines have been sunk upon the dip.

The ore is fine grained, thinly laminated hematite which breaks readily along nearly vertical joints and resembles in many respects that at Cedar Hill and Pilot Knob. It is underlain by brecciated porphyry which grades upward into the thinly banded ore, and is overlain by a coarse grained, dark green porphyry, through which is disseminated finely crystalline hematite. There is no coarse grained ore like that at Iron Mountain and Shepherd Mountain, and no evidence of sulphides, apatite, tremolite, or secondary quartz, nor is the ore magnetic. Occasional partings in the ore and associated rocks show faces coated with micaceous hematite which has a texture somewhat coarser than the ore.

ORIGIN OF THE SPECULAR HEMATITES IN PORPHYRY.

EARLIER THEORIES.

Like others of his time, Whitney*, in 1854, assigned an eruptive origin to these ores, believing them to have been injected into the porphyry under pressure in much the same manner as were the greenstones.

Schmidt**, in the report of 1872, considered the bedded ores at Pilot Knob to have been formed by the replacement of stratified porphyry by iron oxide deposited from chalybeate waters, and those occurring in irregular veins, as at Iron Mountain, to have been formed by the filling of fissures, which were probably caused by the contraction of the porphyry due to cooling.

Nason***, in the report of 1892, advocated a sedimentary origin for the Pilot Knob beds but agreed with Schmidt in the belief that the vein ores were deposited in the fissures through the agency of surface waters. The fissues, however, he regarded as having been formed either by the expansion of the porphyry due to the hydration of anhydrous minerals or by folding. He conceived the Pilot Knob ore beds and associated "conglomerates" to have been deposited in an arm of the sea between high porphyry hills, the weathering of which supplied the rock making materials. Through subsequent elevation and differential erosion, the iron bearing formation became the highest portion of the area, forming the extreme top of Pilot Knob.

Kemp****, who visited the district in 1888, concludes that "it is not improbable that the Pilot Knob ores originated in the saturation and more or less complete replacement of tufaceous layers by infiltering iron oxide."

*Whitney, J. D., Metallic Wealth of the United States: 1854, p. 433.
**Schmidt, A., Iron ores of Missouri: Missouri Geol. Survey, 1872, p. 98.
***Nason, F. L., Iron ores of Missouri: Missouri Geol. Survey, vol. 2, 1892, pp. 50-65.
****Kemp, J. F., Ore deposits of the U. S.: 1893, p. 118.

PROPOSED THEORY.

The specular hematites in porphyry, though differing radically in character and mode of occurrence, are believed to belong to a general class which owes its origin more or less directly to some form of igneous action, and that in the large district underlain by igneous rocks the relatively small area characterized by the ore deposits, most of which lie within a radius of five miles of Pilot Knob, represents a special geologic province in which specular hematite was deposited.

The ores, in general, are regarded as having been deposited from hot, iron-bearing solutions as an after effect of the porphyry extrusion, the solutions coming from the porphyry itself or from a source common to that of the porphyry. That at Shepherd Mountain is very largely a filling of stretch fissures due to the cooling and consolidation of the porphyry; that at Iron Mountain is in part fissure filling, but more largely a replacement of the porphyry; while that interstratified with porphyry breccia, as at Pilot Knob, Cedar Hill, and Russell Mountain, represents the more or less complete replacement and infiltration of stratified tufaceous beds by iron oxide.

As regards the ores at Iron Mountain and Shepherd Mountain, the proposed theory is in accord with Schmidt, and Nason, in so far as fissure filling is advocated, but differs materially as regards the replacement of porphyry by iron oxide and in the nature and source of the iron bearing solutions. In so far as Pilot Knob ore is considered to have replaced stratified, tufaceous beds, the proposed theory is practically in accord with Schmidt, and Kemp, differing from Schmidt mainly in the character of the beds replaced and in the nature and source of the iron-bearing solutions. Kemp does not specify the nature and source of the solutions. With Nason's theory of direct deposition as a sediment, consisting of detrital material derived from the weathering of the adjacent hills, there is no point in common except as regards the stratification of a part of the rock which has been replaced.

The evidence of the action of hot, deep-seated solutions at Iron Mountain lies mainly in the fact that the ore was deposited between periods of vulcanism as indicated by the greenstone dike cutting the ore at Little Mountain and in the abundant development of such minerals as tremolite and apatite with smaller quantities of magnetite, which are so characteristic of deposits formed elsewhere by solutions accompanying igneous action. While it would be possible to have had these minerals produced as an effect of the greenstone intrusion, there is no indication that they were thus formed.

The evidence of deposition from hot solutions at Shepherd Mountain lies mainly in the coarsely crystalline nature of the ore which is chiefly martite altered from magnetite, of which the deposit was originally very largely composed. The evidence of the action of similar solutions at Pilot Knob lies chiefly in its geologic association and general similarity to the Iron Mountain and Shepherd Mountain deposits. Since the associated rocks in each locality are essentially the same, the absence at Shepherd Mountain and Pilot Knob of tremolite and apatite, so abundant at Iron Mountain, also the varying abundance of magnetite in the several deposits, is attributed to a difference in the composition and temperature of the solutions, rather than to a difference in source. Although the Pilot Knob ore is not appreciably magnetic, thin sections disclose the presence of martite throughout much of it. The occurrence of some magnetite cementing fissures in the overlying breccia may also be indicative of the action of hot solutions.

The main objection to deposition from iron-bearing solutions having a deep-seated source is that the porphyry throughout the St. Francois Mountain district, being very much the same in mineral composition and in general much fissured due to consolidation and faulting, might be expected to be much more generally iron bearing. This objection, however, applies equally well to deposition from solutions of a meteoric source for the localization of which there is at present no apparent reason. In the proposed theory, the localization of the deposits is attributed to conditions analogous to those resulting in the frequent localization of certain rare igneous rocks to limited geologic provinces.

The evidence of extensive replacement of porphyry by iron oxide at Iron Mountain is indicated by the relation of the two materials. In many places large and small masses of porphyry were observed to be completely enclosed by ore, as shown in Fig. 2, and the gradation of the ore through tremolite into porphyry is frequent, although the contacts are generally sharp. Most of the ore exposed in the faces of the old cuts occurs in irregular masses and seams, the greater dimensions of which have a prevailingly nearly horizontal position and conform to the rough flow bedding in the porphyry, see Fig. 2. They do not resemble, in any essential particular, a filling of stretch fissures of the usual form. It is true that the main veins at both Big and Little Mountains were steeply inclined. However, that at Big Mountain occurred in the form of a great inverted "U," the limbs of which tapered with depth, with frequent branches radiating into the surrounding porphyry. The deposit at Little Mountain was decidedly circular in form and appears to have ended abruptly at the bottom of the open pit, having retained a width of approximately 40 feet throughout its depth.

The evidence of fissure filling is confined chiefly to the small, nearly vertical ore veins in which comb structures, formed by large crystals of apatite, are common. It is probable that most of the larger ore masses represent the replacement of porphyry along lines of fissure; the smaller, replacement along bedding planes.

The events leading up to the development and present form of the ore deposit at Iron Mountain may be summarized as follows:

(1) Extrusion of the porphyry followed by fissuring and jointing due to shrinkage as a result of cooling and consolidation.

(2) Entrance of hot, iron-bearing solutions through fissures in the porphyry depositing ore in part as fissure filling but chiefly as a replacement of the porphyry. Quartz, amphibole and apatite were deposited with the iron.

(3) Erosion of the porphyry developing mountains having considerable relief. The ore was exposed and partly eroded, forming detrital or talus deposits below the outcrops. This was accompanied by the decomposition of porphyry and the leaching of the accessory minerals, particularly the apatite, from the detrital ores. During the early part of this period, the ore at Little Mountain was intruded by greenstone.

(4) Deposition of the Cambrian sediments over the entire area converting the detrital ores into basal conglomerate and burying the area to unknown depths.

(5) Erosion of the sediments and the further decomposition of the porphyry accompanied by the breaking down of the conglomerate and vein ores to form the surface boulder ore which formerly completely covered the surface of the mountain.

Except in a few minor details the events leading to the formation and present condition of the deposit at Shepherd Mountain are essentially like those outlined for Iron Mountain. The action at Shepherd Mountain, however, was more largely fissure filling than replacement. The ore was deposited chiefly as magnetite without tremolite and apatite, but with considerable iron sulphide. Deposits of pre-Cambrian detrital ore were probably formed but none have so far been discovered.

The evidence indicating that the ore at Pilot Knob is not an original deposit but is due to replacement is essentially as follows:

(1) The ore beds grade both along the strike and the dip into ferruginous porphyry breccia.

(2) Thin sections show the hematite and the included igneous materials in relations which indicate the partial replacement of the latter by the iron oxide. See Figs. 1 to 4, Plate XX.

(3) The ore has the same structures and texture as the tufaceous materials.

(4) Small tabular crystals of hematite occur lining cavities and joints in the porphyry breccias, indicating deposition from solution.

(5) The ore in the breccia is confined very largely to the matrix which consists of the finer volcanic materials that have cooled under greatest stress.

The evidence favoring a pyroclastic rather than a sedimentary origin for the original beds is in the main as follows:

(1) Other than the hematite and the barite, which are secondary, the rocks consist entirely of porphyritic and felsitic materials.

(2) The fragments of the breccia are for the most part exceedingly angular showing no evidence of rounding by wave action. No sand is present, though quartz is common in the larger fragments.

(3) The banding and jointing in the beds are similar to those in volcanic tuffs and breccias in other regions.

(4) The bedding in the ore is conformable to the flow bedding in the underlying porphyry breccia with no intervening conglomerate.

(5) The coarser porphyry breccia which lies conformably upon the ore beds shows no evidence of the sorting effect of water.

(6) The stratified beds grade along the bedding through breccia into massive and but slightly brecciated porphyry.

(7) If the breccia were a true conglomerate the iron ore would be expected to occur as pebbles as well as in the matrix and the order of succession in the iron bearing formation would naturally be reversed, the conglomerate forming the base instead of the top of the series.

The chief evidence of the sedimentary character of the formation lies in the thin lamination of the ore beds and in the occurrence of ripple marks and rain drop prints near their base. These structures, however, also characterize certain stratified volcanic tuffs and therefore cannot be accepted in this case as determinative evidence of sedimentation.

The difference in the amount of decomposition at Pilot Knob and at Iron Mountain and Shepherd Mountain is more apparent than true. The porphyritic materials associated with the Pilot Knob ore all show more or less decomposition, particularly in the coarser breccias. The action here has been largely one of replacement and induration of the original rock, giving it greater power to resist ordinary weathering. However, outside of the ore bearing beds, as in the foot-wall porphyry, decomposition and weathering appear to have been more rapid than common, especially on the north slope. The large accumulation of conglomerate ore indicates the extensive undercutting of the iron-bearing formation through the decomposition of the underlying rocks.

The events leading up to the development and present form of the ore deposit at Pilot Knob may be outlined as follows:

(1) Extrusion of the porphyry followed closely—that is, without any appreciable erosion interval—by the accumulation of the stratified tuffs and volcanic breccia which were in turn succeeded by additional porphyry flows of considerable thickness.

(2) Fissuring of the porphyry due to cooling and consolidation, permitting the entrance of hot, iron-bearing solutions; the more or less complete replacement of the tuffaceous layers and the finer ingredients of the breccias by iron oxide. The vein deposits on the northwest slope of Pilot Knob and at Shepherd Mountain are probably closely related to the fissures through which the solutions gained access to the tuffaceous and brecciated materials.

(3) Elevation and folding of the region, accompanied by the erosion of the pre-Cambrian land surface to nearly its present outlines; undercutting of the north end of the Pilot Knob ore beds which from time to time broke down forming the detrital or talus deposit on the north slope.

(4) Depression of the region below sea level, near the beginning of Middle Cambrian time, accompanied by the deposition of all the formations of the Cambrian above the LaMotte sandstone, burying Pilot Knob and the adjacent hills to an unknown depth.

(5) Re-elevation and erosion of the sediments, resulting in the re-exhuming of the pre-Cambrian land forms, and the further breaking down of the original ore beds and the pre-Cambrian detrital ore, to form the surface boulder ores found on the north slope of the Knob.

BEARING OF THE THEORY OF ORIGIN UPON FURTHER EXPLORATION.

If the proposed theory of the origin of the ores is correct, there are certain reasonable inferences to be drawn as to the depth, shape, and distribution of the various deposits. If the ore bodies at Iron Mountain represents both fissure fiilling and porphyry replacement, it may be inferred that they will be more or less irregular in shape, and that nothing definite can be predicted regarding their character with depth. While the main veins at Big Mountain were found to taper rapidly with depth, diamond drilling at Little Mountain has disclosed the occurrence of numerous smaller veins to a depth of 308 feet below the bottom of the deepest workings. The drill in this case stopped in 8 feet of barren porphyry below which there is good reason to suspect the occurrence of other veins of ores. If the fissures containing the iron ore at Shepherd Mountain are true stretch fissures produced by the consolidation of the porphyry it may be inferred that they will extend to considerable depth without much change in character, this being determined by the depth to which fissuring had occurred at the time of the extrusion of the ore bearing solutions. The possible depths to which these veins may be found is well shown by the diamond drilling in the valley at the north base of this mountain. Hole No. 36 encountered vein ores at a depth of 775 feet, which is about 175 feet A. T., while the large vein, that was worked at the top of the mountain, outcropped at an elevation of about 1600 feet A. T. Disregarding the amount of erosion of the outcropping ore, this difference in elevation gives the veins a known vertical range of 1425 feet.

If the bedded deposits represent the replacement of a volcanic tuff, it may be inferred that the several occurrences of ores of this type do not necessarily represent the remnants of what was originally a continuous ore body, the intervening portions of which have been swept away by erosion, but that each showing represents an individual deposit which, so far as it is possible to determine, may be entirely unrelated to any other except in that they may all be attributed to a common period of vulcanism.

If the ore bearing solutions have had a deep-seated source, due to special geologic conditions within the known ore bearing district, it may be inferred that further prospecting should be confined to that district and particularly to those areas intervening or immediately adjacent to the known deposits. The chances for the discovery of unknown deposits is illustrated by the results of the drilling at the north base of Shepherd Mountain, where six out of eight holes cut ore of which there was absolutely no surface indication. Drill hole No. 42, at the west base of Buzzard Mountain, after passing through 30 feet of surface clay and boulders and nearly 300 feet of limestone, encountered 52 feet of hard, clay-rock and ore-conglomerate above the solid porphyry. At a depth of 394 feet, the drill core contained seven feet and four inches of mixed ore and porphyry, which, however, is reported to be too lean to justify development. In the light of the results of the drilling above referred to, it would appear probable and altogether possible that other commercial deposits of specular hematite may lie within the area adjacent to those already known.

CHAPTER VIII.

IRON ORES OF THE CARBONIFEROUS AND SILURIAN.

HEMATITES OF THE CARBONIFEROUS.

Distribution: Bedded deposits of red hematite occur in the Lower Coal Measures in the area bordering the northern and northwestern portions of the Ozark plateau, including Lincoln, Warren, Montgomery, Callaway, Franklin, Cooper, and Henry counties. These ores are perhaps best developed in Callaway county where seven occurrences have been noted. With the exception of one near New Bloomfield, Callaway county, and one near Gerald, Franklin county, the deposits are undeveloped and very little is known concerning their extent.

Manner of Occurrence: The deposits have been observed chiefly in the Cherokee formation in which they occur at different horizons. They are best developed at or near the contact between the Cherokee sandstone and conglomerate and the Burlington limestone. The ore varies in thickness, although locally the beds may be fairly persistent over a considerable area. At the Dunn property, near New Bloomfield, Callaway county, the ore is reported to have a thickness of seven feet, and to extend over an area of approximately 20 acres. It is overlain by conglomeratic sandstone, and underlain by Burlington limestone. At the Kleinsorde tract, near Gerald, Franklin county, the ore has a thickness of two feet, and is interbedded with Cherokee sandstone near the unconformable contact of that formation with the Jefferson City dolomite. The lateral extent of the deposit has not been determined, but probably does not exceed one or two acres. In Lincoln, Cooper, and Monroe counties the deposits occur as residual ore embedded in the surface clays which overlie the Mississippian limestones. In the vicinity of Calhoun, Henry county, the ore occurs in lenticular masses in Cherokee sandstone into which it grades. In the lower portion of the Pleasanton formation there is a rather persistent shale horizon known as the "red bed," which has a thickness of from 5 to 20 feet, and extends from Lafayette county to the Iowa state line. This shale is highly ferruginous and contains nodules of hematite, which in places are abundant, especially in northern Carroll and southern Livingston counties.

Types of Ore: The ore consists of red and blue hematites of which there are several varieties. The most characteristic of these are: (1) soft red hematite having an earthy texture and a dull velvety luster on a fresh fracture, (2) hard, bluish gray hematite in the form of nodules or concretions, having a dense, fine-grained texture, and breaking with a conchoidal, splintery fracture, (3) soft, red, argillaceous hematite, having a thinly laminated shaly structue by virtue of which it splits readily into thin plates.

The soft, earthy variety is most common. It usually forms the matrix in which the hard nodular ore is enclosed. According to Schmidt* it sometimes encloses spathic iron ore, also spirifers and other fossils. The argillaceous ore is common to the deposits in Franklin county to which it appears to be confined. It is distinctly stratified. The hard, concretionary ore is often thinly laminated, imitating the structures of concretionary chert. The ore contains no secondary minerals. Much of it shows no impurities of any kind, but some of it is sandy and grades along the bedding into ferruginous sandstone. The argillaceous ore of Franklin county is both sandy and shaly, and varies greatly in character from place to place.

In certain localities highly ferruginous sandstone of a deep red color is common in the lower Cherokee. It closely resembles ore but is usually too silicious to be of commercial value.

Chemical Composition: No shipments having been made from this type of deposit, commercial analyses are not available. The following analyses, which were made by this department, are of typical samples of the several varieties of ore described above:

No.	Variety.	Iron.	Silica.	Phos.	Sul.	Combined water.	Moisture.
1	Soft, earthy, red hematite	58.69	6.26	0.018	....	3.22	0.68
2	Hard, nodular, red hematite	56.93	8.20	0.049	....	2.23	0.20
3	Soft, argillaceous, red hematite	50.08	13.16	trace	0.170	3.60	0.45

*Schmidt, A., Iron ores of Missouri: Mo. Geol. Survey, 1872, Pt. 1, p. 85.

CARBONATE ORES OF THE CARBONIFEROUS.

Carbonate of iron has frequently been noted in the area underlain by the Carboniferous or Coal Measures, but not in commercial quantities. It occurs chiefly in the Lower Coal Measures, and is interstratified with shale, limestone, and sandstone. Usually the beds are not over two feet thick, and occur at depths too great to permit of their exploitation.

The following section* on Clear creek about five miles southwest of Knob Noster, Johnson county, indicates the typical occurrence of these deposits:

1 foot black shale.
3 feet shales.
6 feet sandstone.
4 feet sandy shales with some beds of iron carbonate.
1 foot iron carbonate.
1 foot clay shales.
1 foot iron carbonate.

Similar outcrops occur throughout the eastern portion of Johnson county.

In a shaft sunk in coal at New Cambria, Macon county, carbonate of iron was encountered at a depth of 130 feet. The beds are interstratified with chert and limestone, and are not of sufficient thickness to be of commercial value. Similar beds have been encountered in drill holes in the Bevier coal field. Due to its gray color, the carbonate is frequently mistaken for limestone, and it is probable that it occurs in greater abundance in this area than has been observed. Nodules of clay iron stone, embedded in shale, occur frequently in the Upper Coal Measures.

Although the carbonate of iron is comparatively abundant throughout the area underlain by the Coal Measures, the deposits are not of sufficient extent to be utilized under present conditions.

RED OOLITIC HEMATITE OF THE SILURIAN.

In a deep drill hole put down at Forest City, Holt county, four feet of low grade, fossiliferous, oolitic red hematite were encountered at a depth of about 1885 feet. The ore occurs in a single bed which is directly overlain and underlain by shale as shown in the following section:

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*Broadhead, G. C., Geology of northwestern Missouri: Mo. Geol. Survey, 1872, Pt. II, p. 206.

Feet.	Inches.	
		Limestone, depth 1,843 feet.
6	1	Dark blue, platy shale, fossiliferous and pyritiferous.
3	9	Bluish gray, thinly laminated, calcareous shale; pyritiferous and fossiliferous.
0	1	Brownish black, slightly sandy shale, with a granular, oolitic texture; slightly calcareous.
8	4	Bluish green, slightly sandy shale, platy, and fossiliferous.
21	3	Purple shales, thinly laminated; in lower few feet are a few thin, brownish black, bituminous, oolitic streaks of less than an inch in thickness.
3	8	Red, oolitic hematite; fossiliferous.
0	5	Red, earthy, argillaceous hematite.
2	6	Light green, slightly sandy shale.
64	9	Bluish green shale, with a few thin beds of limestone 6 feet above the base.
0	6	Dunn colored, calcareous, fossiliferous shale.
15	9	Dark, bluish green, calcareous shale.
		Limestone.

The ore consists almost entirely of small flattened granules about the size of flax seed (1/20 inch in diameter), through which are scattered fragments of fossils which usually lie nearly parallel to the bedding. It is well cemented and fairly hard but, due to thin, shaly partings, breaks readily along numerous bedding planes.

The ore is low in iron, and high in both sulphur and phosphorous. An average sample taken at intervals of two to three inches throughout the bed ran 41.87% iron, 8.76% silica, 0.344% Phos., 0.451% Sul., 10.77% combined water, and 0.26% moisture.

The ore is not known to outcrop, and even were it merchantable, its great depth would render it unavailable.

CHAPTER IX.

DESCRIPTIONS OF KNOWN DEPOSITS OF IRON ORE.

In this chapter the known deposits of iron ore are described under the head of counties which are arranged alphabetically. Under each county the descriptions are also arragned alphabetically according to the various types of ore which are given the following sequence:

(1) Specular hematite in porphyry.

(2) Red hematite of the Carboniferous.

(3) Hematites of the filled sinks.

(4) Secondary limonite.

(5) Primary limonite.

Of the 642 properties described in this report 448 were examined during the present investigation; the remaining descriptions are incorporated from the text of earlier Survey reports including a few taken from the Tenth Census. The examinations have been made at various times by different members of the Survey staff and in order to indicate by whom the examination was made and the date at which the work was done, the descriptions are signed as follows: G. W. Crane=(C.-1910), V. H. Hughes = (H.-1910), J. W. Bodman = (B.-1910), Wallace Lee = (W. L.-1910), F. L. Nason= (N.-1892), E. H. Lonsdale=(L.-1892), P. N. Moore = (M.-1873), and A. Schmidt = (S.-1872). In a few instances the source of information has been other than the above, in which case the authority is noted in the body of the descriptive matter.

An endeavor has been made to describe each deposit as accurately as possible under the following heads: (1) name and address of the present owner; (2) location by township, range, section, and fractional section; (3) present state of development, including shipments; (4) geologic relations and occurrence of the ore; (5) type and general character of the ore, including analyses where available; (6) location with respect to transportation facilities.

The geologic occurrence, distribution, and relative abundance of the several types of deposits as well as their relation to transportation facilities is shown on the accompanying state and county maps.

The deposits under each county are numbered in rotation and, where accompanied by a county map, there is given an alphabetical list of all the deposits of each type of ore, bearing numbers to correspond with those heading the descriptions and those appearing on the county maps.

BENTON COUNTY.

The iron ore deposits of this county consist exclusively of secondary limonite which occurs in both the boulder and pipe form. The deposits are confined chiefly to the residuum which overlies the Jefferson City formation but occur also filling openings in the Burlington limestone. Outcrops of the underlying formations are numerous, indicating that the residuum is thin.

Mining operations have been confined to the Smith mine, located four miles west of Warsaw. This mine was opened in the early 70's and the ore was smelted at the Osage Iron Works of Camden county. The amount of ore mined is not known but probably did not exceed 100 tons.

SECONDARY LIMONITE.

1. CARPENTER BANK.

Sec. 12, T. 40 N., R. 21 W.

Limonite covers the surface here over only a small area, of perhaps twenty feet in diameter, but is found scattered in less quantity in various other places on the same hill. There is no ore in the strata of the cut, it is found only in the soil covering the strata. Limestone is found under the surface loam and clayey sand, with white chert, in a thin distinct layer. (S.—1872.)

2. GRISSAM BANK.

S. ½, Sec. 28, T. 40 N., R. 21 W.

This prospect, located 6½ miles southeast of Warsaw, consists of an outcrop of secondary limonite in the form of scattered boulders. It covers an area of half an acre on the southwest face of a hill bordering Turkey creek and is about 100 feet above the stream level. Jefferson City dolomite outcrops at intervals on the hill slope from the base to a point just below the iron ore, indicating that the residuum at this place is relatively thin.

The ore consists of rough pipes showing many pseudomorphs of marcasite, some of which is still present in an unaltered state. It is slightly silicious due to inclusions of angular fragments of chert and a small amount of sand. (H.—1910.)

3. GUN BANK.

Sec. 33, T. 40 N., R. 20 W.

Here a large amount of surface limonite is scattered for a distance of fifty feet vertically and five hundred feet along the northern slope of a low, flat hill.

Two test-pits and numerous drill holes have been sunk, all of which struck the ore at a depth of four to six feet below the surface. The ore is of a good quality. (S.—1872.)

4. INDIAN CREEK BANK.

Sec. 26, T. 42 N., R. 21 W.

Here there is a hill about two hundred feet high. At the base and extending probably twenty feet vertically, is a horizontal limestone. Above this, on the western slope, the surface is covered with chert and pieces of limonite. At one place is a large boulder of many tons weight. It is partly formed of fine pipe-ore broken, and the pieces cemented again by ore. Other pipe-ore is mixed with the soil near by. Sandstone probably forms the top of the hill above the limestone.

(S.—1872.)

MILLER BANK.

Owned by Chas. Miller, Warsaw, Mo.

S. ½, Sec. 8, T. 40 N., R. 23 W.

This prospect, located five miles west of Warsaw, consists of an outcrop of secondary limonite in the form of boulders and fragments scattered over an area 40 feet wide by 60 feet long on the north face of a low hill. Small exposures of Burlington limestone, occurring at intervals on the face of the hill, indicate that the mantle of residual material is thin.

The ore occurs chiefly in the form of pipes of small diameter but in part shows arborescent structures. No inclusions of sand or chert were observed and it is evident that the ore is of excellent grade. However, the scattered nature of the outcrop, and the thinness of the residuum, indicate that the amount of ore is very limited. (H.—1910.)

6. RICHWOODS BANK.

Secs. 3 and 4, T. 39 N., R. 22 W.

The limonite here lies upon the western slope, in a belt about ten yards wide, and extending some two hundred feet up the hill.

Above the ore is a yellow sandstone. At the foot of the hill, a few hundred yards distant from the deposit, is an outcrop of limestone. (S.—1872.)

7. SANDS BANK.

Owned by A. J. Sands, Warsaw, Mo.

S. E. ¼, Sec. 36, T. 41 N., R. 22 W.

This prospect, located 5½ miles northeast of Warsaw, consists of an outcrop of secondary limonite in the form of boulders and fragments strewn over the surface of an area 100 feet wide by 150 feet long. The outcrop is situated on the southwest slope of a hill. Small ragged exposures of Jefferson City dolomite occur immediately to the north indicating a thin blanket of residual materials.

The ore occurs chiefly in the form of pipes showing excellent sulphide pseudomorphs and in a number of instances was observed to still retain a core of unaltered marcasite. Except for the sulphide, the ore is quite pure, containing no sand or chert. No developments have been made.

(H.—1910.)

8. SMITH MINE.

Owned by Chas. Smith, Warsaw, Mo.

E. ½, Sec. 16, T. 40 N., R. 23 W.

This mine, located four miles west of Warsaw, is situated in a small ravine which is tributary to Grand river. The ore outcropped over an area varying from 30 to 50 feet in width and about 150 feet long. Developments consist of a number of shallow pits sunk to a depth of 14 feet upon the outcrop, but which are now so badly caved as to disclose very little of the nature of the deposit. Burlington limestone is exposed at intervals around the entire outcrop and the ore apparently occurs filling a fissure in that limestone.

The ore is secondary limonite varying from light brown to dull red in color. It shows no pseudomorphous structures and tends to an earthy texture. Much of it is highly fossiliferous, crinoid casts being abundant. The ore contains a relatively small amount of chert. A sample of the ore showed an analysis of 55.57% iron, 3.42% silica, 0.145% Phos., 0.040% Sul., 2.04% Mn., and 11.04% combined water.

The mine was worked at the time the Osage Iron Works in Camden county was operated and was abandoned when that furnace blew out.

(H.—1910.)

9. WALKER BANK.

Sec. 36, T. 41 N., R. 20 W.

Here at the top of a high, cherty hill, single limonite pieces are widely scattered over an area twenty feet in diameter. The outcrop consists of large boulders of limonite of good quality. (S.—1872.)

BOLLINGER COUNTY.

Bollinger county ranks fifteenth in the production of iron, having shipped a total of 6,361 tons. The iron ore deposits consist of secondary and primary limonite, the relative importance, distribution and locations of which are shown on the accompanying county map. The secondary deposits consist chiefly of boulder and tabular ore with very little pipe ore. The primary deposits are typical of those in the Southeast district. Both types of deposits occur in the cherty residuum overlying the Roubidoux and Gasconade formations which underlie the greater portion of the county. No deposits are known to occur in the area underlain by the Quaternary and Tertiary formations. Outcrops of the Cambrian formations are frequent along the main streams indicating that the residuum is considerably thinner than in the counties immediately to the west.

Iron mining began in this county in the early 70's, it being one of the first in the State to produce brown ore. About 6,000 tons of ore were mined at that time and used chiefly as a flux at the Mine La Motte smelter. Very little work has been done in recent years. Of the total production to date, 4,731 tons were secondary and 1,630 tons primary limonite.

SECONDARY LIMONITE.

1. CRITTS LAND.

Owned by G. W. Critts, Zalma, Mo.

S. W. ¼, S. W. ¼, Sec. 36, T. 30 N., R. 9 E.

This prospect is located six miles south of Lutesville and is situated on a small knoll which forms the point of a ridge where brown ore outcrops almost continuous over an area of about 100 square yards. Much of the ore lies loose upon the surface. It is a uniformly pure, even textured, secondary limonite, containing very little chert and no sand, the principal impurity consisting of a soft, red, tallow clay lining and filling small cavities. No developments have been made. (C.—1910.)

2. GAINES LAND.

Owned by Wm. E. Gaines, Trowell, Mo.

N. W. ¼, S. E. ¼, Sec. 35, T. 30 N., R. 9 E.

Here, fragments and boulders of brown ore lie scattered upon the surface of a limestone ledge, outcropping along the east slope of a high hill. The ore consists of rather light brown, even textured, high grade limonite secondary after marcasite, which originally filled openings in the limestone. While the outcrop is conspicuous, the deposit is not of commercial importance.

(C.—1910.)

3. GILMORE MINE.

Owned by Gilmore & Stevens.

S. E. ¼, N. W. ¼, Sec. 1, T. 31 N., R. 8 E.

This mine is located two miles northwest of Bessville, and about a half a mile northeast of the Belmont Division of the St. Louis, Iron Mountain and Southern R'y. It is situated in a small ravine surrounded on three sides by high hills. The mine consists of a single cut 100 feet long, 50 feet wide, and 15 feet deep. It was opened during the early 70's and is now so badly caved and filled that only large, ferruginous chert boulders remain exposed in the old faces. A small stock pile indicates that the ore is a good quality of secondary limonite containing but little chert and no sand. About 300 tons of ore are reported to have been shipped. C.—1910.)

4. HAHN MINE.

Owned by Jacob Hahn and Son.

N. E. ¼, S. W. ¼, Sec. 11, T. 30 N., R. 9 E.

This mine, located 2½ miles west of Lutesville, is situated on the north face of a high hill. It consists of two cuts, the larger of which is 100 feet long, 60 feet wide, and 35 feet deep. These openings were made during the early 70's and are now badly filled by caving. However, they still show considerable ore which consists of a somewhat cherty and ocherous, secondary limonite, embedded in cherty clay. The hills in this vicinity are covered with a thick mantle of residual chert. (C.—1910.)

5. HOWELL LAND.

Owned by J. C. Howell, Zalma, Mo.

N. W. ¼, N. E. ¼, Sec. 26, T. 29 N., R. 8 E.

This prospect is located about three miles west of Zalma, and is situated near the brow of the west face of a high hill. Here, brown ore is exposed by the upturned roots of a tree and, in a shallow test pit, the ore is a dense, secondary limonite, enclosing a few fragments of chert but no sand. The surface formation consists of a heavy blanket of residual chert with no ore outcropping. (C.—1910.)

6. LUTES (ELI) BANK.

Owned by Eli Lutes, Lutesville, Mo.

S. W. ¼, S. E. ¼, Sec. 25, T. 30 N., R. 9 E.

This bank, located about 4½ miles southwest of Lutesville, is situated upon the south slope of a high ridge where fragments of brown ore outcrop over an area of about an acre. Developments consist of several openings, the largest of which is a cut extending 70 feet into the hill and showing a maximum face of about 20 feet. This work was done in the early 70's and the pits are badly caved, leaving little face exposed.

The ore, of which there is about 40 tons in stock, consists of boulders of high grade, light brown, secondary limonite. The frequent occurrence of marcasite pseudomorphs and the total absence of sand or partly replaced chert, is a characteristic feature. The waste dirt contains considerable small ore which could be saved by washing. Cane creek, one mile east, is the nearest source for water. (C.—1910.)

7. LUTES (JESSE) BANK.

N. E. ¼, N. W. ¼, Sec. 11, T. 30 N., R. 9 E.

At this place the ore had been disclosed by two cuts on the northern slope of a hill, near the top. Scattered over this hill and the next one north, and occurring in the clay and chert at the cut, are found large numbers of hollow concretions of good ore. The main cut is 30 feet deep and shows an extremely irregular mass of ocherous, cherty ore. Much ocher is associated with the ore. Lying above the ore is found, in irregular pieces, a peculiar, silicious, red ore. (M.—1873.)

8. LUX BANK.

Owned by John Lux, Marquand, Mo.

S. W. ¼, S. W. ¼, Sec. 24, T. 32 N., R. 8 E.

This bank, located 2½ miles northeast of Marquand, is situated near the top of the northeast slope of a high, chert covered hill. Developments consist of a single pit 15 feet in diameter and 8 feet deep, from which about 10 tons of cherty brown ore has been mined.

The ore is a cherty, secondary limonite and occurs in 8 to 10 inch boulders embedded in red, cherty clay. The present outcrop is small, since most of the surface ore was added to that taken from the pit to make up a half car load shipment. (C.—1910.)

9. McGREGOR BANK.

Owned by H. P. McGregor, Glen Allen, Mo.

S. W. ¼, N. W. ¼, Sec. 16, T. 30 N., R. 9 E.

This deposit, located about four miles southwest of Glen Allen, is situated upon the south face of a low hill. Developments consist of a small 10-foot cut, made about 30 years ago. The face of the pit shows boulders and fragments of dark brown limonite, embedded in cherty residual clay. The ore is a secondary limonite which is remarkably free from sand and chert. The outcrop is small and is confined to the immediate vicinity of the pit.

(C.—1910.)

10. MYERS BANK.

Owned by W. C. Myers, Buchanan, Mo.

S. E. ¼, N. E. ¼, Sec. 32, T. 30 N., R. 8 E.

This deposit is located about 9½ miles northwest of Zalma and 13 miles southwest of Glen Allen. It outcrops in a horizontal ledge five to six feet thick for a distance of about 100 feet along the base of a high chert covered hill. Ten to fifteen feet below the outcropping ore limestone is exposed in the creek bed. Several dislodged blocks of the ore, three feet or more in diameter, lie at the foot of the hill.

The ore is a secondary limonite. As exposed in the ledge, it is almost solid, very close grained and entirely free from chert and other visible impurities. Its surface is firm, compact and dark brown in color, while a fresh fracture shows a lighter interior and the feather structures of the original marcasite. A type sample of this ore, when analyzed, showed 61.32% iron, 0.86% silica, 0.041% Phos., 0.007% Sul., 10.74% combined water, and 0.10% moisture.

(C.—1910.)

11. PAVLICK BANK.

Owned by Joseph Pavlick, Marquand, Mo.

S. W. ¼, S. W. ¼, Sec. 26, T. 32 N., R. 8 E.

This deposit is located about 1½ miles east of Marquand and is situated on the northeast flank of a high, chert-covered ridge. Here, limonite occurs as scattered fragments over an area of about an acre. Recent developments consist of several shallow pits, all of which show some ore. One 12-foot pit about 30 feet below the crest of the ridge shows the following section:

2 feet—Clay and chert at the surface.

3 feet—Massive brecciated chert boulders.

7 feet—Coarse and fine lump ore embedded in red and yellow clay.

Two rods northwest of the above pit, and at the same elevation, is a shallower pit showing ore in the bottom. On the southwest slope of the same ridge, two shallow pits show ore beneath about eight feet of surface clay and chert. The ore is a secondary limonite. The best grade of ore was taken from the first pit above described, and all of it is merchantable. No shipments have been made. (C.—1910.)

12. RHODES BANK.

Owned by Joe Starkey, Marquand, Mo.

S. W. ¼, S. W. ¼, Sec. 14, T. 31 N., R. 8 E.

This bank is located three miles west of Bessville and about two miles from the St. Louis, Iron Mountain and Southern R'y. It is situated at the base of the north slope of a high hill where brown ore outcrops over an area of about half an acre.

Developments consist of several small pits, from which a few tons of ore have been taken. The ore is a good grade of secondary limonite of the soft, ocherous type, some of which encloses fragments of chert. (C.—1910.)

13. RICHARDS MINE.

Owned by Pearl Richards, Marquand, Mo.

N. E. 1/4, S. W. 1/4, Sec. 2, T. 31 N., R. 8 E.

This mine, located 1½ miles southeast of Marquand, consists of an open cut 60 feet long, 40 feet wide, and 20 feet deep, situated on the east face of a high chert covered hill. This work was done in the early 70's and the pit is now badly filled. The ore is a secondary limonite and occurs embedded in a cherty clay interstratified with layers of nearly solid chert. At present very little ore is exposed in the faces of the cut. Several car loads of ore are reported to have been shipped from this mine. The ore was hauled a quarter of a mile by wagon to a temporary switch on the St. Louis, Iron Mountain and Southern R'y. (C.—1910.)

14. ROGERS BANK.

Owned by Henry Sitzes, Marquand, Mo.

N. E. 1/4, S. W. 1/4, Sec. 11, T. 31 N., R. 8 E.

This property, located three miles west of Bessville, bears a deposit of brown ore which outcrops in a solid horizontal ledge 20 inches thick, along the east side of a small ravine. Developments consist of one shallow cut 20 feet wide, from which about eleven tons of ore have been taken. The ore is a pure, rather soft, secondary limonite, very free from chert and sand. The surrounding hills are chert covered and rise 100 feet or more above the outcropping ore. The thickness of the residuum is not known. The nearest rock ledge consists of limestone, which outcrops in the bed of a stream a quarter of a mile to the north. (C.—1910.)

15. SHELL, T. W., BANK.

N. E. 1/4, S. E. 1/4, Sec. 10, T. 29 N., R. 9 E.

The hill upon which this deposit is found is low and flat, and singular in that almost no chert is found upon it. It seems to be deeply covered with soil, and the only rock visible is the ore, which lies in a belt 50 or 60 feet wide and 200 feet long, over the top of the hill. The most of the ore is upon the southeast slope, and is in large boulders. It is dense, sometimes stalactitic, and usually pure and free from chert. (M.—1873.)

16. TIBBS BANK.

Owned by the Conrad Estate, Marble Hill, Mo.

S. W. 1/4, Sec. 29, T. 31 N., R. 10 E.

This bank, located 2½ miles northeast of Lutesville, is situated on the brow of a north sloping hill, where brown ore outcrops over an area of about half an acre. Developments consist of a small cut and several shallow pits which were made prior to 1873, and are at present badly filled by caving. The outcropping ore and that exposed in a small stock pile consists of a slightly porous, light brown, secondary limonite. While occasional fragments of chert are associated with the ore, it contains no partially replaced chert or grains of sand. Mr. P. N. Moore visited this property during 1873, when the work was new, and reported the ore to lie "in a broken irregular mass much mixed with ocher and embedded in clay; that, so far as could be seen, there was more ocher than ore and the latter was occasionally sulphurous." The immediate hills are thickly covered with chert and occasional fragments of thin bedded sandstone. The only outcropping rock ledge in the vicinity is a dolomite in the stream bed about half a mile to the southeast. (C.—1910.)

17. TURKEY HILL BANK.

Owned by The Pioneer Cooperage Company, St. Louis, Mo.

N. W. ¼, Sec. 32, T. 31 N., R. 10 E.

Brown ore was mined at this place in the early 70's by means of a 20 foot heading entering the base of a high, chert covered hill. This heading is at present badly caved and filled, and very little ore remains in sight. The ore is a secondary limonite and occurs embedded in cherty clay. It originally outcropped as loose boulders upon the hillside and in the ravine, but these have been picked up and included in a small shipment. The ore was hauled by wagon two miles to Lutesville. (C.—1910.)

18. WHITENER MINE.

Owned by G. C. Whitener, Marquand, Mo.

N. W. ¼, S. W. ¼, Sec. 2, T. 31 N., R. 8 E.

This mine, located 1½ miles southeast of Marquand, is one of the old brown ore properties mined prior to 1873. Developments consist of a single cut situated on the north face and near the top of a high, chert covered hill. According to reports, about 70 car loads of ore were mined and shipped to the Blast Furnace at Carondelet. The walls of the pit have caved and exposures consist chiefly of large boulders of ferruginous chert. This property was visited in the spring of 1873 by Mr. P. N. Moore, who described it under the name of the Nifong Bank as follows:

"The ore is exposed at its best on the south wall. It is seen here in an irregular mass 8 to 10 feet thick and about 20 feet long, inclined towards the west at a high angle, overlain by a mass of reddish clay and chert which shows semi-stratification in about the same direction. The ore at the south end of the cut is of good quality; a dense limonite, and comparatively free from chert. That exposed on the west wall is very cherty; so much as to be almost worthless."

The ore is a secondary limonite chiefly of the boulder variety. An analysis of the ore averaged from such of it as was marketable, was published by the Survey in 1873. It ran as follows: Iron 55.70%; insolubles 7.46%; Phos. 0.141%; and Sul. 0.017%.

The haul from this mine was about one mile over a ridge road to Summit Switch on the St. Louis, Iron Mountain and Southern R'y. (C.—1910.)

PRIMARY LIMONITE.

19. ### BAKER MINE.

Owned by Jessie Jackson, Marble Hill, Mo.

N. W. ¼, S. E. ¼, Sec. 31, T. 31 N., R. 10 E.

This mine is located one mile north of Lutesville, and is situated on the brow of a south pointing spur. Here brown ore outcrops and lies scattered upon the hillside. Near the crest of the hill is an open cut, from which a long shallow trench extends about 100 feet down the slope. From these openings about 15 tons of a very porous, dark brown limonite, containing some chert and sand, has been mined.

The ore is a primary limonite and occurs as large, irregular boulders with smaller fragments embedded in residual clay. Several shallow pits, near the crest of the hill, show a large proportion of ferruginous chert and clay.

The development work was done in the early 70's and the openings are now badly filled. Several car loads of ore are reported to have been shipped. (C.—1910.)

20. ### BOLLINGER (B. H.) LAND.

S. E. ¼, N. E. ¼, Sec. 31, T. 29 N., R. 9 E.

On the property of Mr. B. H. Bollinger, limonite is found in the form of broken masses, covering about sixty square yards on the point of the spur of a ridge. It is siliceous, silica occurring principally as small broken chert fragments. The ore masses are usually small and angular and mingled with a few fragments of chert. On the surface surrounding the ore area, these fragments are more numerous. This locality is less than one mile distant from the Brownwood, Zalma Branch Ry. (L.—1892.)

21. ### BOYER LAND.

Owned by A. F. Boyer, Zalma, Mo.

S. E. ¼, N. W. ¼, Sec. 34, T. 29 N., R. 9 E.

This property, located about half a mile east of Zalma, bears an outcrop of brown ore covering an area of several acres, on the west slope of a high ridge. The ore is a porous, primary limonite and is silicious, due to the presence of both fragments of chert and grains of sand. No development work has been done. (C.—1910.)

22. ### CALDWELL BANK.

Owned by J. G. Caldwell, Marble Hill, Mo.

S. W. ¼, S. W. ¼, Sec. 32, T. 31 N., R. 10 E.

This bank, located about one mile northeast of Lutesville, is situated on the west bank of a north and south ravine. Developments consist of a few shallow pits from which some ore was mined and shipped in the early 70's. The ore is a porous, cherty, primary limonite which occurred as large and small boulders embedded in cherty clay. (C.—1910.)

23. ### DONDORE (L. T.) LAND.

Secs. 7, 8, 17 and 18, T. 28 N., R. 8 E.

Limonite is found in several localities within these sections. In one locality the ore occurs as huge, partially uncovered masses and fragments covering an area more than one hundred yards long and nearly fifty yards wide. This ore lies on a very gradual slope with chert fragments on the surface. At the extremities of this area some digging has been done. Here the surface masses were most numerous and largest. The surface ore is of a better quality than that towards the bottom of the cuts, which are four or five feet deep. In these cuts are found limonite, turgite and perhaps other varieties of iron oxide. The lower portion is quite sandy and contains nodules of insoluble material. Ore such as is found here is found about half a mile westward. These deposits are nine miles from Zalma at the extremity of the B., Z. Br. Ry. (L.—1892.)

24. FOX BANK.

Owned by Daniel Fox, St. Louis, Mo.

N. W. ¼, S. E. ¼, Sec. 23, T. 32 N., R. 8 E.

This bank is located 2½ miles northeast of Marquand and is situated near the top of the south slope of a high hill where brown ore outcrops over an area of about one acre. Developments consist of three pits, each approximately 10 feet square and varying from 6 to 8 feet in depth; also one open cut 15 feet wide and 30 feet long with a 25 foot vertical shaft at the deeper end.

The ore, as shown in the pits, consists of large boulders and small fragments embedded in a reddish, cherty clay. Good ore is reported to extend to the bottom of the 25 foot shaft.

The ore is exceedingly cellular, porous type of primary limonite and is both cherty and sandy. It is of fair quality and a marketable product may be developed.

This property was opened in the fall of 1909. No shipments have been made. (C.—1910.)

25. GLENN EMMA MINE.

N. E. ¼, N. W. ¼, Sec. 16, T. 30 N., R. 9 E.

This mine is located four miles southwest of Glen Allen and is situated near the base of the northwest slope of a hill at a point about 20 feet above the level of the valley. It is one of the group of mines opened in this vicinity during the early 70's and is now in an abandoned condition. Developments consist of three irregular cuts opening up the base of the hill through a distance of 200 feet along the slope and about 80 feet wide. From this opening some 1500 tons of boulder limonite are reported to have been mined and shipped. The ore is a cherty, primary limonite of the cellular and concretionary type and occurs embedded in a cherty clay. It is, for the most part, highly silicious, due to the presence of included sand and fragments of chert. (C.—1910.)

26. LEMON (THOMPSON) LAND.

S. ½, Lot 3, Sec. 30, T. 29 N., R. 9 E.

This land is owned by Mr. Thompson Lemon. Massive limonite is found here in a ledge and in boulders and fragments. These almost wholly cover an area about forty yards long and thirty yards wide and are scattered over an area one hundred yards long and thirty yards wide, on the southern and eastern hill slopes, just north of a slight divide between two chert ranges. Only scattered boulders are found in the easternmost portion of this deposit. The ore is siliceous, silica occurring principally as fragments of chert, but also as disseminated grains of sand. This chert could be, to a large extent, removed by cobbing. Fragmental chert is found on the surface of this and neighboring hills. This locality is two or three miles distant from the B. Z. Br. Ry. (L.—1892.)

27. MURDOCK BANK.

Owned by Woodlock and Marks, St. Louis, Mo.

S. E. ¼, N. W. ¼, Sec. 16, T. 30 N., R. 9 E.

This bank, located about four miles southwest of Glen Allen, is situated on the northwest slope of a hill, where brown ore outcrops over an area of about one acre. Developments consist of several small test pits sunk during the early 70's. These encountered very little ore. The outcrop consists of a porous, primary limonite, containing unreplaced chert and grains of sand. (C.—1910.)

28. REVELLE BANK.

Owned by Lawrence Fowler, Trowell, Mo.

N. E. ¼, S. W. ¼, Sec. 10, T. 29 N., R. 9 E.

This bank is located four miles north of Zalma and is situated on the southeast face of the point of a low hill. It was opened in the early 70's by a cut 25 feet wide and 12 to 15 feet deep. Beside the cut, which is now badly caved, is a stock pile of about 30 tons representing all the ore mined. The ore is a primary limonite and occurs embedded in a cherty clay. It is in part porous and cherty, and in part compact with a dense amorphous texture, and contains fine, angular blocks which have apparently been broken from larger boulders. No shipments have been made. (C.—1910.)

29. ROBBINS BANK.

Owned by Monroe Robbins, Bessville, Mo.

N. W. ¼, N. E. ¼, Sec. 10, T. 31 N., R. 9 E.

This deposit, located about 1½ miles northeast of Bessville, is situated on the brow of the north slope of a high hill. Developments consist of one 10 foot pit which shows some ore near the surface. The ore is a dense, dark brown, primary limonite. It is hard and dense, and somewhat silicious due to inclusions of fine irregular grains of quartz. No bedded formation was observed outcropping in the vicinity, and the hill appears to be composed entirely of cherty, residual materials. The outcrop covers an area 25 yards square in the immediate vicinity of the pit. (C.—1910.)

30. SHRUM MINE.

Owned by Jacob Shrum, Marquand, Mo.

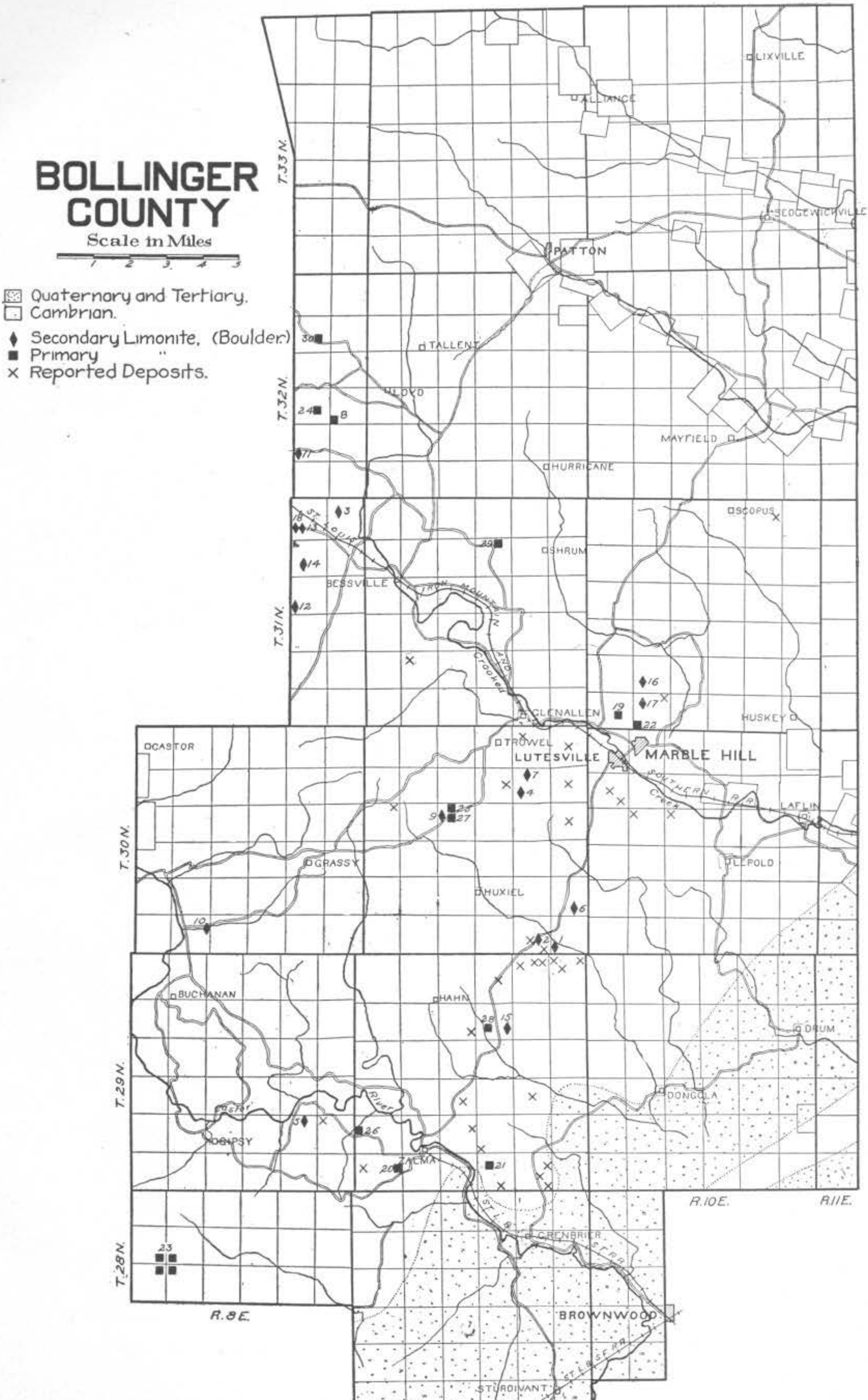
N. W. ¼, S. E. ¼, Sec. 11, T. 32 N., R. 8 E.

This mine, located about three miles northeast of Marquand, is situated on the north slope of a hill. It consists of a cut 20 feet wide and 8 feet deep which was opened during the early 70's and is at present badly filled by caving. The ore is an exceedingly porous, open variety of cherty, primary limonite. Forty tons of ore are reported to have been shipped. The shipment included most of the original surface showing, which was confined to the immediate vicinity of the cut. (C.—1910.)

BOLLINGER COUNTY.

SECONDARY LIMONITE.

No.	Name of Mine or Owner.	Twp. N.	R.	Sec.	Fractional.
1	Critts, G. W., Land	30	9 E.	36	S. W. ¼, S. W. ¼.
2	Gaines, Wm. E., Land	30	9 E.	35	N. W. ¼, S. E. ¼.
3	Gilmore Mine	31	8 E.	1	S. E. ¼, N. W. ¼.
4	Hahn, J., Mine	30	9 E.	11	N. E. ¼, S. W. ¼.
5	Howell, J. C., Land	29	8 E.	26	N. W. ¼, N. E. ¼.
6	Lutes, Eli, Bank	30	9 E.	25	S. W. ¼, S. E. ¼.
7	Lutes, Jesse, Bank	30	9 E.	11	N. E. ¼, N. W. ¼.
8	Lux, John, Bank	32	8 E.	24	S. W. ¼, S. W. ¼.
9	McGregor, H. P., Bank	30	9 E.	16	S. W. ¼, N. W. ¼.
10	Myers, W. C., Bank	30	8 E.	32	S. E. ¼, N. E. ¼.
11	Pavlick, Jos., Bank	32	8 E.	26	S. W. ¼, S. W. ¼.
12	Rhodes Bank	31	8 E.	14	S. W. ¼, S. W. ¼.
13	Richards, P., Mine	31	8 E.	2	N. E. ¼, S. W. ¼.
14	Rogers Bank	31	8 E.	11	N. E. ¼, S. W. ¼.
15	Shell, T. W., Bank	29	9 E.	10	N. E. ¼, S. E. ¼.
16	Tibbs Bank	31	10 E.	29	S. W. ¼.
17	Turkey Hill Bank	31	10 E.	32	N. W. ¼.
18	Whitener, G. C., Mine	31	8 E.	2	N. W. ¼, S. W. ¼.
	PRIMARY LIMONITE.				
19	Baker Mine	31	10 E.	31	N. W. ¼, S. E. ¼.
20	Bollinger, B. H., Land	29	9 E.	31	S. E. ¼, N. E. ¼.
21	Boyer, A. F., Land	29	9 E.	34	S. E. ¼, N. W. ¼.
22	Caldwell, J. G., Bank	31	10 E.	32	S. W. ¼, S. W. ¼.
23	Dondore, L. T., Land	28	8 E.	7, 8, 17, 18.	
24	Fox, Daniel, Bank	32	8 E.	23	N. W. ¼, S. E. ¼.
25	Glenn Emma Mine	30	9 E.	16	N. E. ¼, N. W .¼.
26	Lemon, Thompson, Land	29	9 E.	30	S. ½, Lot 3.
27	Murdock Bank	30	9 E.	16	S. E. ¼, N. W. ¼.
28	Revelle Bank	29	9 E.	10	N. E. ¼, S. W. ¼.
29	Robbins, Monroe, Bank	31	9 E.	10	N. W. ¼, N. E. ¼.
30	Shrum, J., Mine	32	8 E.	11	N. W. ¼, S. E. ¼.
	REPORTED OCCURRENCES.				
	Carelton, A. T	29	9 E.	35	S. E. ¼, N. E. ¼.
	Cato, Peter	29	9 E.	3	S. W. ¼, N. E. ¼.
	Davis, A	29	9 E.	28	S. E. ¼, N. E. ¼.
	Eaker, G. S	30	9 E.	10	E. ½.
	Golden, Peter	29	9 E.	27	S. W. ¼, S. W. ¼.
	Harris, S. E	29	9 E.	35	S. E. ¼, S. E. ¼.
	Levering, F. R	30	9 E.	35	S. E. ¼, S. E. ¼.
	Lutes, John	30	10 E.	7	
	McGregor	31	9 E.	29	N. W. ¼.
	Myers, J. W	30	9 E.	35	N. E. ¼, S. W. ¼.
	Pioneer Cooperage Co	29	9 E.	34	S. W. ¼, S. E. ¼.
	Wells, Sarah	29	9 E.	1	N. W. ¼, N. W. ¼.


BOLLINGER
COUNTY
Scale in Miles
1 2 3 4 5
Quaternary and Tertiary.
Cambrian.
Secondary Limonite, (Boulder)
Primary "
Reported Deposits.
T. 33 N.
T. 32 N.
T. 31 N.
T. 30 N.
T. 29 N.
T. 28 N.
R. 8 E.
R. 9 E.
R. 10 E.
R. 11 E.
LIXVILLE
ALLIANCE
SEDGEWICKVILLE
PATTON
TALLENT
LLOYD
MAYFIELD
HURRICANE
SCOPUS
SHRUM
BESSVILLE
GLENALLEN
HUSKEY
CASTOR
TROWEL
LUTESVILLE
MARBLE HILL
LAFLIN
GRASSY
LEPOLD
HUXIEL
BUCHANAN
HAHN
DRUM
DONGOLA
GIPSY
ZALMA
GRENBRIER
BROWNWOOD
STURDIVANT
St. Louis Iron Mountain and Southern R.R.
Crooked Creek
Castor River
St. L. & S. F. R.R.

REPORTED OCCURRENCES—Continued.

Name of Mine or Owner.	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
Wells, Sarah....................	29	9 E.	1	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Wells, Sarah....................	29	9 E.	35	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
Owner Unknown.................	28	8 E.	17	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
" "	29	8 E.	25	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
" "	29	9 E.	1	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
" "	29	9 E.	2	N. E. $\frac{1}{4}$ and N. W. $\frac{1}{4}$ of N. E. $\frac{1}{4}$.
" "	29	9 E.	2	N. W. $\frac{1}{4}$.
" "	29	9 E.	9	E. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
" "	29	9 E.	21	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
" "	29	9 E.	23	
" "	29	9 E.	31	S. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
" "	30	9 E.	1	
" "	30	9 E.	2	N. W. $\frac{1}{4}$.
" "	30	9 E.	12	
" "	30	9 E.	13	
" "	30	9 E.	18	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
" "	30	10 E.	7	S. E. $\frac{1}{4}$.
" "	30	10 E.	16	N. W. $\frac{1}{4}$.
" "	30	10 E.	17	N. W. $\frac{1}{4}$.
" "	31	10 E.	2	N. E. $\frac{1}{4}$.
" "	31	10 E.	32	N. E. $\frac{1}{4}$.

BUTLER COUNTY.

Butler county ranks thirteenth in the production of iron ore, having shipped a total of 15,810 tons. The iron deposits of the county are exclusively brown ore consisting of both the primary and secondary types. The relative abundance, distribution, and locations of the deposits are shown on the accompanying county map.

The ore occurs in the Cambrian residuum which is apparently very thick, since very few outcrops of the underlying formations occur. The southeast portion of the county is covered by sands and clays of Quaternary age which are not ore bearing.

The secondary deposits consist of both pipe and boulder ores several being almost exclusively pipe ore. The primary deposits consist of the coarsely cellular and sandy ore characteristic of the southeast district.

Iron ore was first mined in this county in 1873 when about 500 tons were shipped from the Hendrickson mine. The next shipment was made in 1900 and since 1902 shipments have been made each year. Of the total production to date, 13,660 tons were secondary limonite, mostly from the Keener area, and 2,150 tons primary limonite, chiefly from the vicinity of Hilliard.

SECONDARY LIMONITE.

1. AGRICULTURAL COLLEGE LAND, NO. 1.

Sec. 21, T. 26 N., R. 6 E.

This land is the property of the State Agricultural College. The limonite here covers an area fifty yards across. The ore is in the form of small masses, on the crest and sides of a divide, between two knolls. There also appears, cropping out at the lower margin of the area, a ledge of ore, the thickness of which is not shown. This ledge is only a few feet above a bed of limestone, which is exposed here. The ore is of good quality, containing little or no siliceous matter. Some scattered chert lies within the area bearing ore and much chert and small blocks of sandstone are found on the knolls adjoining this divide. This deposit is located about one mile from the St. L., I. M. & S. Railway. (L.—1892.)

2. BURKETT BANK.

Owned by W. R. Burkett, Keener, Mo.

N. E. ¼, N. E. ¼, Sec. 22, T. 26 N., R. 5 E.

This bank, located 2½ miles northwest of Hendrickson, is situated on the east slope of a low hill where pipe ore outcrops over an area of about one acre. A 15 foot pit near the upper edge of the outcrop shows boulder and pipe ore throughout its depth. The ore is embedded in cherty clay and is less abundant in the lower than in the upper half of the pit. A shallow 60 foot trench, extending from the pit to near the base of the outcrop, showed three feet of good wash dirt throughout its entire length. The ore in this dirt consisted chiefly of small fragments of pipe limonite.

In a small ravine near the north end of the same 40 acres, is a group of three small pits each about six feet deep. Two of these contained little or no ore, while the third showed an abundance of ore embedded in cherty clay throughout its depth.

The ore on this property is very largely of the pipe variety. Much of it consists of small fragments which cannot be recovered except by washing. A small stream which crosses the east edge of the area will supply a moderate amount of water. (C.—1910.)

3. HENDRICKSON MINE.

Owned by H. Magill, Hendrickson, Mo.

S. E. 1/4, N. W. 1/4, Sec. 18, T. 26 N., R. 6 E.

This property, located about one mile east of Hendrickson, is one of the old mines in which no work has been done since the early 70's, when about 500 tons of ore were mined and shipped. Developments consist of two circular cuts, a 30 foot shaft, and a 100 foot tunnel driven from the side of the hill in the direction of the shaft. The shaft and tunnel are now in a caved condition and the open cuts are also badly filled. The ore occurred, for the most part, in irregular masses enclosed in red, cherty clay. It is secondary limonite, showing many sulphide pseudomorphs, and varies in character from a soft, yellow ocher to boulders having decided red and blue shades, some of which give a red streak. Much of the ore in a stock pile of 100 tons is silicious, from the presence of enclosed fragments of chert. The ore exposed in the open cuts, however, appears to be an average quality of secondary limonite. A sample taken of the ore in stock showed 57.58% iron, 3.16% silica, 0.374% Phos., 0.171% Sul., 10.09% combined water, and 0.933% moisture.

During the time it was operated, this mine was connected by a narrow gauge tram with the St. Louis, Iron Mountain and Southern R'y. (C.—1910.)

4. HENDRICKSON (N. W.) LAND.

Sec. 20, T. 26 N., R. 6 E.

Semi-massive and stalactitic limonite is found here in small masses and boulders strewn over an area about seventy yards square on the slope of a knoll. The ore is but slightly siliceous and the boulders are mingled with scattered fragments of chert and small blocks of sandstone, with no bedded rock exposed near by. This locality is less than one-half of a mile distant from the St. L., I. M. & S. R'y. (L.—1892.)

5. KAUFFMAN MINE.

Owned by Isaac Luke, Keener, Mo.

N. E. 1/4, N. E. 1/4, Sec. 11, T. 26 N., R. 5 E.

This mine, located two miles west of Hendrickson, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened during 1908 at which time 243 tons of ore were mined and shipped. The ore gave returns of 50.25% iron, 15.00% silica, 0.068% Phos., 0.17% Mn., and 3.00% moisture, which indicates that it is a somewhat cherty, secondary limonite. (C.—1910.)

6. LUKE MINE.

Owned by Missouri Iron Ore Company, St. Louis, Mo.

S. W. ¼, N. W. ¼, Sec. 11, T. 26 N., R. 5 E.

This mine, located at Keener, is situated at the north base of a low hill very near the level of Black river. It consists of three irregular cuts from which approximately 6,500 tons of ore have been mined and shipped. The largest opening is 100 feet long by 60 feet wide, with a maximum depth of 35 feet. A smaller cut to the west shows a face of 18 feet, while one on the east is somewhat smaller. All of these openings show ore, the faces in places carrying ore from top to bottom. However, in the large cut there is about 12 feet of barren clay and chert above the ore. There are also several streaks of barren clay extending from the surface to the bottom of the pit and these, in some cases, have not been removed.

Two small pits near the crest of the opposite side of the hill showed similar conditions, and it is not unlikely that the ore body may be found to extend irregularly through the hill.

The ore is secondary limonite very largely of the pipe variety and occurs as boulders and small fragments embedded in a cherty clay. Some of it is nearly solid, but in cross-section shows a stalactitic structure. A portion of the ore carries considerable chert but very little or no sand. Chert fragments, large and small, are commonly mixed with the ore-bearing clay.

So large a part of the ore is small that washing is required. It is mined by hand and trammed 300 yards to a one-log washer which is equipped with one cylinder screen and two hand jigs. By this method a wash product, averaging 52.65% iron, 11.60% silica, 0.08% Phos., 0.11% Mn., and 4.0% moisture, is produced. The grade of the ore could be considerably improved by better equipment.

The washed ore is trammed 150 yards to the Iron Mountain and Southern R'y. at Keener. Water is obtained from the Black river a quarter of a mile to the west. (C.—1910.)

7. MAGILL MINE.

Owned by H. Magill, Hendrickson, Mo.

E. ½ Lot 1, N. W. ¼, Sec. 19, T. 26 N., R. 6 E.

This mine, located half a mile southeast of Hendrickson, is situated on the southwest slope of a high hill about 100 feet above and not over 200 yards east of the St. Louis, Iron Mountain and Southern R'y. Developments consist of two small pits sunk upon an outcrop of brown ore which covers an area of about four acres. The pits are about 12 feet in diameter by 5 feet deep and encountered ore throughout their depth. The ore is a secondary limonite and occurs both as large boulders and small fragments embedded in a matrix of red, cherty clay. Much of the dirt on the dumps from which the boulder ore has been picked will wash 50% ore.

This property was opened during 1903 at which time two car loads of ore giving returns of 46.53% iron, and 49.01% iron were mined and shipped.

(C.—1910.)

8. PLETZ (F.) MINE NO. 1.

Owned by H. Magill, Hendrickson, Mo.

S. W. 1/4, S. W. 1/4, Sec. 19, T. 26 N., R. 6 E.

This mine is located 1½ miles south of Hendrickson and half a mile west of the Black river. It has not been visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened in 1903 by Mr. Ferdinand Pletz, who, during that and the following year, shipped 517 tons of ore which averaged 56.69% iron, 8.54% silica, 0.056% Phos., and 0.25% Mn. Judging from the analysis, the ore is a secondary limonite. (C.—1910.)

9. PLETZ (F.) MINE NO. 2.

Owned by Isaac Luke, Keener, Mo.

N. W. 1/4, N. W. 1/4, Sec. 11, T. 26 N., R. 5 E.

This mine, located half a mile east of Keener, was not visited by a member of this department, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened by Mr. Ferdinand Pletz in 1903 at which time 79 tons of ore, averaging 56.89% iron, 5.71% silica, and 0.056% Phos. were mined and shipped. Judging from the analysis, the ore is a secondary limonite. (C.—1910.)

10. SEXTON BANK.

Owned by A. W. Sexton.

Lot 2, N. W. 1/4, Sec. 7, T. 26 N., R. 6 E.

This property, located 1½ miles northeast of Hendrickson, has been developed by five shallow pits, from which about 20 tons of ore have been mined and shipped. Two of the pits, which are situated near the east slope of a hill on the south half of the tract, showed secondary limonite of both the boulder and pipe variety. Three of the pits, which are situated on the south slope of a gentle hillside on the north half of the tract, developed ore of the secondary type to a depth of five feet. The ore occurred as large boulders embedded in clay and ocherous materials. It is light brown in color, and very pure, being practically free from both sand and chert. The outcrop at this place covers a small area in the immediate vicinity of the pits. (C.—1910.)

11. THOMAS LAND.

Owned by J. P. Thomas, Keener, Mo.

S. E. 1/4, N. W. 1/4, Sec. 11, T. 26 N., R. 5 E.

This tract is located half a mile southeast of Keener and adjoins the Luke mine on the east. Developments consist of two 12 foot pits which have been sunk upon the south face of a low hill. One of these showed three feet of barren, cherty clay at the surface, beneath which was six feet of clay with some ore and three feet of pay ore in the bottom. The ore is a secondary limonite very largely of the pipe variety. The second pit showed no ore but an abundance of well rounded Tertiary pebbles throughout the first three feet of surface material. The only surface indications on the tract consisted of a little surface ore near the first pit. (C.—1910.)

12. THOMPSON (G. E.) BANK.

Owned by G. E. Thompson.

N. E. ¼, N. E. ¼, Sec. 7, T. 26 N., R. 6 E.

This property, located 2½ miles northeast of Hendrickson, is marked by an outcrop of secondary limonite in the form of large boulders scattered over an area of half an acre, on the crest of a low hill. Developments consist of several pits 5 to 6 feet in depth from which about one car load was mined and shipped during 1907. The ore is very largely of the pipe variety and occurs embedded in cherty clay. It contains very little chert and no sand.

A five foot pit, situated in a small ravine near the southwest corner of the tract, revealed boulders of secondary limonite of a massive texture, no pipe ore being found. The outcrop at this place was restricted to the immediate vicinity of the pit. (C.—1910.)

13. THOMPSON BANK.

Owned by Mrs. M. M. Thompson.

N. ½ Lot 1, N. W. ¼, Sec. 7, T. 26 N., R. 6 E.

This property is located about two miles northeast of Hendrickson and joins the Sexton tract on the east and the Scott tract on the south. Developments consist of two groups of pits, one of which is situated upon the brow of the east face of a hill and the other near its base. The upper group consists of a 30 foot cut, 12 feet wide and 8 feet deep, just below which is a six foot pit, and 100 feet north of the latter is a 45 foot shaft. The cut is now badly caved but it is reported to have produced about a car load of ore. The six foot pit showed very little ore. The 45 foot shaft produced less than 500 pounds of ore, which was found scattered throughout its depth embedded in clay. The ore is a secondary limonite, chiefly of the boulder form. The surface showing is not strong and covers an area of about an acre in the immediate vicinity of the pit.

The lower group of pits is situated in an old orchard about 200 yards east and 50 feet below those just described. One pit, 30 feet long, 12 feet wide, and 6 feet deep, showed a good face of pipe ore from the surface to the bottom. The dirt is reported to have been about four-fifths ore. A second pit, 15 feet south of the first, showed considerable ore in the bottom. A third and fourth pit, 50 and 75 feet respectively from the larger cut, showed no ore. The only surface indication of ore at this place was a small outcrop, upon which the larger cut was made. The ore in all cases is secondary after the sulphide and uniformly of good grade. (C.—1910.)

14. TURNER MINE.

Owned by Henry Casey, Keener, Mo.

S. W. ¼, N. E. ¼, Sec. 11, T. 26 N., R. 5 E.

This mine, located 1½ miles east of Keener, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened by Mr. Henry Turner in 1907 at which time 23 tons were mined and shipped. The ore gave returns of 56.04% iron, 7.90% silica, 0.103% Phos., 0.11% Mn., and 3.0% moisture, which indicates that it is a good quality of secondary limonite. (C.—1910.)

PRIMARY LIMONITE.

15. ALLEN BANK.

Owned by St. Francois River Land and Iron Company, Poplar Bluff, Mo.

E. ½, Lot 2, N. W. ¼, Sec. 4, T. 24 N., R. 6 E.

This prospect, located about one mile west of Poplar Bluff, consists of an outcrop of silicious, primary limonite which cap the points of two low hills. One shallow pit sunk within the outcrop produced several tons of ore but did not determine the depth of the deposit. The ore occurs in large boulder-like masses which weigh nearly a ton each. It is exceedingly porous and contains silica in the form of both chert and sand. The ore taken from the bottom of the pits appears to be less cherty than that occurring at the outcrop. (C.—1910.)

16. BLUE SPRING BANK.

S. E. ¼, S. E. ¼, Sec. 26, T. 26 N., R. 7 E.

Here the ore is found in large and small pieces, and in one place in a solid bed, overlying an outcrop of ten feet of Third Magnesian limestone, which shows at thirty feet above the bottom of the hill. The ore is in an outcrop about seventy-five feet along the slope, and thirty feet wide. It is quite sandy. (M.—1873.)

17. DEAL MINE NO. 1.

Owned by E. E. Deal, Hilliard, Mo.

N. E. ¼, S. E. ¼, Sec. 9, T. 25 N., R. 6 E.

This mine, located about half a mile east of Hilliard, is situated near the head of a small ravine which drains to the south. Developments consist of one large opening 100 feet long, 40 feet wide, and 30 feet deep from which 1015 tons of ore were mined and shipped during 1908. The face of the pit shows a few scattered boulders of silicious, brown ore embedded in cherty clay. The ore is primary limonite and is highly silicious, due to the presence of both sand and fragments of chert. Locally it is exceedingly cherty and resembles more nearly an iron chert breccia. An average of six shipments is as follows: 48.60% iron, 14.96% silica, 0.067% Phos., 0.49% Mn., and 3.6% moisture. (C.—1910.)

18. DEAL MINE NO. 2.

Owned by E. E. Deal, Hilliard, Mo.

N. W. ¼, S. E. ¼, Sec. 9, T. 25 N., R. 6 E.

This mine, located a quarter of a mile east of Hilliard, is situated near the top of the west face of a high, chert covered hill. Developments consist of an open cut 60 feet long, 40 feet wide, and 25 feet deep from which nine car loads of ore have been shipped to the lead smelter at Herculaneum. The ore is a silicious, primary limonite very similar to that obtained from Mine No. 1. It was sold for $2 per ton F. O. B. Hilliard and is reported to have averaged 44% iron.

On the S. E. ¼ of the S. E. ¼ of the same section, is an outcrop of primary limonite consisting of a few fragments of surface ore scattered along the crest of a high north and south ridge. Developments consist of four shallow pits, each of which show ore similar in character and occurrence to that described under mines Nos. 1 and 2. In one pit small pockets of manganese, in the form of pyrolusite and wad, were encountered. Fifty-two tons of this ore, shipped during 1909, gave returns of 39.91% iron, 16.70% silica, 0.066% Phos., 6.42% Mn., and 3.0% moisture. (C.—1910.)

19.

DOVER MINE.

Owned by Geo. Dover, Hilliard, Mo.

S. E. ¼, N. E. ¼, Sec. 17, T. 25 N., R. 6 E.

This mine, located about one mile southwest of Hilliard, is situated on the crest of a low ridge which borders Black river on the west. The outcrop consists of boulders of primary limonite which are scattered over an area of half an acre. It has been opened by two shallow cuts, from which a car load of ore was mined and shipped during 1907. The ore is of the usual, porous type and is highly silicious due to the presence of both chert and sand. (C.—1910.)

20.

GEORGE TRACT NO. 1.

Owned by Ed. George.

S. W. ¼, Sec. 24, T. 26 N., R. 7 E.

This deposit is located just west of the St. Francois river and is approximately one mile from the St. Louis and San Francisco R'y. at a point 2½ miles northeast of Rombauer. The outcrop is composed of scattered boulders of brown ore which occur over an area 225 yards long by 100 yards wide. Developments consist of two pits 30 and 18 feet deep. The deeper pit shows very little ore. The 18 foot pit shows cellular, primary limonite and thin layers of chert embedded in red clay. The ore is somewhat silicious due to the presence of chert and sand. (B.—1910.)

21.

GEORGE TRACT NO. 2.

N. E. ¼, Sec. 24, T. 26 N., R. 7 E.

This deposit, located three miles northeast of Rombauer, is situated on the crest of a secondary ridge 200 yards west of the St. Francois river. Boulders of primary limonite, intermingled with blocks of sandstone, quartzite, and chert, outcrop for a distance of 180 yards along the crest of the ridge, on the higher portions of which Tertiary pebbles are abundant.

Developments consist of an open cut 20 feet in diameter and 10 feet deep, and two test pits, each of which have a depth of 30 feet. The open cut is situated on the point of the ridge and exposes a six foot ledge of cellular, sandy limonite overlain by three feet of Tertiary pebbles. The upper portion of the ore bed is conglomeratic, consisting of Tertiary pebbles cemented with limonite. The pits are located 180 yards apart, and show throughout their depth thin layers of silicious limonite interbedded with decomposed dolomite and layers of hard chert. The ore is the porous, cellular type enclosing fragments of chert and grains of sand. No shipments have been made. (B.—1910.)

22. GEORGE TRACT NO. 3.

N. W. ¼, N. W. ¼, Sec. 25, T. 26 N., R. 7 E.

This prospect consists of an outcrop of primary limonite in the form of fragments and occasionally boulders scattered over an area 50 yards long by 40 yards wide in a small ravine.

The ore varies in texture from compact to cellular, and contains some sand, although it is not notably silicious.

Tertiary pebbles and boulders of sandstone and chert cap the surrounding hills. (B.—1910.)

23. GOVERNMENT LAND NO. 1.

S. E. ¼, S. E. ¼, Sec. 24, T. 25 N., R. 4 E.

Here the limonite covers an area about thirty yards square, on a bench on the slope of a chert covered hill. The ore is but fair in quality, being slightly siliceous, silica occurring as chert. Within the area little else than the ore is seen, but on all sides are many chert fragments. The St. L., I. M. & S. Ry. is about thirteen miles from this deposit. (L.—1892.)

24. HILL MINE.

Owned by David Hill, Poplar Bluff, Mo.

N. W. ¼, Sec. 4, T. 25 N., R. 6 E.

This mine, located about two miles north of Hilliard and half a mile east of the St. Louis, Iron Mountain and Southern R'y., was opened in 1907. Developments consist of three small cuts, two of which are upon the crest of a ridge and the third in a small ravine at its base. The two cuts upon the ridge are 15 and 30 feet in diameter and about 5 feet deep. They show an abundance of large and small boulders of porous, brown ore embedded in a red, cherty clay, and are reported to have produced several car loads of fair grade ore. The cut in the ravine is a narrow 20 foot trench which was apparently in nearly solid ore. Some ore outcrops in the immediate vicinity of each of the pits but there is no continuity of outcrop.

The ore consists of large boulders and small fragments of a somewhat silicious, dark brown, primary limonite containing pot-like cavities which enclose clay and are lined with botryoidal growths of goethite which, in places, nearly fills the cavities. Some sand occurs in the dense ore although there is little or no chert. The presence of unusual quantities of goethite greatly improves the quality of the ore. No important amount of wash dirt was observed about the pits. (C.—1910.)

25. HILLIS MINE.

Owned by Alford Hillis, Hendrickson, Mo.

N. W. ¼, N. E. ¼, Sec. 23, T. 26 N., R. 5 E.

This mine, located 1½ miles southwest of Hendrickson, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened in 1907 by Mr. Alfred Hillis, who shipped 61 tons of ore. The ore is a somewhat silicious limonite, which gave returns of 47.96% iron, 14.30% silica, 0.089% Phos., 1.50% Mn., and 3.50% moisture. Judging from the analysis, it is of the primary type. (C.—1910.)

26. HOOPER MINE.

Owned by St. Francois River Land and Iron Company, Poplar Bluff, Mo.

N. E. 1/4, N. W. 1/4, Sec. 28, T. 25 N., R. 6 E.

This mine, located about two miles northwest of the city of Poplar Bluff, is situated on the north slope of a hill, as shown by the accompanying

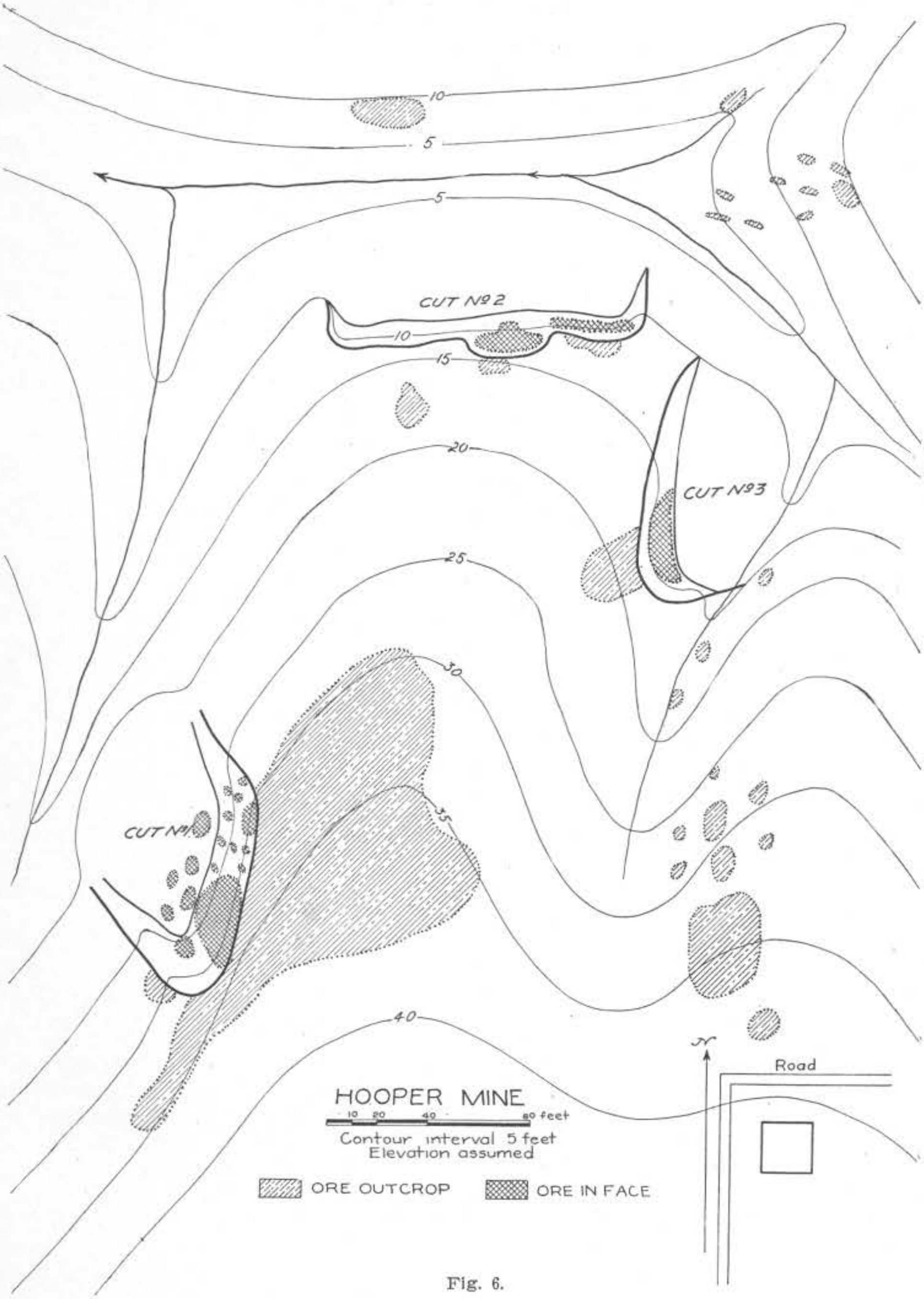


Fig. 6.

topographic sketch. (Fig. 7.) The outcrop is composed of large boulders of porous, brown ore occurring at intervals over an area of about two acres.

The mine consists of three open cuts flanking the hillside. Cut No. 1, on the west side of the hill, is 100 feet long and 50 feet wide with a maximum depth of 10 feet. The face and bottom of this cut shows many large boulders of ore embedded in a cherty clay. Some of the boulders weigh several tons each. Cut No. 2, at the north end of the hill, is 125 feet long and 20 feet wide with a maximum depth of 9 feet. Boulder ore is exposed in the face at the east end of this pit, directly above which the ore outcrops. Pit No. 3, on the east flank of the hill, is 90 feet long and 30 feet wide with a maximum depth of 10 feet. Some ore is exposed in the face of this pit at a point immediately beneath a small surface showing. The ore is a porous, primary limonite and is silicious, due to the presence of fragments of chert and sand.

This property was opened in 1908 and about 200 tons of ore, which ran 44.71% iron, 18.70% silica, 0.080% Phos., 2.10% Mn., and 4.00% moisture have been mined and shipped. (C.—1910.)

27. INDIAN FORD BANK NO. 1.

N. ½, N. E. ¼, Sec. 24, T. 26 N., R. 7 E.

Here the ore is found on a low hill, not above fifty feet high. The ore lies on the southeastern slope of the hill in an oblong mass (or rather two masses with a vacant space between them), about three hundred feet long and one hundred at its widest. It reaches about half way down the hill. The most of this ore outcrop is in large pieces, but in the center they lie so closely connected as to seem an almost solid mass of broken ore. In quality it is porous and cherty, rather than sandy. (M.—1873.)

28. INDIAN FORD BANK NO 2.

N. E. ¼, Sec. 23, T. 26 N., R. 7 E.

The principal mass of the limonite ore at this point lies on the southeast slope of a hill about one hundred and ten feet high. It shows at its thickest about ten feet below the top, although it is thinly scattered over the top and thick again at about the same level on the northwest. It reaches some thirty feet below the summit, extending down in a belt about eighty to one hundred feet wide. In its most promising outcrop it shows apparently solid but limited in extent, while the most of the ore is in large pieces. The quality of the ore is poor, being both cherty and sandy. (M.—1873.)

29. INDIAN FORD BANK NO. 3.

S. ½, N. W. ¼, Sec. 23, T. 26 N., R. 7 E.

The ore here occurs on the southeastern slope of a hill about thirty feet high. Near the top it shows an almost entirely coherent mass, seventy-five feet to one hundred feet long, and extends with this width down the slope, about one hundred and fifty feet, in an outcrop of broken pieces, ranging from six inches to three feet in diameter. The ore is porous and quite free from chert, but is inclined to be sandy. (M.—1873.)

30. INDIAN FORD BANK NO. 4.

S. ½, N. W. ¼, Sec. 22, T. 26 N., R. 7 E.

This is a large deposit of ore, occurring on the northwestern slope of a hill about fifty feet high. Near the top, the ore lies in an apparently coherent mass, and below, it scatters, spreading over a large area. The ore is lean, soft and sandy. (M.—1873.)

31. LEIB BANK.

Owned by Frank Leib, Harrisburg, Pa.

N. W. ¼, S. W. ¼, Sec. 28, T. 25 N., R. 6 E.

This prospect is located about three miles west of Poplar Bluff and about half a mile southwest of the Hooper mine. It consists of an outcrop of silicious, primary limonite covering an area of about four square rods along the county road. A 20 foot shaft, sunk near the north edge of the outcrop,—as a prospect for clay,—shows considerable highly silicious ore mixed with chert and clay. The area within the outcrop has not been tested. (C. 1910.)

32. MILLER LAND.

Owned by Ed. Dennis, Hilliard, Mo.

N. W. ¼, N. E. ¼, Sec. 35, T. 26 N., R. 6 E.

This prospect, located 3½ miles northeast of Hilliard, consists of an outcrop of cellular, primary limonite, situated on the points of two low hills which are about 200 yards apart. Dolomite of the Gasconade formation is exposed along the stream bed below the outcrop.

The ore is silicious, due to the presence of both sand and chert. That composing the eastern outcrop contains some goethite lining cavities. No developments have been made. (B.—1910.)

33. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 10.

S. W. ¼, N. W. ¼ and N. W. ¼, S. W. ¼ } Sec. 27, T. 25 N., R. 4 E.

This tract, located 13 miles southeast of Grandin, bears an outcrop of brown ore which covers an area of about two acres on the southeast point of a high, chert covered hill. Developments consist of six pits varying from 8 to 30 feet in depth, the distribution of which are shown on the accompanying topographic sketch. (Fig. 8.)

No. 1 pit, 30 feet deep, is reported to show ore to a depth of 20 feet with 10 feet of clay and flint in the bottom. The ore is a porous, primary limonite containing some fine sand and small, irregular flakes of decomposed chert, but, on the whole, is of merchantable grade and appears to occur in massive boulders with very little clay. Apparently, it grades downward into a ferruginous chert and clay. A heavy outcrop of boulder ore occurs about this pit. Pit No. 2, 17 feet deep, is reported to show ore in clay and flint to the bottom. The dump shows considerable ore which is mixed with more clay and flint than at pit No. 1. Pit No. 3, 20 feet deep, is reported to show 18 feet of ore. The best of this ore is exceedingly porous, contains much clay and chert, and is not merchantable. Pit No. 4, 23 feet deep, shows ore throughout its depth from within three to four feet of the surface. The ore occurs in large massive boulders as in pit No. 1 and grades into ferruginous chert and clay below. There is considerable dense, argillaceous ore which lies in solid masses and grades into the porous ore. A few boulders of very porous silicious ore out-

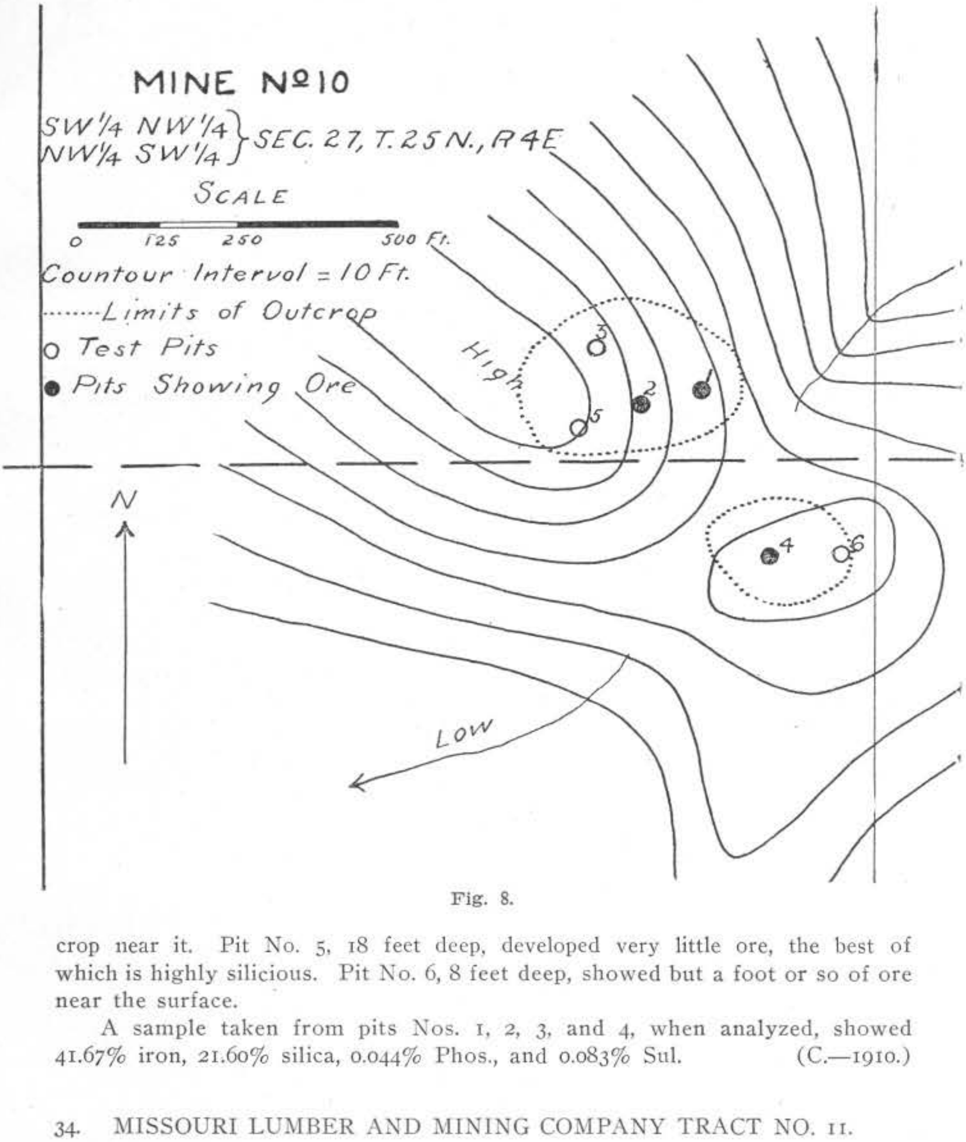


Fig. 8.

crop near it. Pit No. 5, 18 feet deep, developed very little ore, the best of which is highly silicious. Pit No. 6, 8 feet deep, showed but a foot or so of ore near the surface.

A sample taken from pits Nos. 1, 2, 3, and 4, when analyzed, showed 41.67% iron, 21.60% silica, 0.044% Phos., and 0.083% Sul. (C.—1910.)

34. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 11.

S W. ¼, N. W. ¼, Sec. 35, T. 25 N., R. 4 E.

This tract is located 12 miles west of Poplar Bluff and about one mile southeast of tract No. 10. It has been prospected by eight pits which are distributed over the crest and southeast face of an east pointing spur upon the surface of which a few boulders of silicious, primary limonite outcropped. Four pits sunk along the southeast face of the hill, and varying from 8 to 23 feet in depth, showed no ore. One pit sunk 30 feet in the bed of the ravine at the base of the hill shows streaks of dense, silicious ore one to two feet thick, interspaced with clay and flint of about the same thickness to a depth of 23 feet, and bottomed in white clay.

A 27 foot drift, extending into the base of the hill from this pit, cut yellow clay with a few thin seams of ferruginous material but no merchantable ore. A 13 foot pit, sunk at the end of this drift, shows cherty clay bearing seams of ore which increased in thickness toward the bottom where the ore is reported to be solid. An old pit, at the east end of the hill, perhaps 10 feet higher than the pit last described, shows considerable ore on the dump. This pit is reported to have been originally 20 feet deep and to show ore to the bottom. However, its present caved condition makes inspection impossible. (C.—1910.)

35. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 12.

N. E. ¼, S. W. ¼, Sec. 36, T. 25 N., R. 4 E.

This tract is located 10 miles west of Poplar Bluff and about 1½ miles southeast of tract No. 11. It bears two unusually fine outcrops of primary limonite, situated near the base of the southeast face of a high hill. Both of these outcrops have been prospected by a number of test pits, the relative

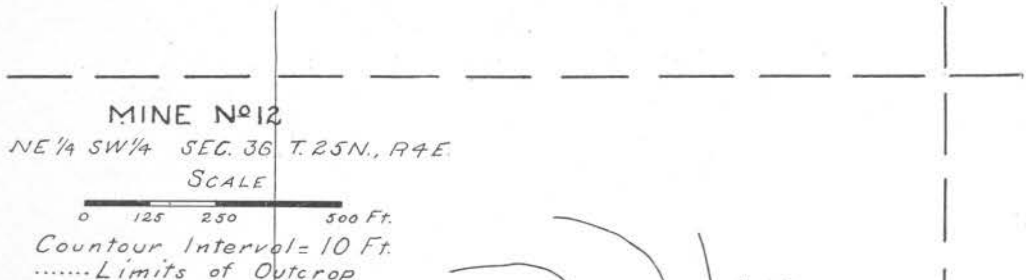


Fig. 9.

position of which may be seen on the accompanying topographic sketch. (Fig. 9.) As numbered on this sketch, the several pits may be described as follows:

Pit No. 1, 22 feet deep, shows 10 feet of silicious ore at the top with 12 feet of sand and flint in the bottom. This pit is at the very edge of the ravine on a steep slope. Large boulders of ore outcrop on the bank below the shaft and the ore runs to about the level of the ravine. Pit No. 2, 27 feet deep, shows only yellow sand and flint. However, large boulders of ore outcrop all about and below it. Pit No. 3, 33 feet deep, showed a dense, silicious ore to a depth of 23 feet with sandy clay and flint in the bottom. It is situated on a point about 12 feet above the stream bed and heavy boulders of cherty ore outcrop all about it. Pit No. 4, 15 feet deep, shows two feet of surface clay, two feet of ore, and 11 feet of sand and ferruginous chert. Pit. No. 5, 23 feet deep, showed fair ore to a depth of five feet. This ore is in general like that occurring in pits Nos. 6 and 10. Pit No. 6, 23 feet deep, is reported to show ore the entire depth. The dump shows a highly silicious limonite badly mixed with yellow, sandy, decomposed chert. Pit No. 10, 27 feet deep, is reported to show ore to a depth of 25 feet. The ore on the dump is similar to that of shaft No. 6.

Samples, taken from pits Nos. 3, 5, 6, and 10, and from the outcrop, when analyzed, showed results as follows:

No.	Pit.	Iron.	Silica.	Phos.	Sulphur.	Combined water.
1	No. 3	40.84%	24.90%	0.081%	0.069%	....
2	No. 5	31.54	30.67	0.029	0.025	9.903%
3	Nos. 6 and 10	31.43	30.10	0.044	0.136	....
4	Outcrop	48.10	16.74	trace	0.025	10.30

(C.—1910.)

36. MISSOURI UNIVERSITY LAND NO. 1.

S. W. ¼, S. W. ¼, Sec. 3, T. 25 N., R. 6 E.

This deposit, located one mile northeast of Hilliard, consists of a heavy outcrop of primary limonite which extends for a distance of 200 yards along the crest of a secondary ridge. A portion of the outcrop consists of a ledge and massive boulders of ore.

The ore is highly cellular and is silicious, due to the presence of decomposed and hard chert. (B.—1910.)

37. MISSOURI UNIVERSITY LAND NO. 2.

S. W. ¼, N. W. ¼, Sec. 15, T. 25 N., R. 6 E.

This property is located about one mile southeast of Hilliard and half a mile east of the St. Louis, Iron Mountain and Southern R'y. The outcrop consists of large boulders of primary limonite covering an area 170 by 100 yards, along the crest and upper slopes of a secondary ridge.

The ore is highly cellular and is somewhat silicious, due to the presence of small quantities of sand, chert, and clay. Goethite occurs lining cavities in the ore. No developments have been made. (B.—1910.)

38. MISSOURI UNIVERSITY LAND NO. 3.

N. E. ¼, Sec. 15, T. 25 N., R. 6 E.

This property, located about one mile southeast of Hilliard, consists of an outcrop of primary limonite which occurs along the crest of a ridge. The principal showing is confined to an area 200 feet long and 100 feet wide on the southeast quarter of that tract. No developments have been made. The ore is cellular and highly silicious, due to the presence of both sand and chert.

Near the center of the tract primary limonite outcrops at two places, one on the point of a secondary ridge and the other at the junction of the secondary and main ridges 300 yards to the southwest. The former outcrop consists of large boulders scattered over an area 200 feet long and 50 feet wide while the latter covers an area 400 feet by 150 feet.

The ore, at both places, is cellular and quite free from sand though occasional fragments of chert were observed. (B.—1910.)

39. SHARP LAND.

Owned by Boyd E. Sharp.

N. W. ¼, Sec. 35, T. 26 N., R. 6 E.

This prospect, located about 3½ miles northeast of Hilliard, consists of an outcrop of cellular, primary limonite, which extends for about 100 yards along the crest of a ridge.

The ore is silicious from the presence of both sand and chert. Some goethite occurs, lining cavities in the ore.

Adjoining this tract, on the east, is an area of 40 acres, over which occur scattered boulders of limonite. Here, a 23 foot pit is reported to have encountered boulders of ore embedded in clay throughout its depth. The ore contains much sand and chert. (B.—1910.)

40. SHEETS LAND.

Owned by M. M. Sheets, Williamsville, Mo.

W. ½, Sec. 12, T. 26 N., R. 4 E.

This tract, located three miles west of Keener, bears an outcrop of primary limonite covering an area of about five acres. Developments consist of four shallow pits, the largest of which is 20 feet long, 12 feet wide, and 5 feet deep. All four pits show an abundance of ore embedded in cherty clay. The depth of the ore was not determined.

The ore is highly cellular and is silicious, due to the presence of fragments of hard and decomposed chert and sand. Much of it is merchantable and the prospect warrants further development.

Near the eastern edge of the tract is a similar outcrop of primary limonite covering an area of about two acres. No developments have been made. The ore at this place is more silicious than that on the western portion of the tract. Some of it is hard and dense and grades into a light brown, ferruginous chert. (C.—1910.)

41. SHROUT'S BANK.

N. E. ¼, N. E. ¼, Sec. 16, T. 25 N., R. 6 E.

The ore here lies in scattered lumps, for a distance of five hundred feet along the steep slope, and perhaps one hundred feet wide, while, at one place at the top of the hill, a solid outcrop is seen showing six or seven feet in thickness of very cherty and siliceous limonite. The outcrop of solid ore does not show for any great length. There are in it occasional seams of better ore running through the mass, but the best showed silica in coarse grains. The whole outcrop is extremely sandy, and the ore of the solid outcrop is both sandy and cherty.

In the N. E. ¼, of the S. E. ¼, of this same section, there is a smaller outcrop of ore in large and small pieces scattered over an area one hundred feet east and west, by one hundred and seventy-five feet north and south; at some places the mass seems to be solid. The ore is porous, semi-concretionary and quite cherty, while many of the cavities of the concretions are filled with sand. (M.—1873.)

42. SMITH AND COMPANY BANK.

Owned by W. E. Smith and Company.

S. ½, Sec. 17, T. 25 N., R. 6 E.

This prospect, located about one mile west of Hilliard, is situated upon the crest of a northeast-southwest trending ridge, along which primary limonite outcrops at frequent intervals. Developments consist of three cuts, the largest of which is 25 feet long, 7 feet wide, and 7 feet deep. Each of the cuts showed considerable ore in the face and in the bottom. The ore is highly silicious, due to inclusions of both sand and fragments of chert. No shipments have been made. (C.—1910.)

43. ST. FRANCOIS BANK.

S. ½ N. W. ¼, Sec. 24, T. 26 N., R. 7 E.

Limonite occurs here on a steep slope of a hill, about eighty feet high, which rises almost from the edge of the water, on the west side of the St. Francois river. The ore has been traced for a distance of five hundred and fifty feet along the hill. It lies scattered in immense boulders from the sixty-five foot level. At this height, for a distance of two hundred to three hundred feet, the ore shows a persistent outcrop, which seems in a number of places to be solid and is in position. The thickness of it could not be well ascertained. At the southern end of the hill the ore lies in greater abundance over a wider surface, and lower down on the hill, in broken pieces of greater or less size. Some two or three hundred yards to the southwest, on the bank of a small branch which flows into the St. Francois river, is a large amount of ore lying scattered in small boulders, on both sides of the creek. The ore is only medium in quality, being porous and sandy with small chert admixtures at some places. (M.—1873.)

44. ST. FRANCOIS RIVER LAND AND IRON COMPANY TRACT.

Owned by St. Francois River Land and Iron Company, Poplar Bluff, Mo.

S. ½, S. E. ¼, Sec. 18, T. 25 N., R. 6 E.

This prospect, located about two miles southwest of Hilliard, consists of an outcrop of primary limonite which covers an area 40 feet in diameter on the upper northeast slope of a high hill. The ore is of the usual porous, silicious character. No developments have been made. (C.—1910.)

45. TURK LAND.

Owned by John Turk.

N. W. ¼, S. E. ¼, Sec. 19, T. 25 N., R. 6 E.

This prospect, located about 2½ miles southwest of Hilliard, consists of an outcrop of primary limonite on the crest of a chert covered ridge. The ore is highly cellular and is silicious, due to the presence of both sand and chert. No developments have been made. (C.—1910.)

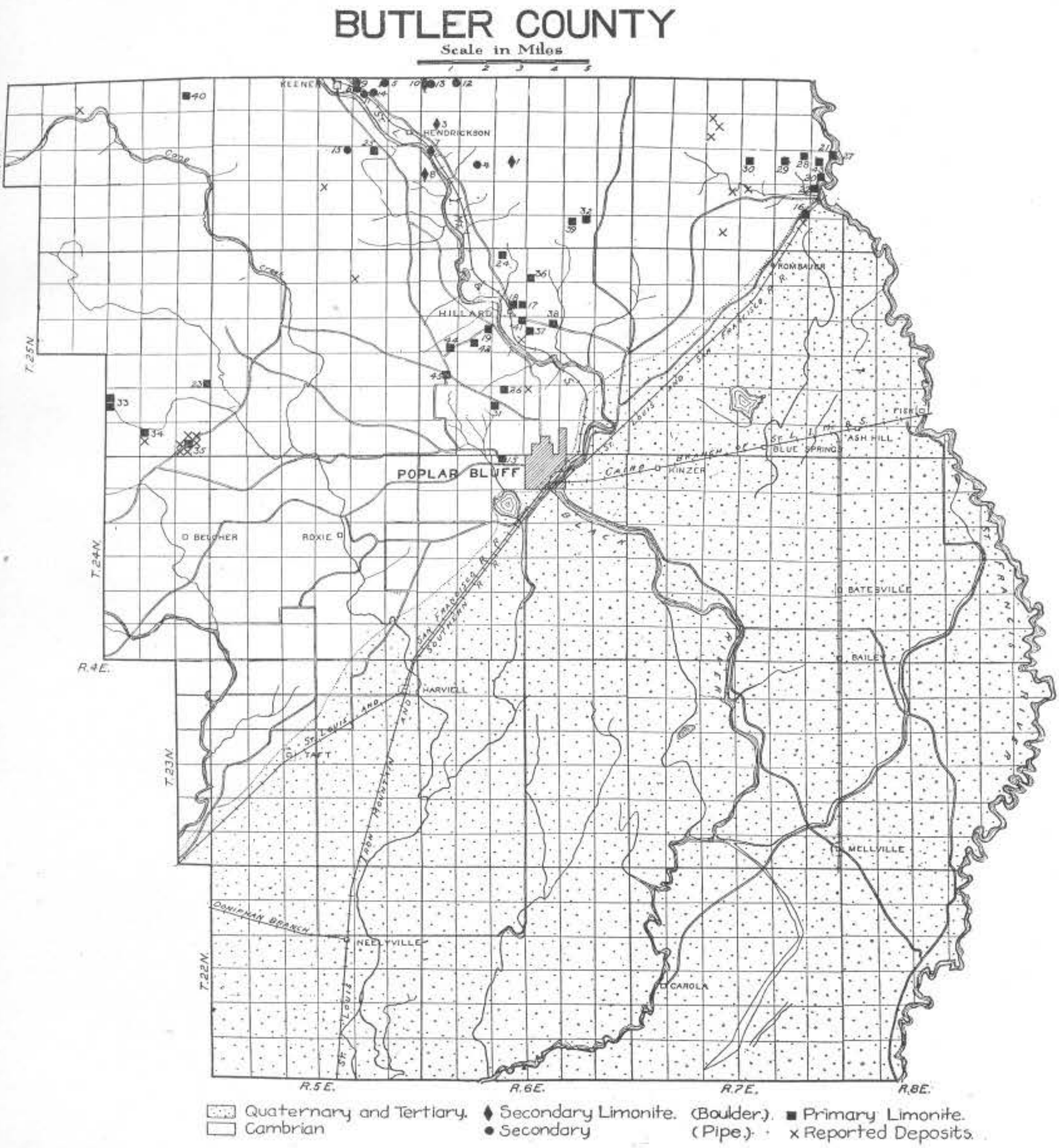
BUTLER COUNTY.

SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Agricultural College Land No. 1..	26	6 E.	21	
2	Burkett, W. R., Bank...........	26	5 E.	22	N. E. ¼, N. E. ¼.
3	Hendrickson Mine..............	26	6 E.	18	S. E. ¼, N. W. ¼.
4	Hendrickson, N. W., Land.......	26	6 E.	20	
5	Kauffman Mine.................	26	5 E.	11	N. E. ¼, N. E. ¼.
6	Luke Mine......................	26	5 E.	11	S. W. ¼, N. W. ¼.
7	Magill, H., Mine................	26	6 E.	19	E. ½ Lot 1, N. W. ¼.
8	Pletz, F., Mine No. 1............	26	6 E.	19	S. W. ¼, S. W. ¼.
9	Pletz, F., Mine No. 2............	26	5 E.	11	N. W. ¼, N. W. ¼.
10	Sexton, A. W., Bank............	26	6 E.	7	Lot 2, N. W. ¼.
11	Thomas, J. P., Land............	26	5 E.	11	S. E. ¼, N. W. ¼.
12	Thompson, G. E., Bank..........	26	6 E.	7	N. E. ¼, N. E. ¼.
13	Thompson, M. M., Bank.........	26	6 E.	7	N. ½ Lot 1, N. W. ¼.
14	Turner, Henry, Mine............	26	5 E.	11	S. W. ¼, N. E. ¼.

PRIMARY LIMONITE.

15	Allen Bank.....................	24	6 E.	4	E. ½ Lot 2, N. W. ¼.
16	Blue Spring Bank...............	26	7 E.	26	S. E. ¼, S. E. ¼.
17	Deal, E. E., Mine No. 1..........	25	6 E.	9	N. E. ¼, S. E. ¼.
18	Deal, E. E., Mine No. 2..........	25	6 E.	9	N. W. ¼, S. E. ¼.
19	Dover, Geo., Mine..............	25	6 E.	17	S. E. ¼, N. E. ¼.
20	George, Ed., Tract No. 1.........	26	7 E.	24	S. W. ¼.
21	George, Ed., Tract No. 2.........	26	7 E.	24	N. E. ¼.
22	George, Ed., Tract No. 3.........	26	7 E.	25	N. W. ¼, N. W. ¼.
23	Government Land No. 1..........	25	4 E.	24	S. E. ¼, S. E. ¼.
24	Hill, David, Mine...............	25	6 E.	4	N. W. ¼.
25	Hillis Mine......................	26	5 E.	23	N. W. ¼, N. E. ¼.
26	Hooper Mine....................	25	6 E.	28	N. E. ¼, N. W. ¼.
27	Indian Ford Bank No. 1.........	26	7 E.	24	N. ½, N. E. ¼.
28	Indian Ford Bank No. 2.........	26	7 E.	23	N. E. ¼.
29	Indian Ford Bank No. 3..........	26	7 E.	23	S. ½, N. W. ¼.
30	Indian Ford Bank No. 4.........	26	7 E.	22	S. ½, N. W. ¼.
31	Leib, Frank, Bank..............	25	6 E.	28	N. W. ¼, S. W. ¼.
32	Miller Land.....................	26	6 E.	35	N. W. ¼, N. E. ¼.
33	Mo. Lum. & Min. Co. Tract No. 10	25	4 E.	27	S. W. ¼, N. W. ¼. N. W. ¼, S. W. ¼.
34	Mo. Lum. & Min. Co. Tract No. 11	25	4 E.	35	S. W. ¼, N. W. ¼.
35	Mo. Lum. & Min. Co. Tract No. 12	25	4 E.	36	N. E. ¼, S. W. ¼.
36	Mo. University Land No. 1......	25	6 E.	3	S. W. ¼, S. W. ¼.
37	Mo. University Land No. 2......	25	6 E.	15	S. W. ¼, N. W. ¼.
38	Mo. University Land No. 3......	25	6 E.	15	N. E. ¼.
39	Sharp, Boyd E., Land...........	26	6 E.	35	N. W. ¼.
40	Sheets, M. M., Land............	26	4 E.	12	W. ½.
41	Shrout's Bank..................	25	6 E.	16	N. E. ¼, N. E. ¼.
42	Smith & Co. Bank..............	25	6 E.	17	S. ½.
43	St. Francois Bank...............	26	7 E.	24	S. ½, N. W. ¼.
44	St. Fran. Riv. L. & I. Tract......	25	6 E.	18	S. ½, S. E. ¼.
45	Turk, John, Land...............	25	6 E.	19	N. W. ¼, S. E. ¼.


BUTLER COUNTY
Scale in Miles
1 2 3 4 5
KEENER
HENDRICKSON
HILLARD
POPLAR BLUFF
BEECHER
ROXIE
ROMBAUER
BLUE SPRINGS
ASH HILL
KINZER
BATESVILLE
BAILEY
HARVIELL
TAFT
NEELYVILLE
CAROLA
MELLVILLE
DONIPHAN BRANCH
T.26N.
T.25N.
T.24N.
T.23N.
T.22N.
R.4E.
R.5E.
R.6E.
R.7E.
R.8E.
Quaternary and Tertiary.
Cambrian
Secondary Limonite. (Boulder).
Secondary (Pipe).
Primary Limonite.
x Reported Deposits.

REPORTED OCCURRENCES.

Name of Mine or Owner.	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
Carpenter, E.	25	5 E.	2	S. W. ¼, S. W. ¼.
Corrigan, J. C.	25	6 E.	27	N. W. ¼, N. W. ¼.
Owner Unknown	25	4 E.	35	N. W. ¼, S. W. ¼.
" "	25	4 E.	36	S. W. ¼, N. E. ¼.
" "	25	4 E.	36	S. E. ¼, N. W. ¼.
" "	25	4 E.	36	N. W. ¼, S. W. ¼.
" "	25	4 E.	36	S. ½, S. W. ¼.
" "	25	4 E.	36	N. W. ¼, S. E. ¼.
" "	25	5 E.	2	S. W. ¼, S. W. ¼.
" "	25	6 E.	16	N. E. ¼, S. E. ¼.
" "	26	4 E.	9	S. W. ¼, S. W. ¼.
" "	26	5 E.	27	N. W. ¼.
" "	26	7 E.	16	N. W. ¼.
" "	26	7 E.	16	S. E. ¼, N. W. ¼.
" "	26	7 E.	16	N. W. ¼, S. W. ¼.
" "	26	7 E.	27	N. W. ¼.
" "	26	7 E.	28	N. E. ¼.
" "	26	7 E.	33	
" "	26	7 E.	35	N. E. ¼.

CALLAWAY COUNTY.

HEMATITES OF THE CARBONIFEROUS.

1. BARTLETT LAND.

Owned by James Bartlett, New Bloomfield, Mo.

N. E. 1/4, Sec. 4, T. 45 N., R. 10 W.

This property is located about two miles east of New Bloomfield. It was prospected several years ago by two open cuts, one driven into the north and one into the south bank of a small ravine. The north cut, which is the larger, was driven for a distance of 60 feet in a northerly direction. It is about 12 feet wide and had a maximum depth of 10 feet. The material removed consisted of yellow, thin-bedded shale, red shale, sandstone, and red hematite. The ore is reported to have occurred as a bed in the bottom of the cut and to have had a maximum thickness of five feet. The cut in the south bank disclosed similar conditions.

From information obtainable, the ore body comprises two distinct types: (1) an earthy, fine-grained red ore, and (2) distinct lenses of hard, compact, red hematite, included in the former. The former type presents a soft, velvety appearance on fresh fracture. The hard compact hematite readily breaks into shell-like fragments on the blow of a hammer, which discloses a concentric structure. Both types of ore were observed in the dump pile.

A sample of the hard blue ore shows an analysis of 56.93% iron, 8.20% silica, 0.049% Phos., and 2.23% combined water; the earthy ore shows an analysis of 58.69% iron, 6.26% silica, 0.018% Phos., and 3.22% combined water.

Conglomeratic sandstone, having a slight dip to the east, outcrops in the stream bed a few yards east of the cuts. From this and other evidences, it is probable that the ore occupies a trough in the underlying Burlington limestone. (H.—1910.)

2. DUNN BANK.

Owned by Dunn Heirs, New Bloomfield, Mo.

Sec. 32, T. 46 N., R. 10 W.

This bank, located about 1½ miles east of New Bloomfield, was prospected 30 years ago, the pitting covering an area of 20 acres. Shafts,—the deepest of which was 32 feet,—are reported to have penetrated a body of red hematite averaging seven feet in thickness. The following descending section is reported by Mr. F. L. Nason, who visited the property in 1891:

5 to 7 feet.	Clay and chert.
6 "	Fossiliferous sandstone conglomerate.
7 "	Ore.
3 "	Unknown.
	Burlington limestone.

Mr. Nason also reports that the ore and conglomerate were exposed in a small ravine east of the shafts, but these exposures were covered by detritus at the time of a recent visit.

The ore body is reported to consist of a dense, crumbly red hematite containing lenses of hard, compact hematite of a darker color. The following analysis was made in 1892 by the St. Louis Sampling and Testing Works on samples collected by F. L. Nason: Iron, 57.20%; insoluble matter, 9.66% Phos., 0.07%.

Shaft Hill, which is located across a ravine south of the Dunn Bank, was visited in 1872 by Dr. A. Schmidt, who reports the conglomerate and sandstone as underlying the ore bed. At the time of a recent visit to Shaft Hill, these beds were not exposed. (H.—1910.)

3. DUNN (RICHARD) BANK.

Sec. 21, T. 46 N., R. 10 W.

Strata of red hematite are perceptible three miles north of New Bloomfield, on the road to Fulton. The ore outcrops in the road for a distance of about 12 feet down the slope. Sandstone shows above and below the ore. A quarter of a mile west, on the same slope and level, stratified ore has been found immediately below the soil. (S.—1872.)

4. HENDERSON BANK.

Sec. 12, T. 45 N., R. 11 W.

Here numerous and rounded surface ore is seen in several places on the two hills, west of the road; loose surface ore along the road on the northern slope of the eastern hill; a small and indistinct outcrop of stratified ore at the foot of this hill, near the ravine, and finally loose surface ore in the ravine. The two western hills are composed of Encrinital limestone which is laid bare in several places and seems to reach the summits. Loose ore has been ploughed up on the plateau on the northern hill. The ore is dark red, fine grained hematite in thin layers, and is associated with layers of chert. The exposure extends over a few feet only. (S.—1872.)

5. KNIGHT BANK.

Sec. 2, T. 46 N., R. 10 W.

Here a fine outcrop of dense and fine grained hematite is seen on the eastern slope of a low hill. The ore is more than two feet thick. It can be seen in only two places, about twenty feet apart. Due east of this hill, small and large pieces and plates of ore are found loose in the bed of Middle Auxvasse creek. On the low hill just south of the hill, on which ore was just described as occurring, outcrops of ferruginous sandstone overlaid by thin seams of red ore are noticed. These outcrops are on both the northern and southern slopes. (S.—1872.)

6. MURPHY'S HILL.

Sec. 15, T. 45 N., R. 10 W.

Here no ore is to be seen in place, but large, somewhat rounded pieces and plates of red ore are found in two ravines. The hill itself seems to be composed of sandstone. Large masses of limestone are, however, projecting from the lower part of the slope, apparently between the sandstone. (S.—1872.)

7. OLD DIGGINGS.

Sec. 22, T. 45 N., R. 10 W.

Here the lower part of the hill seems to be composed of sub-carboniferous limestone, the upper of ferruginous sandstone. Large and small fragments of chert are found all over the ground. The red hematite has been discovered near the top of the hill, on both sides of the ravine. On the western, a hole was dug a number of years ago and it is said many tons of ore were taken out. On the east of the ravine, and rather close to it, an outcrop is perceptible, consisting of a five-inch stratum of solid, pure, red hematite. The total thickness cannot be seen. (S.—1872.)

8. SHAFT HILL.

N. W. ¼, Sec. 4, T. 45 N., R. 10 W.

Near the summit of a nearly round hill red hematite occurs in nodules or lenticular concretions, composed of several concentric layers, and apparently imbedded in loose sand, sometimes in thin layers, alternating with layers of loose sand, sometimes as thick, massive strata. A shaft was dug about thirty years ago on the eastern slope of the hill near a ravine, at a level considerably below the regular ore-bed. This shaft went eight feet through sand and broken ore and chert. Under the regular ore bed there is conglomerate of chert and sandstone, sandstone and limestone; above it occurs chert and soil. (S.—1872.)

CAMDEN COUNTY.

The iron ore deposits of this county consist exclusively of secondary limonite of which two occurrences are known. The residuum is thin and conditions are not favorable for large deposits. About 1873 a furnace known as the Osage Iron Works was built on the Osage river at a point about 15 miles above Linn Creek. This furnace is reported by Nason* to have been operated three or four years and then abandoned on account of the fact that no ore bodies were found sufficiently large to supply the furnace. Probably not more than 300 tons of pig iron were produced.

SECONDARY LIMONITE.

1. FURNACE BANK.

Lot 3, Sec. 4, T. 39 N., R. 18 W.

Limonite is found here, lying on the irregular surface of the Third Magnesian limestone, which makes up the main body of the hill. The ore seems to form in some places a layer of irregular thickness on the limestone and to fill pockets and cavities in this rock. One of these cavities was found to be at least twelve feet deep. The openings show a considerable quantity of good limonite. (S.—1872.)

2. WHITE BANK.

S. E. ¼, Sec. 7, T. 39 N., R. 18 W.

Limonite is found here in a bed, one to four feet thick. It occurs in the following section. Layers of yellow sand and variegated clays with more or less broken strata of sandstone; a layer of white chert one to three inches

*Nason, F. L., Iron ores of Missouri: Missouri Geol. Survey, 1892, p. 315.

thick; white and green clay in thin and irregular layers, with sand and chert, one to three feet thick; dark red to brown, strongly ferruginous clay or loam six inches to two feet thick; limonite soft and earthy, enclosing irregular masses of hard, solid ore of more or less stalactitic structure; a layer of decomposed limestone from two to thirty inches thick and the regular Third Magnesian limestone. (S.—1872.)

CAPE GIRARDEAU COUNTY.

The iron ore deposits of this county consist exclusively of primary limonite of the southeast Missouri type. The two deposits which have so far been brought to the attention of this Bureau are practically undeveloped. Twenty-five tons of ore, the source of which was not learned, were shipped from this county in 1907.

PRIMARY LIMONITE.

1. SHURBERN AND BURDEN LAND.

Owned by A. E. Shurbern and Albert Burden, Altenburg, Mo.

W. ½, Sec. 25, T. 33 N., R. 13 E.

This property is located two miles west of Neelys, the nearest shipping point on the Mississippi river and the St. Louis and San Francisco R'y. Brown ore outcrops along the crest and west end of a high, chert covered ridge. No developments have been made. The ore is a primary limonite which is, for the most part, highly silicious due to the presence of sand and fragments of chert. It is in part compact and in part porous. Where porous the cavities are often lined with a thin film of black velvety goethite. A drill hole near the west point of the ridge is reported to have struck white sandstone beneath the ore. (B.—1910.)

2. WEISS BANK.

Owned by Geo. Weiss, Cape Girardeau, Mo.

N. E. ¼, Sec. 10, T. 32 N., R. 13 E.

This property is located five miles northeast of Jackson and one mile from the Cape Girardeau and Chester R'y. The outcrop, which is situated near the head of a small ravine, consists of a few boulders of primary limonite scattered over an area of one acre. Developments consist of a small open cut ten feet deep the face of which exposes thin beds of soft, impure tripoli containing nodules of hard chert. This material is veined with a silicious limonite which replaces the tripoli. The surface boulders average one foot or more in diameter and break with a rough, splintery fracture. They are brown in color, often containing thin veins of goethite and decomposed chert fragments. Some of them have a roughly laminated structure. No ore has been shipped. (B.—1910.)

REPORTED OCCURRENCES.

N. E. ¼, Sec. 10, T. 30 N., R. 12 E.
N. W. ¼, Sec. 10, T. 31 N., R. 13 E.

CARTER COUNTY.

Carter county ranks sixteenth in the production of iron ore, having shipped a total of 3,517 tons. The iron deposits are exclusively brown ore consisting of both the secondary and primary types, the relative abundance, distribution, and locations of which are shown on the accompanying county map.

The ore occurs in the residuum overlying the Roubidoux and Gasconade formations which, aside from a few outliers of granite and porphyry, underlie the greater portion of the county.

The secondary deposits include both the pipe and boulder ores, several being very largely pipe ore. The primary deposits consist of the coarsely cellular, silicious ore characteristic of the Southeast District.

Iron mining began in this county in 1902, since which time 1,962 tons of secondary and 1,555 tons of primary limonite have been shipped.

SECONDARY LIMONITE.

1. BROWN (J. C.) LAND NO. 1.

N. ½, Sec. 35, T. 27 N., R. 1 E.

Limonite is found here extending from the point of a spur of a hill down a rather steep slope, covering the greater portion of an area two hundred and seventy-five feet long and fifty feet wide.

The ore occurs in the form of fragments and rough masses, or boulders of massive ore. At the point of the spur, and at the margin of the deposit, the ore is quite cherty, elsewhere it is non-siliceous. These boulders contain small ocherous particles; but, on the whole, are quite compact. Thirty feet down the slope a shaft forty feet deep was put down in 1882. The section here was as follows: loose ore fragments on the surface and in the red clay; at a depth of six feet, one side of the shaft is a mass of hard chert two feet thick with rough masses of good ore imbedded in the clay, on the other three sides ore occurs in this manner to a depth of twenty feet from the surface. Below this depth to the bottom of the shaft, which is also in ore, the ore is in a more solid bed, occurring in larger masses with a less amount of clay, rendering blasting necessary. Other *more shallow* holes have been dug within this deposit and iron was invariably found beneath.

This locality is about three miles distant from the Current River railway and there is now a strong probability that a spur from Chilton will be laid in the valley at the foot of the hill. This if built will bring this deposit only about one hundred and fifty yards from railroad transportation. (L.—1892.)

2. CARTER (A.) AND MISSOURI LUMBER AND MINING CO. LAND NO. 2.

Center of N. W ¼, Sec. 13, T. 26 N., R. 1 E.

On the property of Mr. Alex. Carter and of the Missouri Lumber and Mining Company. Limonite occurs here on the foot of a gradual slope covering eight or ten square yards. The ore is found in irregularly shaped masses. Higher up the hill, on steeper slopes, and mingled with the masses of iron ore, fragments of chert and small blocks of hard sandstone occur. The majority of the ore masses are of fair quality, others are siliceous, silica occurring as small chips of chert. This locality is but little more than one mile from Chilton. (L.—1892.)

3. CARTER CO. MILLING AND MERCANTILE COMPANY BANK.

S. E. ¼, Sec. 4, T. 26 N., R. 2 W.

This bank, located about one mile east of Fremont and 200 yards south of the St. Louis and San Francisco R'y., is situated on the north bank of a ravine. The outcrop covers an area 40 yards square, within which the surface is thickly strewn with boulders of limonite and scattered boulders of chert and sandstone. The only developments consist of a five foot test pit located near the center of the outcrop. This pit exposes pipe ore, embedded in red, sandy clay. The ore is free from chert and much of it is in small fragments that can be recovered only by washing. (B.—1910.)

4. HAHN BANK.

Owned by J. H. Hahn, Winona, Mo.

W. ½, S. W. ¼, Sec. 13, T. 26 N., R. 1 W.

This bank, located six miles south of Van Buren, is situated low on the point of a hill, bordering Chilton creek. The outcrops consist of large boulders of massive brown ore, extending from a small ravine up the east slope of the hill for a distance of 150 feet, completely covering an area of that diameter. Developments consist of several shallow pits, all of which show ore. One pit seven feet deep shows a nearly solid mass of ore throughout its entire depth.

The ore is a compact, dark brown, secondary limonite. It is somewhat silicious due to inclusions of sand and fragments of chert. (C.—1910.)

5. HOLLAND MINE.

Owned by Carter County Milling and Mercantile Co., Fremont, Mo.

N. W. ¼, S. W. ¼, Sec. 4, T. 26 N., R. 2 W.

This mine is located about one mile west of Fremont and is situated upon the west brow of a high hill. It consists of an open cut 40 feet long, 25 feet wide and 9 feet deep, from which 54 tons of ore were mined and shipped during 1903. The ore occurs embedded in residual, cherty clay and is composed chiefly of thin plates and botryoidal secondary limonite. That shipped gave returns of 51.87% iron, 10.87% silica, and 0.052% Phos.. The outcrop, consisting of occasional fragments of boulder ore, is restricted to the immediate vicinity of the cut. (C.—1910.)

6. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 18.

N. W. ¼, N. E. ¼, Sec. 16, T. 25, R. 3 E.

This tract is located about a quarter of a mile west of the south fork of Beaver Dam creek, and about three miles east of Grandin. The ore outcrops near the base of the west slope of a low hill over an area of about one acre. Developments consist of nine pits varying from 15 to 27 feet in depth, the distribution of which is shown on the accompanying topographic sketch. (Fig. 10.) Pits Nos. 1 to 5, which are within the area of outcrop, all show ore, while the remainder encountered only barren materials.

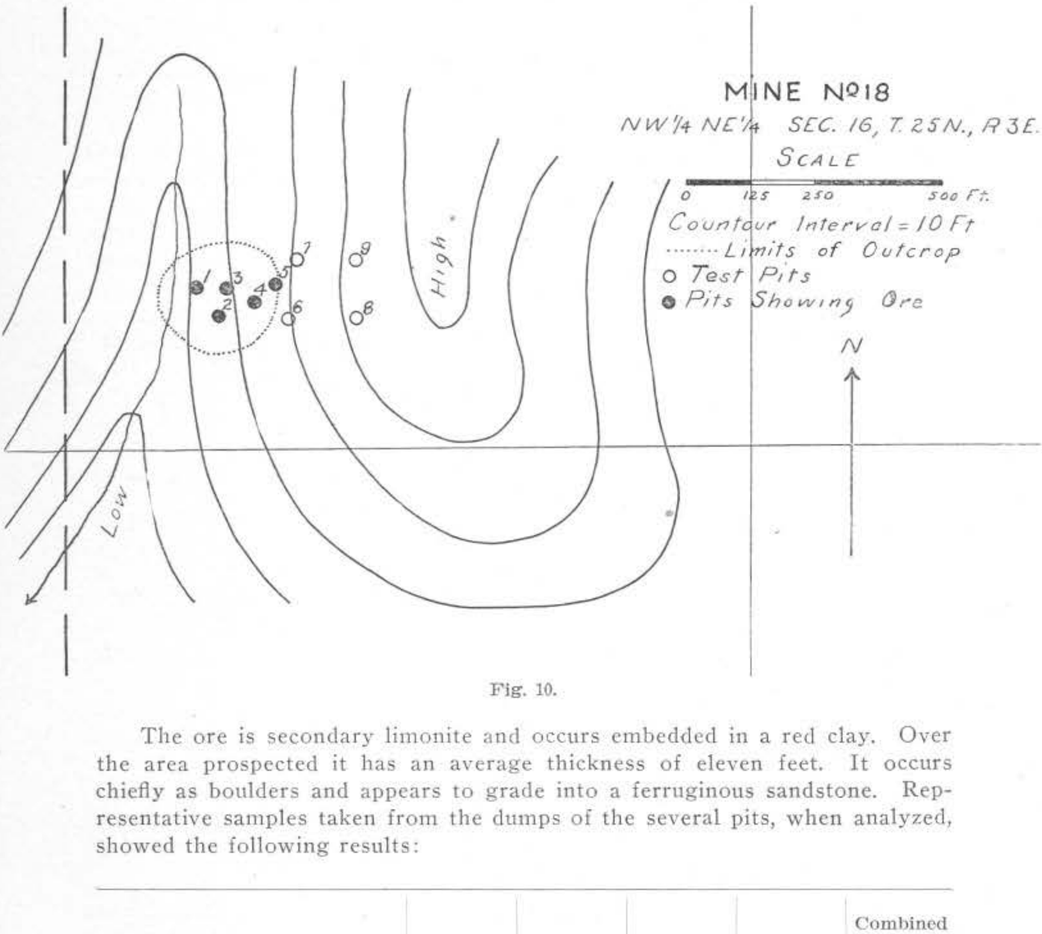


Fig. 10.

The ore is secondary limonite and occurs embedded in a red clay. Over the area prospected it has an average thickness of eleven feet. It occurs chiefly as boulders and appears to grade into a ferruginous sandstone. Representative samples taken from the dumps of the several pits, when analyzed, showed the following results:

Pit.	Iron.	Silica.	Phos.	Sulphur.	Combined water.
No. 1	58.109%	3.908%	0.094%	0.37%	11.22%
Nos. 2, 3, and 4	48.69	13.27	0.063	none	10.55
No. 5	49.54	10.90	0.115	0.151	....

(C.—1910.)

7. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 20.

S. E. ¼, N. W. ¼ }
N. E. ¼, S. W. ¼ } *Sec. 12, T. 25 N., R. 2 E.*

This deposit is located 1½ miles east of Grandin and is situated on the west slope of a chert covered hill. The outcrop extends over an area of about one acre. It has been opened by several small pits, the largest of which is 50 feet long, 20 feet wide, and 8 feet deep. Most of the pits show ore, of which three car loads were mined and shipped during 1909. The ore consists of small pipes and thin plates of secondary limonite, and occurs embedded in a cherty clay. Only the larger boulders have been loaded in mining, though much of the dirt will run about one-third wash ore. The ore shipped gave returns of 56.37% iron, 6.20% silica, 0.106% Phos., 0.11% Mn., and 1.07% alumina.

(C.—1910.)

8. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 22.

S. ½, S. W. ¼, Sec. 2, T. 26 N., R. 1 E.

This deposit, located one mile northwest of Chilton, has been developed by ten pits which have been sunk within an area of approximately four acres. As shown on the accompanying topographic sketch, Fig. 11, these pits occur in three groups about the head of a steep ravine.

Of pits Nos. 1, 2, and 3, No. 2 alone shows ore. This pit was sunk at the head of a small open cut and disclosed 20 feet of secondary limonite, mostly of the pipe variety, embedded in red clay and underlain by barren materials. The lateral extent of the ore body is limited to holes Nos. 1 and 3. Some ore has been shipped from the open cut.

Of the second group of pits Nos. 4 to 8 inclusive, No. 5, 6, 7, and 8 show pipe and boulder ore in clay to an average depth of about seven feet.

The third group of pits Nos. 9 and 10 showed no ore.

A mine sample of the ore from pit No. 2, ran 58.81% iron, 3.34% silica, 0.116% Phos., 0.369% Sul., and 10.75% combined water. A similar sample from pits Nos. 5, 6, 7, and 8 showed 59.29% iron, 2.99% silica, 0.096% Phos., 0.299% Sul., and 11.25% combined water. (C.—1910.)

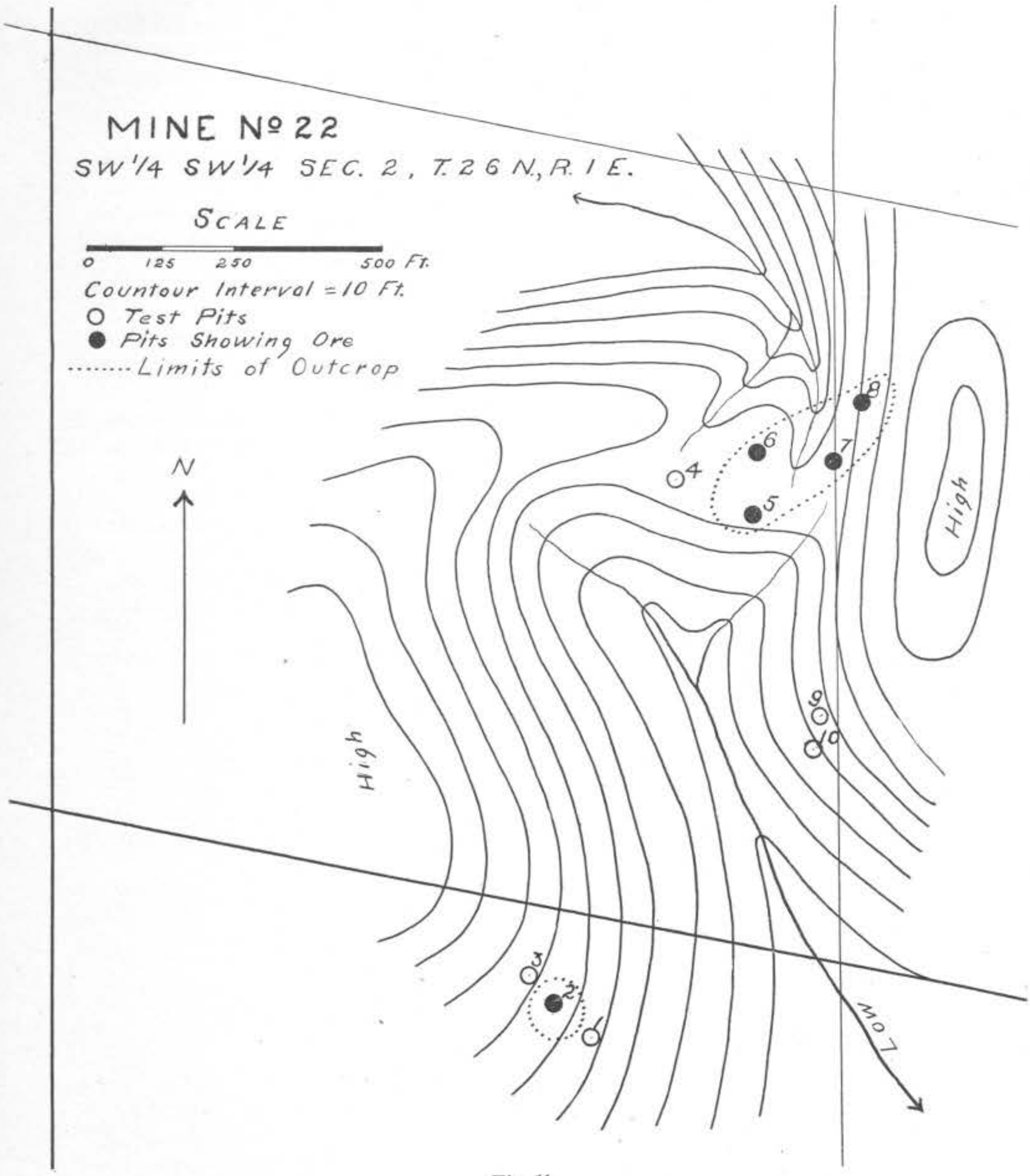

MINE Nº 22
SW 1/4 SW 1/4 SEC. 2, T. 26 N., R. 1 E.
SCALE
0 125 250 500 Ft.
Countour Interval = 10 Ft.
Test Pits
Pits Showing Ore
Limits of Outcrop
N
High
High
Low
1
2
3
4
5
6
7
8
9
10

Fig. 11.

9. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 23.

N. E. 1/4, N. W. 1/4, Sec. 2, T. 26 N., R. 1 E.

This deposit, located 1½ miles northwest of Chilton, outcrops over an area of about three acres on the east slope of a high, chert covered hill. (Fig. 12.) Developments consist of seven pits varying from 8 to 25 feet in

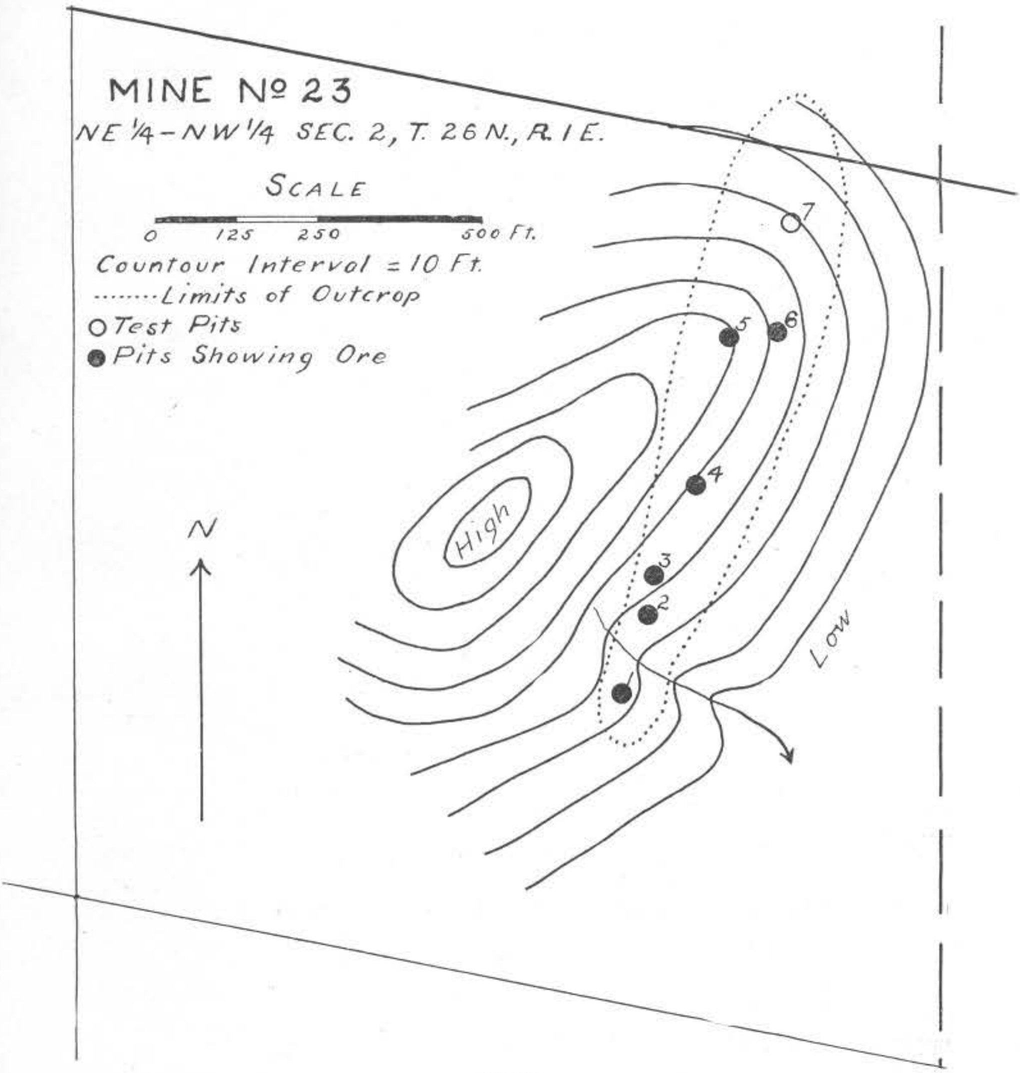


Fig. 12.

depth, five of which show ore. The thickness of the ore varies from 4 to 20 feet but averages about 8½ feet over an area of approximately two acres. The ore is a commercial grade of secondary limonite of both the boulder and pipe varieties. It occurs as large and small fragments embedded in a red, cherty clay, and usually lies from two to three feet below the surface.

Samples from pits Nos. 1, 3, and 5, when analyzed, gave results as follows:

Pit.	Iron.	Silica.	Phos.	Sulphur.
No. 1	53.77	9.40	0.107	0.082
No. 3	56.14	4.80	0.158	0.055
No. 5	57.19	4.20	0.121	0.068

(C.—1910.)

10. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 24.

S. W. ¼, S. W. ¼, Sec. 7, T. 26 N., R. 2 E. and the

S. E. ¼, N. E. ¼, Sec. 13, T. 26 N., R. 1 E.

This tract, located two miles southeast of Chilton and a quarter of a mile east of the Current river, is situated upon the crest and west slope of a hill 170 feet high. Developments consist of nine test pits, six of which show boulders of secondary limonite, embedded in cherty clay. The records of the pits are as follows:

Pit.	Depth.	Ore-bearing clay.	Barren clay.	Pit bottomed in
1	8 feet	6 feet	2 feet	Clay.
2	7 "	4 "	3 "	"
3	9 "	4 "	5 "	"
4	6 "	None	6 "	"
5	10 "	3 feet	7 "	"
6	30 "	5 "	25 "	"
7	20 "	None	20 "	"
8	8 "	4 feet	4 "	"
9	10 "	None	10 "	"

A sample of the ore taken from pits Nos. 1, 2, 3, 6, and 8, ran 59.93% iron, 0.079% Phos., 3.80% silica, 0.09% Mn. (Sampled by the Missouri Lumber and Mining Company and analyzed by the St. Louis Blast Furnace Company.) (C.—1910.)

11. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 26.

S. E. ¼, S. W. ¼, Sec. 11, T. 26 N., R. 1 E.

This tract, located three-quarters of a mile southwest of Chilton, and about one quarter of a mile south of the Current river, is situated upon the upper slope of a high, chert covered hill. Developments consist of seven test pits, five of which show boulders of secondary limonite embedded in cherty clay to depths ranging from 8 to 22 feet. The records of the pits are as follows:

Pit.	Depth.	Ore-bearing clay.	Barren clay.	Pit bottomed in
1..............	13 feet.........	None...........	13 feet.........	Clay.
2..............	8 "	"	8 "	"
3..............	10 "	8 feet.........	2 "	"
4..............	18 "	14 "	4 "	"
5..............	20 "	16 "	4 "	"
6..............	20 "	20 "	....	Ore +clay.
7..............	22 "	22 "	....	Ore +clay.

A sample of the ore taken from pits Nos. 3, 5, and 6 ran iron 59.77%, silica 2.63%, Phos. 0.062%, Mn., 0.07%. (Sampled by the Missouri Lumber and Mining Company and analyzed by the St. Louis Blast Furnace Company.)

(C.—1910.)

12. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 27.

E. ½, N. E. ¼, Sec. 14, T. 26 N., R. 1 E.

This tract, located one and a half miles south of Chilton, and half a mile south of the Current river, is situated in a deep ravine, draining south into a branch which empties into the Current river about one mile to the east. Developments consist of eight test pits, five of which show boulders of secondary limonite embedded in cherty clay to depths ranging from four to ten feet. The complete records of the pits are as follows:

Pit.	Depth.	Ore-bearing dirt.	Barren clay.	Pit bottomed in
1..............	15 feet	None...........	15 feet	Cherty clay.
3..............	14 "	"	14 "	" "
2..............	12 "	8 feet.........	4 "	" "
4..............	12 "	10 "	2 "	" "
5..............	8 "	None...........	8 "	" "
6..............	7 "	"	7 "	" "
7..............	10 "	4 feet.........	6 "	" "
8..............	8 "	8 "	....	Not indicated.

A sample of the ore taken from pits Nos. 3, 4, and 8, when analyzed, ran 57.91% iron, 5.30% silica, 0.167% Phos., and 0.14% Mn. (Sampled by the Missouri Lumber and Mining Company, and analyzed by the St. Louis Blast Furnace Company.)

A large quantity of ore is reported to outcrop in the vicinity of the pits.

(C.—1910.)

13. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 29.

W. ½, S. W. ¼, Sec. 12, T. 26 N., R. 1 E.

This tract, located one mile southeast of Chilton, is situated upon the crest and east slope of a range of hills. Developments consist of 9 test pits, four of which show boulders of secondary limonite embedded in cherty clay to depths ranging from four to eight feet below the surface. The records of the pits showing ore are as follows:

Pit.	Depth.	Ore-bearing clay.	Barren clay.	Pit bottomed in
3	12 feet	4 feet	8 feet	Cherty clay.
5	18 "	7 "	11 "	" "
8	8 "	4 "	4 "	" "
9	13 "	8 "	5 "	" "

A sample of the ore taken from pits Nos. 3, 5, 8, and 9, when analyzed, ran 58.73% iron, 2.90% silica, 0.053% Phos., and 0.07% Mn. (Sampled by the Missouri Lumber and Mining Company, and analyzed by the St. Louis Blast Furnace Company.) (C.—1910.)

14.

SNYDER MINE.

Owned by J. B. Snyder.

S. ½, Sec. 22, T. 27 N., R. 2 W.

This bank, located 1½ miles north of Fremont, is situated on the crest of a high, narrow ridge along which boulders of secondary limonite oucrop for a distance of 90 yards. The ore has been quite extensively mined by means of open cuts, which now expose ore and broken beds of quartzite embedded in red clay.

Both pipe and massive limonite occurs in this bank, the former predominating. The pipes for the most part occur singly, though they are often clustered, in which case the spaces between them are filled with clay. The massive ore is confined to the southwestern portion of the bank and shows no evidence of pipe structure. The boulders of this type usually have an ocherous center.

During 1903 this mine produced 727 tons of ore, one car load of which showed 54.90% iron, 8.15% silica, and 0.083% Phos. Only boulder ore was shipped and the dumps contain much good wash dirt. (B.—1910.)

PRIMARY LIMONITE.

15.

CRESCENT MINE.

Owned by A. Fischer, Ellsinore, Mo.

S. E. ¼, S. W. ¼, Sec. 33, T. 27 N., R. 3 E.

This mine, located about three-quarters of a mile north of Ellsinore, is situated on the gentle north slope of a low hill. It consists of three open cuts from which 286 tons of ore were mined and shipped during 1903. Two of the cuts are about 60 feet long, 30 feet wide and 10 feet deep, while the third is somewhat smaller. One of the larger cuts is in nearly solid ore. The other two also show an abundance of ore embedded in cherty clay.

The ore is primary limonite of the porous, cellular type and contains a small amount of sand and fragmental chert. Returns on one car load, representing an average shipment, showed 44.85% iron, 22.61% silica, 0.100% Phos., and 8.0% moisture. (C.—1910.)

16. CROMMER AND McPHERSON BANK.

W. ½, S. W. ¼, Sec. 27, T. 27 N., R. 3 E.

This bank, located two miles north of Elsinore, is situated on the crest and south slope of a high, chert covered hill. Developments consist of two cuts entering the base of the hill and a shallow 80 foot trench extending up the hillside above the cuts. Each of these openings is in good ore. The ore is primary limonite of the cellular type. It occurs embedded in red, cherty clay and much of it is exceedingly cherty.

One hundred yards east of the above developments similar ore outcrops in large boulders over an area 100 feet in diameter. The ore at this place is not so cherty as that exposed in the cuts.

Situated on the crest of the hill is an outcrop of silicious primary limonite covering approximately one acre. Several shallow pits have been sunk at this place, each of which show cherty ore to a depth of six feet. No shipments have been made. (C.—1910.)

17. HUTCHINSON MINE.

Owned by D. H. Hutchinson, Elsinore, Mo.

S. W. ¼, S. W. ¼, Sec. 33, T. 27 N., R. 3 E.

This mine, located about three-quarters of a mile north of Elsinore, is situated on the top of a flat divide. It consists of two openings, each about 50 feet long, 30 feet wide, and 12 feet deep, from which 255 tons of ore were mined and shipped during 1903. At present both pits are badly filled by caving, but all exposed faces show an abundance of ore. The ore is a porous, primary limonite containing very little chert or sand. That shipped gave returns of 47.84% iron, 15.77% silica, and 0.063% Phos. The outcrop is light and restricted to the immediate vicinity of the pits. (C.—1910.)

18. MALIN MINE.

Owned by Phoenix Mining Co., Elsinore, Mo.

S. E. ¼, Sec. 33, T. 27 N., R. 3 E.

This mine, located one mile north of Elsinore, is situated on the north face of a chert covered ridge. It consists of four circular openings ranging from 30 to 40 feet in diameter and from 10 to 15 feet in depth, from which 40 tons of ore were mined and shipped during 1907.

The ore occurs at a depth of from three to four feet and consists chiefly of large massive boulders of silicious, primary limonite. That nearest the surface is usually the more silicious, the additional silica consisting not so much of enclosed chert as of thin seams of sand. The ore shipped gave returns of 42.58% iron, 19.15% silica, 0.070% Phos., 2.85% Mn., and 3.0% moisture. (C.—1910.)

19. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 5.

S. W. ¼, N. E. ¼, Sec. 7, T. 25 N., R. 3 E.

This prospect, located 2½ miles east of Grandin, consists of an outcrop of primary limonite extending over an acre or more on the point of a secondary spur. It has been tested by six pits all of which encountered some ore. In each case the ore occurred at the surface and was cut out below by cherty clay. In two of the pits it extended to a depth of 20 feet.

In general the ore is very silicious, containing both quartz and chert which cannot be easily separated by washing. A representative sample taken from five of the pits ran 39.18% iron, 32.45% silica, 0.043% Phos., 0.618% Sul., and 8.39% combined water. (C.—1910.)

20. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 6.

S. W. ¼, N. E. ¼, Sec. 18, T. 25 N., R. 2 E.

This prospect, located 3½ miles west of Grandin, consists of an outcrop of silicious primary limonite, situated upon the crest of a hill. Developments consist of eight pits ranging from 4 to 33 feet in depth, none of which show merchantable ore. Further prospecting is unwarranted. (C.—1910.)

21. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 7.

S. E. ¼, S. E. ¼, Sec. 2, T. 25 N., R. 3 E.

This prospect, located seven miles east of Grandin, is situated on the crest of the divide between Beaver and Ten Mile creeks.. Scattered fragments of ore outcrop over an area of about one acre. Developments consist of 12 pits ranging from 6 to 24 feet in depth, the distribution of which is shown on the

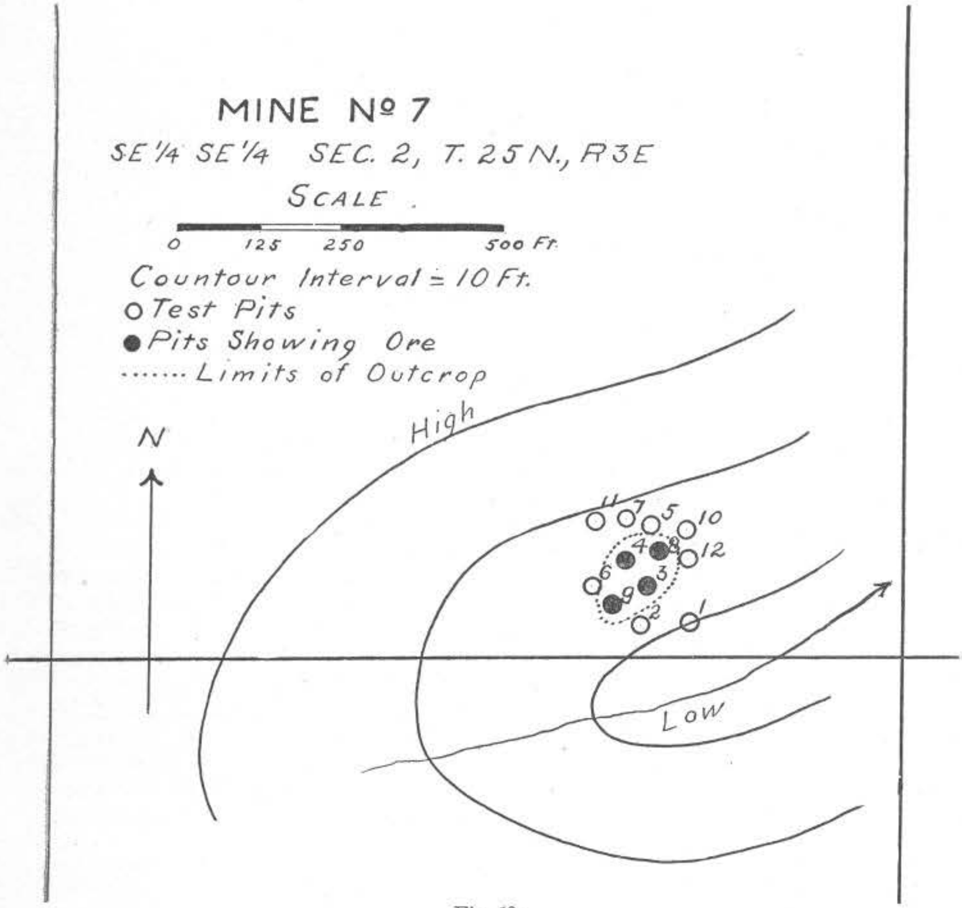


Fig. 13.

accompanying topographic sketch, Fig. 13. Pits Nos. 3, 4, 8, and 9 show ore, which occurs embedded in clay and chert and has been shown to have an average thickness of about 22 feet over an area of approximately 2000 square feet.

The ore is a primary limonite and is highly silicious due to the presence of both chert and sand. A mine sample from pit No. 4 ran 44.47% iron, 17.62% silica, 0.045% Phos., and 0.055% Sul. A similar sample from pits Nos. 3 and 9 ran 41.42% iron, 21.46% silica, 0.038% Phos., 0.145% Sul., and 10.06% combined water. (C.—1910.)

22. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 8.

S. E. ¼, N. E. ¼ & N. E. ¼, S. E. ¼ } *Sec. 31, T. 26 N., R. 4 E.*

This tract, located nine miles northeast of Grandin, has been developed by two groups of pits, the number and distribution of which are shown on the accompanying topographic sketch, (Fig. 14). In the western group which includes pits Nos. 1 to 7, there are two showing ore. Pit No. 2, 46 feet deep, is reported to show ore to a depth of 45 feet. A large percentage of the material removed from this pit is merchantable ore.

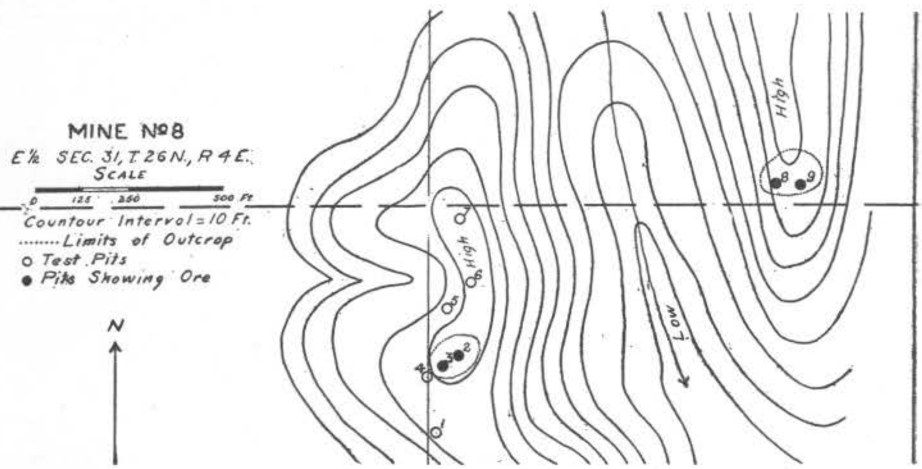


Fig. 14.

Pit No. 3, 35 feet deep, is reported to be in ore throughout its depth. The better grade of ore appears to be near the surface. Pits Nos. 2 and 3 are 50 feet apart and are surrounded by a strong outcrop covering an area of about 2000 square yards. The ore is a primary limonite which is highly silicious due to the presence of cemented and partly replaced chert. A representative sample of the ore from Pit No. 2 shows 46.56% iron, 17.80% silica, 0.056% Phos., and 0.048% Sul.

Pits Nos. 8 and 9 are 70 feet apart and both show ore to a depth of 19 feet. The ore is similar in all respects to that at pits Nos. 2 and 3. A representative sample taken from the dumps showed 45.08% iron, 18.50% silica, 0.045% Phos., and 0.052% Sul. (C.—1910.)

23. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 17.

N. ½, Sec. 25, T. 26 N., R. 2 E.

This tract lies on the crest of a divide between Ten Mile creek and the north fork of Little Black creek at a point about three miles southeast of Hunter. It has been tested by eleven pits, the distribution of which is shown on the accompanying topographic sketch, (Fig. 15).

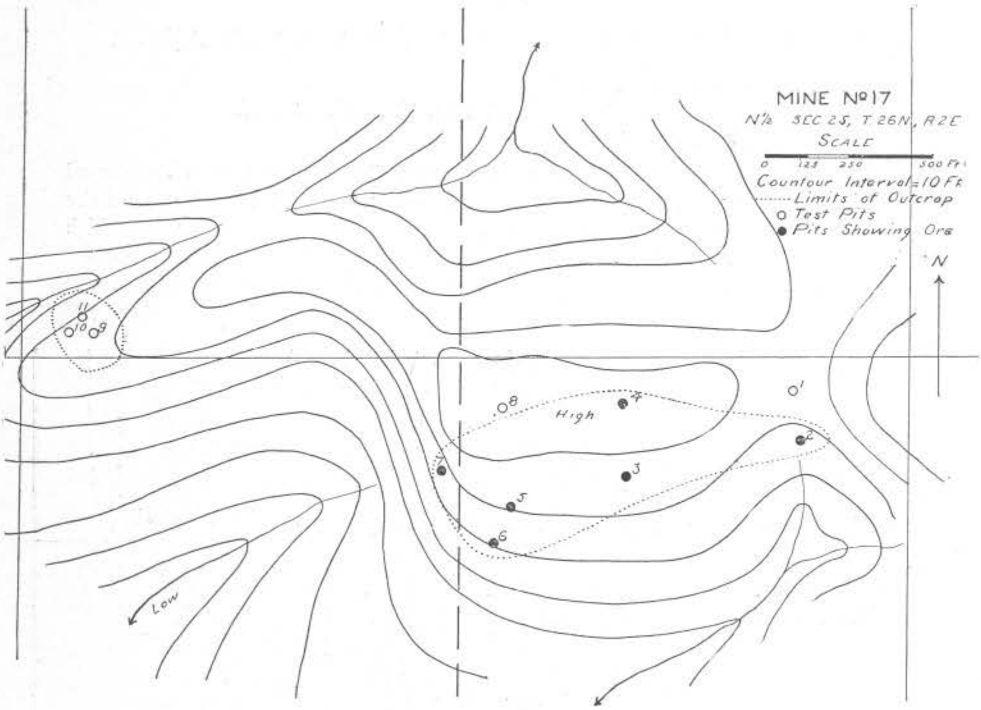


Fig. 15.

Pits Nos. 2, 3, 4, 5, 6, and 7, ranging from 17 to 27 feet in depth, show boulder ore embedded in cherty clay. The ore varies from 5 to 25 feet in thickness and the above developments indicate an average thickness of about nine feet over an area of approximately three acres. The ore is a primary limonite and is, for the most part, highly silicious due to the presence of partly replaced chert and sand. It is in part porous or cellular and in part hard and dense, the latter type being the more silicious. Representative samples of the ore taken from pits Nos. 2 and 3 and pits Nos. 10 and 11 showed the following analyses:

Pit.	Iron.	Silica.	Phos.	Sulphur.	Combined water.
No. 2	40.18%	18.20%	0.061%	0.076%	....
No. 3	44.20	17.60	0.042	0.151	....
Nos. 10 and 11	24.73	37.63	0.063	0.108	9.138%

(C.—1910.)

24. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 19.

N. E. ½, S. E. ¼, Sec. 32, T. 26 N., R. 3 E.

This tract, located five miles northeast of Grandin, is situated upon the crest of a rather flat topped ridge near Ten Mile creek. It is developed by ten pits ranging from 8 to 30 feet in depth. The materials encountered consist of ferruginous chert and sand, none of which would grade over 35% metallic iron. The outcrop at this place is composed of a few loose fragments of dense, dark brown, secondary limonite entirely free from chert and sand and quite unlike that encountered in the pits. The developments do not warrant further prospecting. (C.—1910.)

25. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 21.

S. ½, Sec. 4, T. 25 N., R. 2 E.

This deposit, located two miles northwest of Grandin, is situated upon the crest of a ridge where it outcropped over an area of about one acre. Developments consist of six test pits ranging from 10 to 24 feet in depth which show the ore to have an average thickness of 18 feet over an area of approximately half an acre. The ore is, for the most part, highly silicious and occurs mixed with much clay and chert. The large proportion of waste materials and the low grade of the ore does not warrant mining operations under present conditions. (C.—1910.)

26. MORELAND BANK.

N. E. ¼, N. E. ¼, Sec. 28, T. 27 N., R. 3 E.

Limonite is found here covering an area about sixty yards long and thirty yards wide. The ore occurs over a hill slope of moderate inclination in the form of large boulders and small pieces and in what may prove to be a ledge. The ore is somewhat siliceous, silica appearing both as fine grains of sand and as small chert fragments. Small masses of chert are on all sides of the exposed iron ore, but very little lies within the area. This deposit is about three miles distant from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

27. ORCHARD MINE.

Owned by the Orchard Iron Mining Co., Elsinore, Mo.

E. ½, Sec. 35, T. 27 N., R. 3 E.

This mine is located a quarter of a mile south of Orchard Switch, on the St. Louis and San Francisco R'y., and is situated near the crest of the divide followed by that railroad.

The mine consists of several cuts, the largest of which is 120 feet long, 45 feet wide, and has a maximum depth of 20 feet. The ore occurs as large and small boulders embedded in a cherty, residual clay, the depth of which has not been determined. The ore is a porous, silicious, primary limonite which is in every way similar to that mined at Puxico. The outcrop is very light, but shallow test pits show much ore a few feet below the surface over an area of about an acre in the vicinity of the larger cut. This mine was opened in 1908 and during that and the following year 337 tons of boulder ore, averaging 47.21% iron, 16.30% silica, 0.072% Phos., 1.08% Mn., and 3.00% moisture, were mined and shipped.

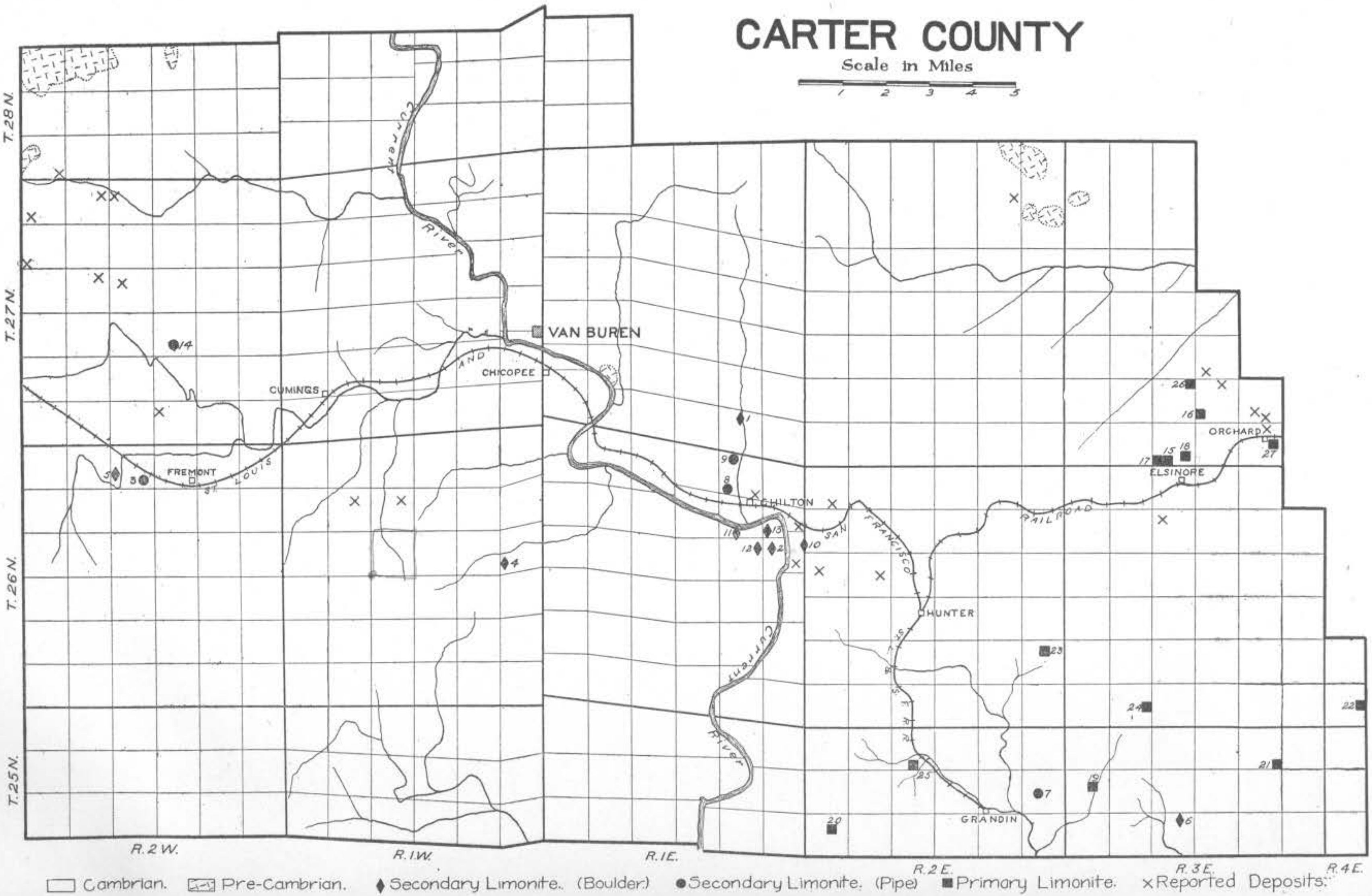
Recently a washing plant of 50 tons capacity has been installed on the property. This plant is equipped with two 26 foot logs, screens, crusher, four sets of jigs, and a picking belt. Water is obtained from a drilled well 247 feet deep. This plant was installed in the fall of 1910, and, up to August 1st, 1911, has cleaned about 3500 tons of ore. Much of the dirt handled contains 75% ore, and averages about 40%. Nothing leaner than 30% dirt is put through the mill.

The grade of the washed ore is shown in the following table of analyses representing shipments between March and July, 1911. (Analyses by the St. Louis Blast Furnace Company.)

Number.	Iron.	Silica.	Alumina.	Mn.	Phos.	Moisture.
1	48.67	14.90	2.16	1.60	0.069	4.0
2	48.06	15.40	2.40	1.03	0.060	....
3	46.12	19.50	2.00	1.00	0.052	....
4	48.50	15.70	2.19	1.63	....	5.0
5	48.89	14.50	2.84	1.60	....	4.0
6	47.73	15.30	2.26	1.90	....	....
7	44.73	20.30	2.10	1.45	....	....
8	47.23	17.08	2.338	1.38	0.060	4.50

(C.—1910.)

Analysis No. 8 is an average of 12 shipments.


CARTER COUNTY
Scale in Miles
1 2 3 4 5
T. 28 N.
T. 27 N.
T. 26 N.
T. 25 N.
R. 2 W.
R. 1 W.
R. 1 E.
R. 2 E.
R. 3 E.
R. 4 E.
VAN BUREN
CHICOPEE
CUMINGS
FREMONT
CHILTON
HUNTER
ELSINORE
ORCHARD
GRANDIN
Current River
St. Louis and San Francisco Railroad
St. L. & S. F. R. R.
Cambrian.
Pre-Cambrian.
Secondary Limonite. (Boulder)
Secondary Limonite. (Pipe)
Primary Limonite.
Reported Deposits.

CARTER COUNTY.

SECONDARY LIMONITE.

No.	Name of Mine or Owner.	Twp. N.	R.	Sec.	Fractional.
1	Brown Bank No. 1	27	1 E.	35	N. ½.
2	Carter (A) and Mo. L. & Min. Co.	26	1 E.	13	N. W. ¼, center of.
3	Carter Co. Mill & Merc. Co.	26	2 W.	4	S. E. ¼.
4	Hahn Bank	26	1 W.	13	W. ½, S. W. ¼.
5	Holland Mine	26	2 W.	4	N. W. ¼, S. W. ¼.
6	Mo. Lum. & Min. Co. Tract No. 18	25	3 E.	16	N. W. ¼, N. E. ¼.
7	Mo. Lum. & Min. Co. Tract No. 20	25	2 E.	12	S. E. ¼, N. W. ¼. N. E. ¼, S. W. ¼.
8	Mo. Lum. & Min. Co. Tract No. 22	26	1 E.	2	S. ½, S. W. ¼.
9	Mo. Lum. & Min. Co. Tract No. 23	26	1 E.	2	N. E. ¼, N. W. ¼.
10	Mo. Lum. & Min. Co. Tract No. 24	26 26	2 E. 1 E.	7 13	S. W. ¼, S. W. ¼. S. E. ¼, N. E. ¼.
11	Mo. Lum. & Min. Co. Tract No. 26	26	1 E.	11	S. E. ¼, S. W. ¼.
12	Mo. Lum. & Min. Co. Tract No. 27	26	1 E.	14	E. ½, N. E. ¼.
13	Mo. Lum. & Min. Co. Tract No. 29	26	1 E.	12	W. ½, S. W. ¼.
14	Snyder Mine	27	2 W.	22	S. ½.

PRIMARY LIMONITE.

15	Crescent Mine	27	3 E.	33	S. E. ¼, S. W. ¼.
16	Crommer and McPherson Bank	27	3 E.	27	W. ½, S. W. ¼.
17	Hutchinson Mine	27	3 E.	33	S. W. ¼, S. W. ¼.
18	Malin Mine	27	3 E.	33	S. E. ¼.
19	Mo. Lum. & Min. Co. Tract No. 5.	25	3 E.	7	S. W. ¼, N. E. ¼.
20	Mo. Lum. & Min. Co. Tract No. 6.	25	2 E.	18	S. W. ¼, N. E. ¼.
21	Mo. Lum. & Min. Co. Tract No. 7.	25	3 E.	2	S. E. ¼, S. E. ¼.
22	Mo. Lum. & Min. Co. Tract No. 8.	26	4 E.	31	S. E. ¼, N. E. ¼. N. E. ¼, S. E. ¼.
23	Mo. Lum. & Min. Co. Tract No. 17	26	2 E.	25	N. ½.
24	Mo. Lum. & Min. Co. Tract No. 19	26	3 E.	32	N. E. ¼, S. E. ¼.
25	Mo. Lum. & Min. Co. Tract No. 21	25	2 E.	4	S. ½.
26	Moreland Bank	27	3 E.	28	N. E. ¼, N. E. ¼.
27	Orchard Mine	27	3 E.	35	E. ½.

REPORTED OCCURRENCES.

Abbott, M	28	2 W.	31	S. E. ¼, S. E. ¼.
Carnahan, L. T	27	3 E.	22	S. ½, S. W. ¼.
Carnahan, L. T	27	3 E.	27	N. W. ¼, N. E. ¼.
Carter Co. Mill and Merc. Co	27	2 W.	4	S. W. ¼, N. W. ¼.
Carter Co. Mill and Merc. Co	27	2 W.	5	S. E. ¼, N. E. ¼.
Carter Co. Mill and Merc. Co	27	2 W.	6	S. W. ¼.
Carter Co. Mill and Merc. Co	27	2 W.	7	S. W. ¼, S. W. ¼.
Carter Co. Mill and Merc. Co	27	2 W.	16	S. E. ¼, N. W. ¼.
Carter Co. Mill and Merc. Co	27	2 W.	17	N. E. ¼.
Jaque, Jas	26	1 E.	2	S. E. ¼, S. E. ¼.

REPORTED OCCURRENCES—Continued.

Name of Mine or Owner.	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
Kelley, Mrs.	26	1 E.	13	S. E. ¼.
Mo. Lum. & Min. Co. Tract	26	2 E.	6	S. W. ¼, S. E. ¼.
Mo. Lum. & Min. Co. Tract	26	2 E.	18	S. E. ¼, N. W. ¼.
Mo. Lum. & Min. Co. Tract	26	1 W.	8	S. W. ¼, N. E. ¼.
Mo. Lum. & Min. Co. Tract	26	1 W.	9	S. W. ¼, N. E. ¼.
O'Reilley, Pat	27	2 E.	2	E. ½.
Smith, D.	26	2 E.	17	E. ½.
Snyder, J. B.	27	2 W.	34	W. ½, N. W. ¼.
Owner unknown	26	1 E.	12	S. E. ¼, S. E. ¼.
" "	26	3 E.	9	N. W. ¼.
" "	27	3 E.	26	E. ½, S. W. ¼.
" "	27	3 E.	26	S. W. ¼, S. E. ¼.
" "	27	3 E.	35	N. W. ¼, N. E. ¼.

CHRISTIAN COUNTY.

Christian county ranks tenth in the production of iron ore, having an accredited output of 30,112 tons. The ore deposits are exclusively primary limonite, consisting chiefly of goethite, the distribution and locations of which are shown on the accompanying map of the Southwest Limonite District, p. 254.

Iron ore was first mined in this county in 1904 since which time shipments have been made each year.

PRIMARY LIMONITE.

1. ANGUS MINE.

Owned by Thos. Angus, Billings, Mo.

E. ½, S. W. ¼, Sec. 18, T. 27 N., R. 23 W.

This mine is located about five miles southeast of Billings and is situated on the eastern edge of an area in which Cherokee sandstone forms the surface rock. The outcrop covers an area of several acres within which ore has been mined from several pits and open cuts, the largest of which is 30 feet in diameter and 10 feet in depth. Each of these openings shows large, irregular masses and boulders of ore embedded in red clay.

The ore consists of primary limonite which occurs as "bombs" and as large cellular masses. The "bomb" ore, which forms a large part of the deposit, is nearly always lined with a thin coating of black, lustrous goethite. Only a small portion of the ore exposed contains an appreciable amount of chert. Chert breccia cemented with limonite is, however, sometimes encountered. Eight shipments, totaling 1928 tons, have averaged 50.60% iron, 13.04% silica, 0.102% Phos., 0.50% Mn., and 3.87% moisture. (H.—1910.)

2. ARNT MINE.

S. E. ¼, S. E. ¼, Sec. 24, T. 27 N., R. 24 W.

This mine, located about five miles southeast of Billings, consists of an open cut 150 feet long, 30 to 50 feet wide, and 10 feet deep, the walls of which show fragments and boulders of ore embedded in clay.

The ore consists of primary limonite and goethite. Some of the limonite occurs cementing chert, forming a breccia or conglomerate which contains so large a proportion of chert as to make commercial separation difficult. The mine has produced 1162 tons of ore averaging 49.9% iron, 12.10% silica, 0.092% Phos., and 0.45% Mn. (H.—1910.)

3. FRISCO MINE.

Center Sec. 4, T. 27 N., R. 24 W.

This mine is located half a mile northwest of Billings. It was opened in 1904 and operated to the fall of 1907, producing about 23,000 tons of ore. The mine consists of an open cut 960 feet long, 35 to 100 feet wide, and from 2 to 20 feet deep. The walls of the pit show small fragments of ore, boulders of chert and boulders of conglomerate embedded in clay. The ore is particularly abundant near the surface where it composes from 40 to 50% of the subsoil to a depth of four feet.

The ore consists of dark brown limonite and fibrous goethite. In places it occurred free in the clay, in others it appears to have formed the cementing material of a conglomerate consisting of boulders of Burlington chert.

The dump is composed of chert boulders, clay and low grade iron ore. The latter consists of brecciated chert cemented by limonite and is of too low grade to be of commercial value.

A log washer was operated on the property and a large part of the output consisted of washed ore. Shipments show an average analysis of 51.05% iron, 10.49% silica, 0.199% Phos., and 0.609% Mn.

This deposit is apparently located on the edge of an outlier of Pennsylvanian sediments. In the field northwest and west of the mine, fragments of ore occur on the surface intermingled with boulders of sandstone. (H.—1910.)

COLE COUNTY.

SECONDARY LIMONITE.

1. GATY (E. W.) LAND.

Sec. 21, T. 42 N., R. 12 W.

At this point several pits have been dug, revealing a good quality of ore. The hill is broken by several deep ravines extending north, along the sides of which, and about eighty feet below the hill top, are the ore beds.

In some of the pits no ore was found. A soft, yellowish and a harder porous brown limonite is found in others.

2. LOTHIAN (B.) LAND.

Sec. 22, T. 42 N., R. 12 W.

Limonite is found here attached to the chert just over the sandstone, and lies in loose masses for more than one hundred feet down the hill, becoming fewer as the descent is made. Near the upper part it is strewn along for one hundred feet east and west. It is of good quality, occurring in a columnar form.

CRAWFORD COUNTY.

Crawford county ranks third in the production of iron ore having an accredited output of 1,408,125 tons. With the exception of three undeveloped deposits of secondary limonite, the known commercial ore bodies consist of red and specular hematites. The distribution and locations of these deposits are shown on the accompanying county map.

Iron mining began in this county with the construction of the Harrison-Reeves Bloomery on Thicketty creek, three miles southeast of Bourbon, in 1820, followed by the Scotia furnace in 1849, and the Midland furnace in 1875. Since the erection of the Scotia furnace mining operations have been practically continuous up to the present time. The annual shipments since 1892 are shown in production table No. 6, page 9.

According to Mr. B. B. Reagan, the Midland furnace went out of blast permanently March 4th, 1894, since which time most of the ore mined in Crawford county has been smelted at the Sligo furnace.

HEMATITES OF THE FILLED SINKS.

1. BENTON CREEK MINE.

Owned by J. and M. Dun, Bellefontaine, Ohio.

S. E. ¼, Sec. 32, T. 36 N., R. 5 W.

This mine, located four miles southwest of Cook's Station, is situated on the crest of a low hill. Developments consist of two long open cuts, driven at right angles to each other, which at present have a maximum depth of 25 feet and a maximum width of 100 feet. The cuts are badly caved and the extent to which the deposit has been removed could not be ascertained.

The original outcrop, which covered an area of five acres, was one of the most promising in the Central district. A peculiar feature of the outcrop was a zone of very heavy boulders of specular ore extending across the hill in a northwest-southeast direction. The larger cut, the side walls of which consist of partly brecciated chert, followed this zone.

The ore mined consisted of specular and red hematites. A sample of the outcrop showed an analysis of 56.01% iron, 17.97% silica, 0.098% Phos., 0.21% Sul., 0.05% alumina, 0.19% lime, and 0.08% magnesia.

This mine was opened in 1873 and worked intermittently until 1887, producing a total of 47,533 tons of ore. (H.—1910.)

2. BUFFUM MINE.

Owned by Crawford County Colonization Company, St. Louis, Mo.

Sec. 32, T. 37 N., R. 4 W.

This mine, located about half a mile north of Keysville, produced a small amount of ore prior to 1892. The property was not visited and the present condition of the mine is not known.

3. CARD MINE.

Owned by David McIntosh, Cuba, Mo.

S. E. ¼, Sec. 13, T. 38 N., R. 5 W.

This mine, located four miles south of Cuba, produced 3,000 tons or ore prior to 1892. The property was not visited and the present condition of the mine is not known.

4. CHERRY VALLEY MINES.

Owned by The Meramec Iron Company, Bellefontaine, Ohio;

Leased by the Sligo Furnace Company, St. Louis, Mo.

E. ½, S. W. ¼, Sec. 4, T. 37 N., R. 3 W.

This property is located 5½ miles southeast of Steelville and is connected by standard gauge railroad with the Salem branch of the St. Louis and San Francisco R'y.

Though among the oldest, it is at present the largest producer in the central ore district. It was first opened in 1879 and was worked almost continuously up to June 1st, 1898, producing approximately 553,000 tons of ore. Between June 1st, 1898, and July 1st, 1904, the property was not worked, but since the last named date it has been operated under lease by the Sligo Furnace Company. The total production to December 31st, 1910, was 736,800 tons.*

The property consists of two deposits mined by two large open pits known as No. 1 and No. 2 mines. Of these, the eastern or No. 2 mine is somewhat the larger. The accompanying topographic sketch, (Plate XXV), shows the relation of the deposits to each other and to the surface features. It will be noted that, topographically, Mine No. 1 occupies a divide while Mine No. 2 is situated in a ravine, the difference in surface elevation being fully 70 feet. Both mines are splendid types of the filled sink deposits, No. 1 being especially well developed. Though nearly worked out, this pit is still very well preserved and has afforded exceptional opportunities for study. For this reason it is described here in considerable detail.

CHERRY VALLEY NO. 1.

This mine was opened in 1879 and up to January 1st, 1910, had produced approximately 300,000 tons of ore. Mining has been conducted by both the open pit and underground methods. The open pit, which is roughly oval in outline, has a maximum length of 480 feet and varies from 160 to 250 feet in width. In depth it varies from 75 feet at the southwest end to 97 feet at the northeast end. From the latter point, developments have been carried underground to an additional depth of 32 feet. Plate XXVI is a large scale plat of the mine showing the workings and the position of the rim of dipping sandstone.

The hill upon which the mine is located, and those in the immediate vicinity, are, from all surface indications, composed entirely of Roubidoux sandstone. Drilling, just without the limits of the rim rock, shows a sandstone to have a thickness of at least 200 feet in which case it extends fully 50 feet below the lowest level of the mine. No limstone has been encountered in the immediate vicinity.

The rim rock, which varies from 5 to 20 feet in width, is well developed on three sides of the pit. The sandstone, in the outer portion of the rim is usually normal in color and texture while that nearer the pit becomes increasingly quartzitic and brecciated and often highly ferruginous.

The beds of the rim dip at all angles from 5 to 45° towards the interior of the pit. Nearer the pit the dip flattens considerably, becoming nearly horizontal at the face so that the ore contact cuts diagonally across the bedding. This structure is shown in Fig. 2, Pl. XXVII, which represents a section of the east wall of the old incline opening to the north.

The ore outcrop was confined very largely to the interior of the rim rock and formed a small knoll directly over the widest portion of the pit. It consisted chiefly of hard, blue, specular hematite, occurring in large and small boulders, some of which weighed many tons. In addition to the specular hematite, there was some brown ore scattered upon the south slope of the hill and extending beyond the limits of the rim.

The shape of the ore body and associated rock structures are shown in the accompanying cross-sections, Figs. 1 and 2, Plate XXVII, platted along the lines A-B, C-D, and E-F as indicated in Plate XXVIII.

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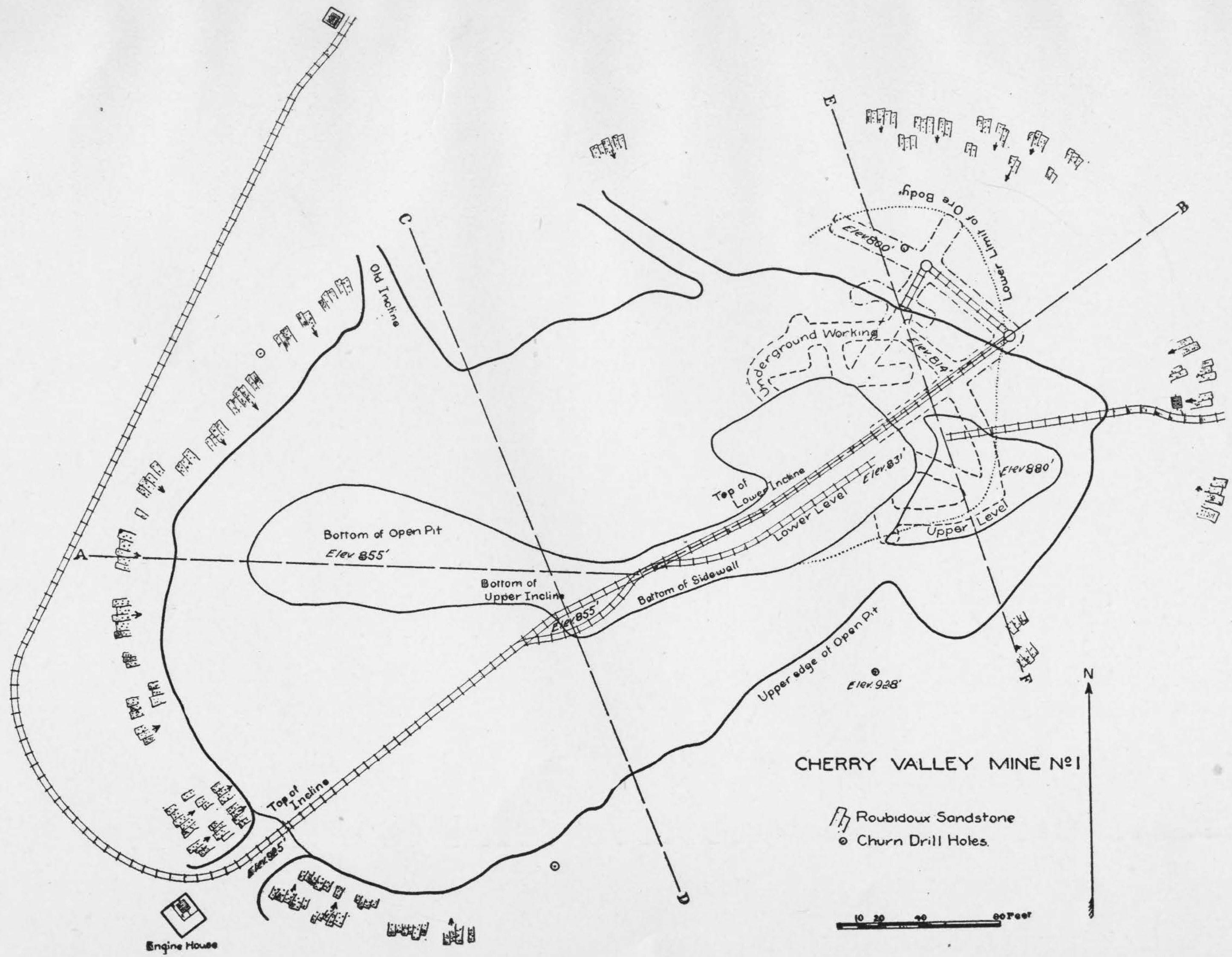
*For annual production see table No. VII, p. 10.


CHERRY VALLEY MINE No 1
Roubidoux Sandstone
Churn Drill Holes.
Old Incline
Underground Working
Lower Limit of Ore Body
Elev 800'
Elev 814'
Top of Lower Incline
Lower Level
Elev 831'
Elev 880'
Upper Level
Bottom of Open Pit
Elev 855'
Bottom of Upper Incline
Elev 855'
Bottom of Sidewall
Upper edge of Open Pit
Elev 928'
Top of Incline
Elev 885'
Engine House
A
B
C
D
E
F
N
10 20 40 80 Feet

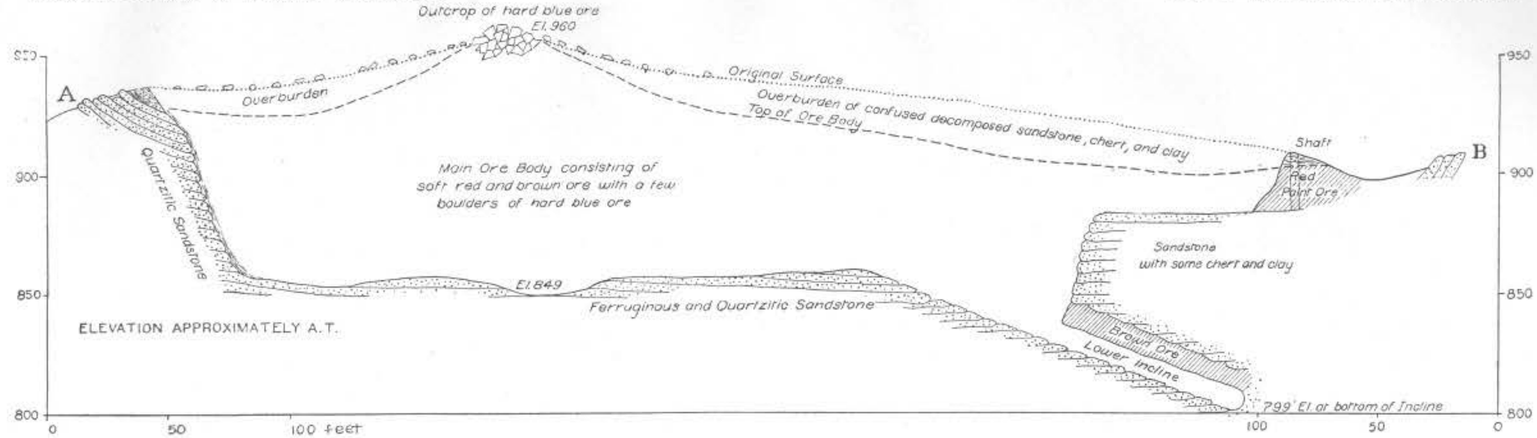


Fig. 1. LONGITUDINAL SECTION OF CHERRY VALLEY MINE NO. 1 ALONG LINE A-B OF PLATE XXVI.

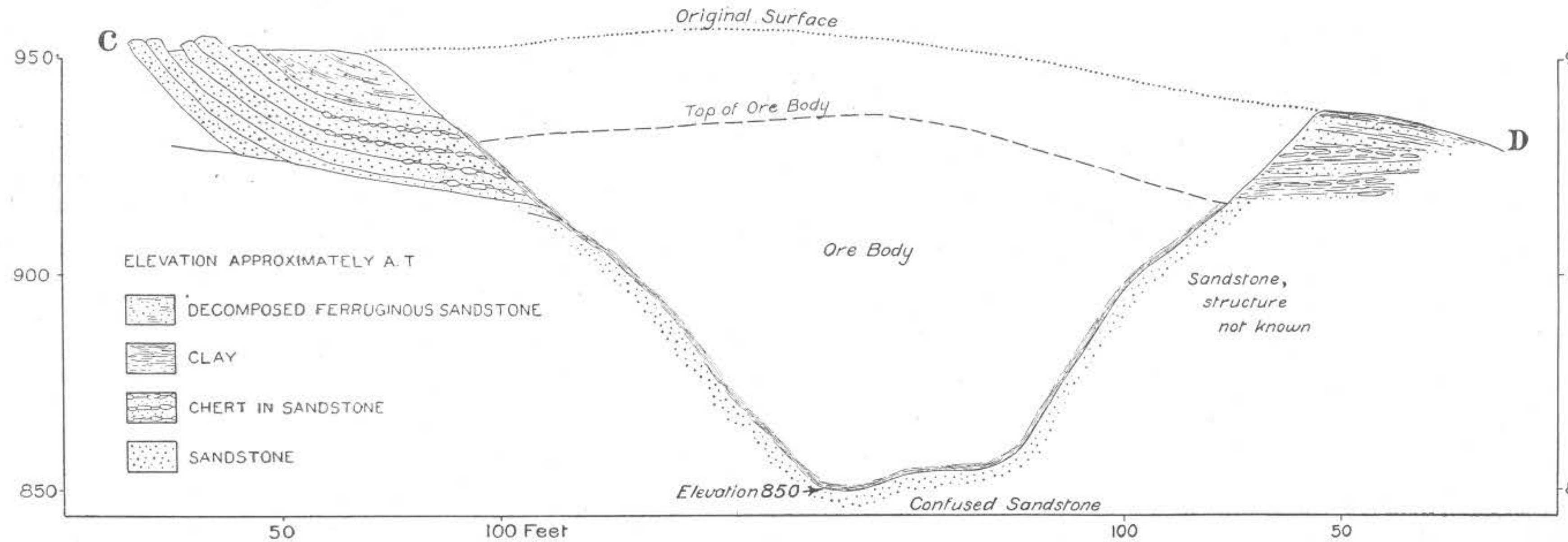


Fig. 2. CROSS SECTION OF CHERRY VALLEY MINE NO. 1 ALONG LINE C-D OF PLATE XXVI.

The ore body is irregularly canoe shaped, being much wider across the top than at the bottom. Beneath the point of outcrop, it had a thickness of nearly 100 feet. Through the middle of the pit, between the base of the upper incline and the top of the lower incline, the overburden was heavier and the bottom a few feet higher, reducing the thickness of the ore to about 70 feet.

At the extreme eastern end of the mine, the ore forms two levels, one of which lies above and the other beneath a 35 foot ledge of bedded clay, chert, and quartzitic sandstone. The ore in the lower level has a thickness of 15 to 20 feet and pitches at an angle of 22° in a northeasterly direction. At the bottom of the incline it is cut out abruptly by a wall of soft sandstone sloping toward the pit. Drifts, extended north and south from the incline, encountered at other points the same wall of sandstone which limits the deposit at that end of the mine.

The ore in the upper level lies in a nearly horizontal bed, having a maximum thickness of 20 feet. It has been followed 60 feet beyond the face of the lower level, and is reported to be worked out.

Usually the contact between the ore and the wall rock is somewhat regular and is marked by a thin seam of iron stained clay from one to six inches thick. In some places, however, it is very irregular and there is no clay

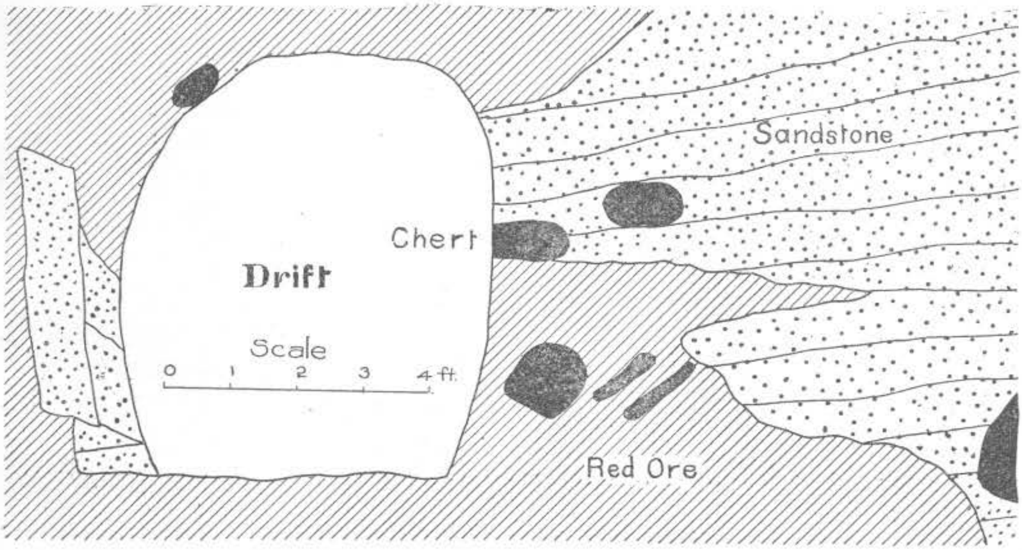


Fig. 16. Side wall contact, Cherry Valley No. 1 Mine.

intervening. Fig. 16, which is a sketch of the drift at the extreme right of the underground workings, shows the irregular nature of the contact at this place, and the occurrence of isolated fragments of sandstone and chert scattered through the ore near the contact. Thirty feet directly above this point, near the west end of the upper level, there is about ten feet of red ore still clinging to the wall rock. The contact of the ore and the sandstone is well exposed, and is more irregular than seems to have been the case throughout the larger part of the pit. The wall rock consists of soft and hard sandstone, dipping 6 to 7° towards the pit. The soft sandstone is confined mostly to a narrow strip nearest the ore contact, and the contact between good ore and the wall rock is sharp. Scattered throughout the ten feet of ore, are fragments of green, oolitic chert occurring in layers or stringers as if in a bedded position. Nearer the contact, this bedded structure is not so well marked. At one place a five inch layer of red ore, underlain by a four to six inch layer of soft brown ore, extends several feet along the bedding in the sandstone. Above and below this ore are layers of oolitic chert of a light green color. Pseudomorph structures after marcasite are well developed in this ore, especially in that nearest the contact, and it is plainly secondary to the sulphide.

The floor of the pit, as exposed near the top of the lower incline, consists of ferruginous sandstone and chert, with thin clay seams partly replaced by soft, greasy, red hematite. This material is but slightly disturbed but dips about 4° with the incline. The contact with the ore dips 20 to 25° and cuts across the bedding of the underlying material. The materials in the bottom of this mine are much less disturbed than is usual of this type of deposit. In most cases they consist of fragments of ferruginous chert and sandstone, mixed with clay and ore. Figure 17 shows the character of the foot-wall contact at the head of the lower incline.

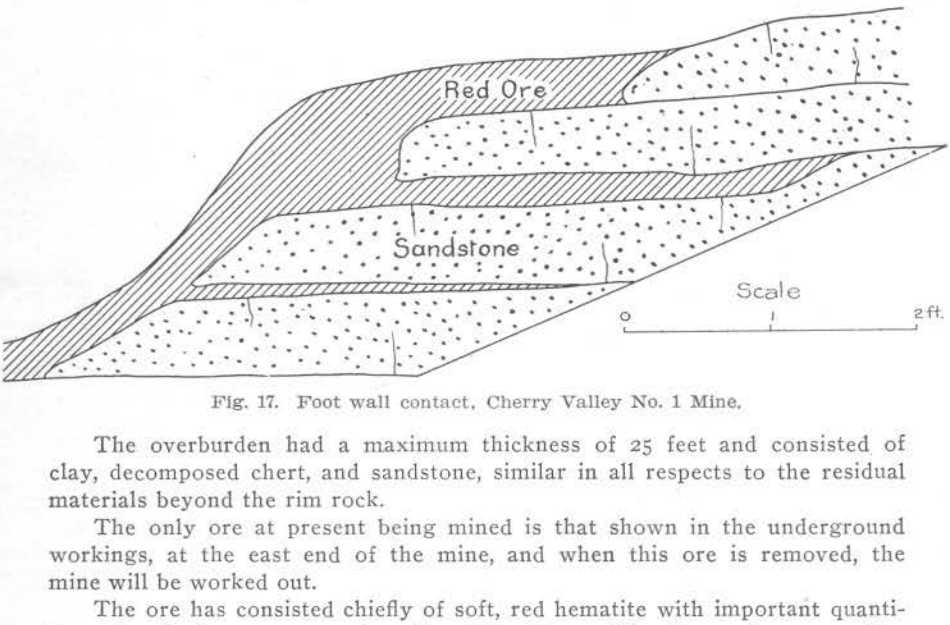


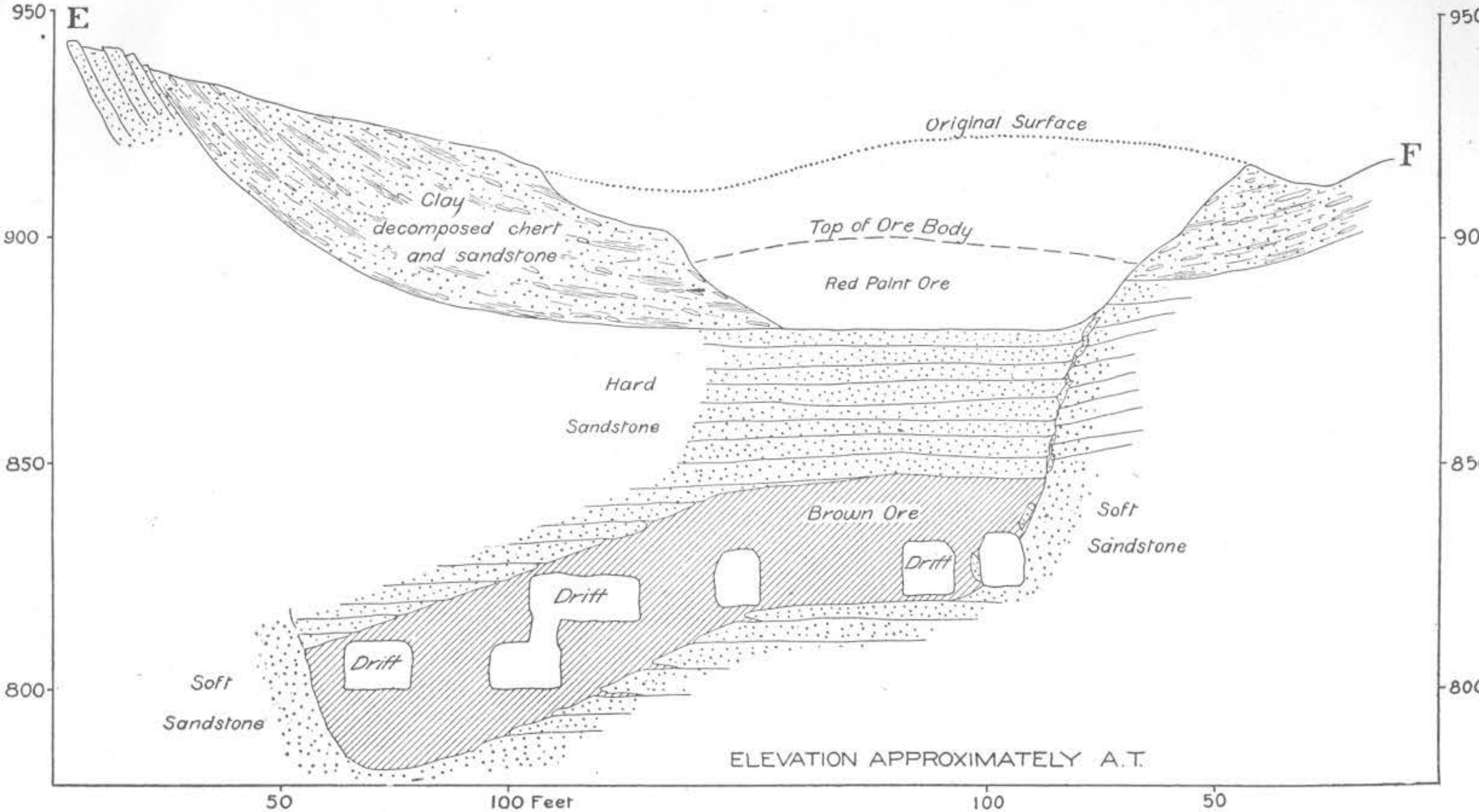
Fig. 17. Foot wall contact, Cherry Valley No. 1 Mine.

The overburden had a maximum thickness of 25 feet and consisted of clay, decomposed chert, and sandstone, similar in all respects to the residual materials beyond the rim rock.

The only ore at present being mined is that shown in the underground workings, at the east end of the mine, and when this ore is removed, the mine will be worked out.

The ore has consisted chiefly of soft, red hematite with important quantities of soft, brown ore and scattered boulders of hard specular ore. The largest single occurrence of the specular ore was in the outcrop. Soft, greasy, red to purple hematite, the so-called paint ore, occurred in the upper level at the northeast end of the mine.

The chief mineral impurities are quartz, clay, and marcasite. Quartz, which was probably deposited with the original sulphides, occurs as small crystals scattered through the ore and lining small cavities. Occasionally large geodes of ore will be lined with large crystals of amethystine quartz. Clay occurs filling joints and openings in the ore and introduces both silica and alumina. Marcasite occurs locally in the lower portion of the deposit, but has not in any case been encountered in such quantities as to affect the commercial grade of the ore. Calcite rarely occurs, or is entirely absent, and the ore seldom runs over 0.20% in lime.



CROSS SECTION OF CHERRY VALLEY MINE NO. 1 ALONG LINE E-F OF PLATE XXVI.

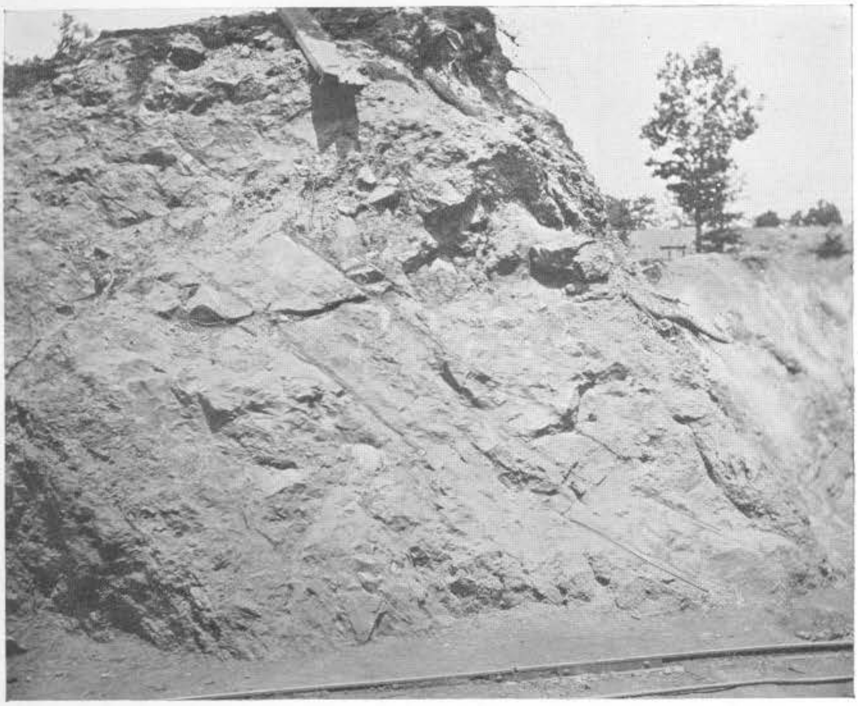


Fig. 1. CHERRY VALLEY MINE NO. 1, SHOWING DIPPING SANDSTONE AT TOP OF INCLINE.

Fig. 2. CHERRY VALLEY MINE NO. 1, LOOKING NORTHEAST.

Wasts materials, in the form of fragments of sandstone and boulders of chert, occur locally about the margins of the deposit. Their appearance is usually the signal for the appearance of the wall rock.

The ore is a medium grade, non-bessemer hematite, of which the following analyses of shipments made during the first half of 1911 are fairly representative: (Analyses made by the Sligo Blast Furnace Company.)

Number.	Iron.	Silica.	Alumina.
1	58.27%	9.35%	1.18%
2	57.37	9.40	1.30
3	59.12	7.15	1.60
4	58.30	8.95	1.83
5	56.85	11.05	1.95
6	57.99	10.35	1.78
7	57.98	9.375	1.60

No. 7 is an average of six analyses.

(C.—1910.)

5. CHERRY VALLEY NO. 2.

W. ½, S. E. ¼, Sec. 4, T. 37 N., R. 3 W.

This mine was opened a few years later than Mine No. 1 and, up to December 31st, 1910, had produced approximately 440,000 tons of ore. Mining has been conducted entirely by the open pit method and has resulted in an elliptical opening, 600 feet long, 400 feet wide, and from 100 to 150 feet deep.

The wall rock, wherever exposed, consists entirely of sandstone, no limestone having been encountered. The rim rock is not so fully developed as at Mine No. 1, but is well exposed for short distances along the north, northwest, and southwest sides of the pit, where it dips strongly toward the pit. The outcrop, which was confined to a small hill between two ravines which crossed the present site of the pit, consisted of large boulders of specular hematite and was similar to that at Mine No. 1.

The ore body formed a great lense shaped mass, which was thickest directly beneath the outcrop, from which point it thinned and pitched toward both ends. On the east and west it was enclosed by nearly vertical walls of sandstone with which it lay in sharp contact. On the north and south it dipped beneath a heavy ledge of sandstone.

The overburden consisted of decomposed chert, clay, and sandstone which in some places was 30 feet thick. Across the middle of the pit the ore bottomed on an east and west "hog back" of sandstone, chert, and clay containing abundant iron sulphide. From this point, the ore deepened both to the north and the south. At the time the mine was visited it was filled with waste to a depth of from 20 to 30 feet and only in the south face was there much ore in sight. Recently, the south end of the pit has been cleared out and it is reported that there is still much ore to be obtained from that part of the mine. The north end of the mine has not been uncovered and is reported to be nearly worked out.

There is little difference in the ore from mines No. 1 and No. 2, and the description of that at No. 1 will apply equally well here. C.—1910.)

6. CHRISTY BANK.

Owned by the Christy Heirs.

S. E. ¼, N. W. ¼, Sec. 12, T. 38 N., R. 2 W.

This bank is located 12 miles southeast of Leasburg, close to the Washington County line. It is situated on the south face of a hill near the head of a small ravine. As shown by the accompanying topographic sketch, the deposit is marked by a strong outcrop of red hematite and an almost continuous rim of dipping Roubidoux sandstone enclosing a filled sink having an area of about seven acres. Fig. 19 is a northwest-southeast section across the east end of the sink.

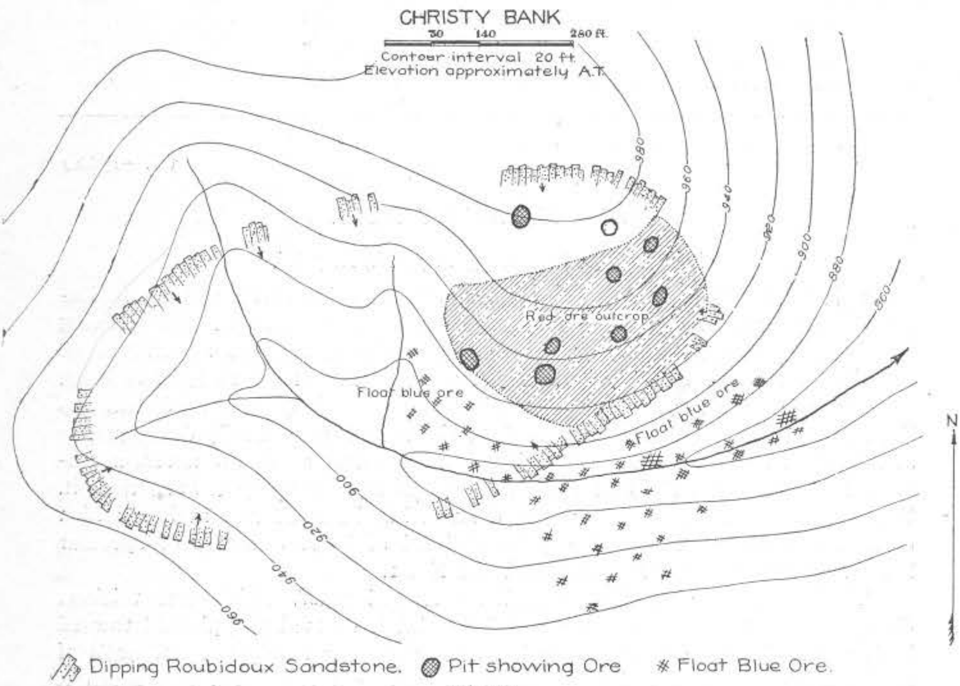


Fig. 18.

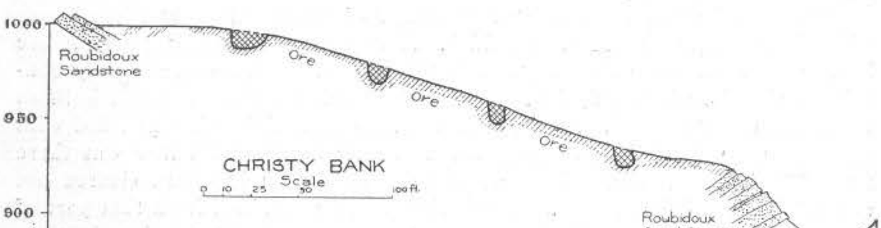


Fig. 19.

The ore outcrop, as indicated, is almost unbroken over an area of about two acres. In the ravine at the base of the hill are many large and small boulders of blue specular ore occurring as float and for the most part lying without the area of the sink.

Originally the outcrop of blue ore was probably much stronger as it is reported that years ago many tons of this ore were gathered from the surface and delivered at the old Scotia furnace located a few miles to the west.

Developments consist of nine shallow test pits, eight of which show pure, soft red hematite throughout their depth.

No ore was observed in the west end of the sink. Neither is the sandstone ferruginous at that place, while in the vicinity of the outcropping ore it is highly so.

This bank has by far the best surface showing of any undeveloped property in the district. Its undeveloped state appears to be due chiefly to the fact that it lies in a rough country about 12 miles from the nearest railroad. Should the ore be found, by test drilling, to extend toward the west end of the sink, the bank may prove to be one of the largest deposits in the district.

(C.—1910.)

7. CLARK MINE.

Owned by the Crawford County Colonization Company, St. Louis, Mo.

N. E. ¼, N. E. ¼, Sec. 26, T. 38 N., R. 4 W.

This mine is located two miles northeast of Steelville and is situated upon the west face of the point of a hill projecting southeast from a high ridge. Like the Griffith mine, it is marked by a well defined sink structure. The area of the sink is shown by a rim of pitching Roubidoux sandstone, encircling it on three sides; the larger diameter extending northeast-southwest. The rim is not exposed for a short distance across the south end of the sink. Within this area one open cut, two shafts, and several shallow pits have been sunk.

The open cut, which is about 100 feet long, 40 feet wide, and 10 feet deep, was made on the north end of the rim where the latter crosses the highest point of the hill. Considerable soft red ore has been mined from this cut. The ore was found in a layer 12 inches or more thick between heavy beds of quartzitic chert and sandstone which dip about 25° toward the center of the sink.

A shallow pit located about 200 feet southeast of the cut exposes the east rim of the sink but shows very little ore. A 70 foot pit, 30 feet east of the shallow pit and just outside of the rim of the sink, shows only ocherous, decomposed cotton rock and a soft, silicious clay that may represent decomposed chert and limestone. A 102 foot shaft, located about 100 feet southwest of the 70 foot pit, and well within the area of the sink, shows, throughout its depth, decomposed chert and quartzitic sandstone enclosing occasional thin seams of ore. The best seam of ore occurs at a depth of 72 feet and consists of 6 inches of hard blue hematite containing some sand and chert. The dip of the formation is strongly to the west, toward the middle of the sink.

A shallow pit sunk on the southeast edge of the rim shows some soft red ore and a cherty, ferruginous rim rock pitching to the northwest. In the ravine near the base of the west slope of the hill, are many shallow pits from which considerable hard, blue, silicious ore has been mined.

With the exception of the 102 foot shaft, the prospecting here has not been deep and has afforded little knowledge of the extent of the ore body. A position upon the hillside about midway between the open cut at the northeast end of the sink and the shallow diggings in the ravine at its base is suggested as the best point for further prospecting. On the whole, the well developed sink structure and the several showings of ore mark the property as worthy of a thorough investigation.

An analysis of the soft, red ore showed 55.37% iron and 0.075% Phos.

(C.—1910.)

8. COPPER HILL MINE.

Owned by the Missouri Copper Mountain Mining Company, Sedalia, Mo.

S. W. ¼, N. W. ¼, Sec. 24, T. 40 N., R. 2 W.

This mine is located 3½ miles southeast of Sullivan in the extreme northeast corner of Crawford county. It is situated upon the crest and north face of a high hill which rises 230 feet above the flood plain of the Meramec river flowing at its base. The upper 100 feet of the hill is composed of Roubidoux sandstone, the outcrops of which, for the most part, dip toward the center of

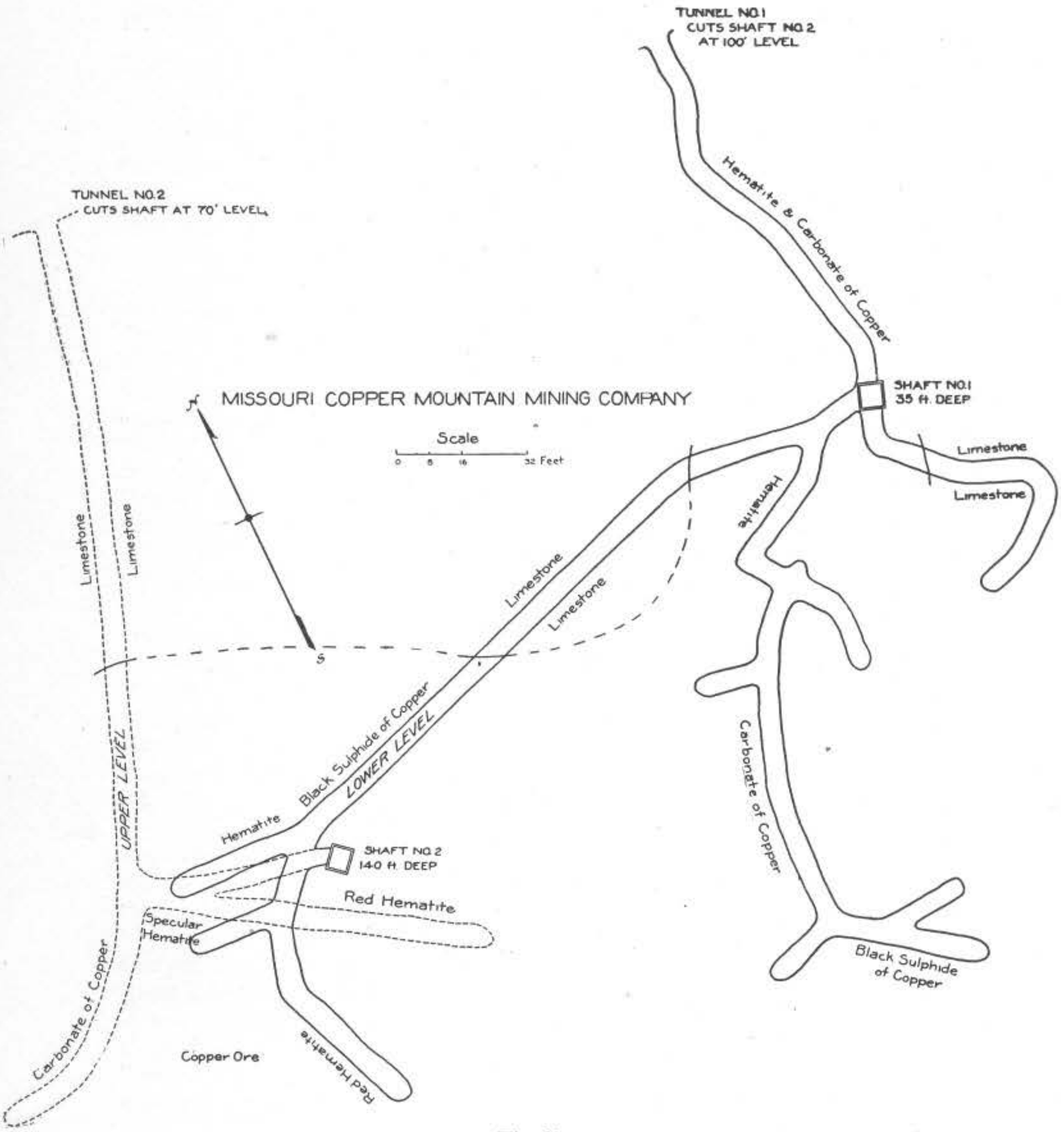


Fig. 20.

the hill, indicating the existence of a filled sink. The lower portion of the hill is composed of Gasconade limestone, the beds of which appear to be horizontal.

Mining has been conducted by means of two open cuts, which were made near the crest of the hill during the early 70's, and by two shafts sunk on the north face of the hill during the past few years. One cut is 130 feet long, 90 feet wide, and 20 feet deep, while the other is about half that size. From these cuts several thousand tons of red and specular ore have been taken. The ore is chiefly red hematite and is overlain by beds of ferruginous sandstone. Several small pits sunk in the vicinity of the larger cuts showed ore occurring under similar conditions.

Fig. 20 is a plat of the underground developments. Shafts Nos. 1 and 2, on the north slope of the hill, are 35 and 140 feet deep respectively. The bottom of shaft No. 1 and the 100 foot level of shaft No. 2 are also reached by tunnels entering from the hillside. Near the bottom of shaft No. 1, 8 feet of brown ore with some copper and iron sulphides were encountered. Shaft No. 2 cut red hematite from the 30 to the 100 foot level, below which it followed the line of a vertical two foot seam in the limestone. This seam was encased by a layer of hard pyrite and marcasite with some chalcopyrite, while the interior consisted of soft red clay enclosing both of these minerals and their alteration products.

The iron ore taken from the deeper shaft is a soft, red hematite which breaks down easily and, where undercut, required timbering. It is in many respects like that of the Leslie mine. Much of it is highly calcareous and some of it bears structures of crystalline limestone indicating the replacement of that rock. The major portion of the ore, however, is secondary after the sulphide.

The open cuts upon the crest of the hill appear to have disclosed only the upper portion of the ore body. They are high above and several hundred feet distant from the more recent shafts and tunnels, but in view of the well defined filled sink structures it is probable that the two ore showings will be found to be the extremities of a single ore body. If so, there is a large body of ore available. The present developments should be connected by a drift or drilled in order to determine this fact.

The property was not operated between the years 1876 and 1904. In 1904 it was worked for copper, and produced 22,500 pounds of that metal.* During the years 1905 to 1909 and incident to the copper developments, 735 tons of red ore were mined and shipped. This ore averaged 53.61% iron, 9.00% silica, 0.125% Phos., and 0.15% Mn. (Analysis made by the St. Louis Blast Furnace Company.) (C.—1910.)

9. CRAIG MINE.

Owned by S. J. Craig, Cook Station, Mo.

S. E. ¼, N. W. ¼, Sec. 24, T. 36 N., R. 5 W.

This mine is located about one mile north of Cook Station, in the southwestern corner of the county. It is situated on the south slope of a high hill, the base of which is skirted by the Meramec river and the Sligo branch of the St. Louis and San Francisco R'y. The mine consists of several irregular open pits sunk upon the hillside. A number of these openings connect with two tunnels driven into the hill at the level of the railroad. The filled sink

*For a full description of the occurrence of the copper, see Mo. Copper Deposits, H. F. Bain, Bulletin No. 267, U. S. Geol. Survey, pp. 47-50.

structure at this place is indicated by the occurrence of high bluffs of Roubidoux sandstone both on the east and on the west, the beds of which dip steeply toward the mine. Within the synclinal basin thus formed, is exposed 15 feet or more of cherty dolomite which appears to underlie a considerable portion of the hill. The ore body occurred in the sandstone above this dolomite and is reported to have been very irregular in shape. Only the open pits were examined and these appear to be worked out. The ore was chiefly hematite of the red and specular varieties including some soft, greasy, paint ore. A number of test pits recently sunk upon the hillside above the old workings developed no extension of the deposit. According to Nason, the mine produced 10,398 tons prior to 1892. (C.—1910.)

10. FERGUSON MINE.

N. ½, S. E. ¼, Sec. 21, T. 37 N., R. 4 W.

This mine, located 3½ miles south of Steelville, is reported by Nason to have produced 2,570 tons of ore prior to 1892. The present condition of the mine is not known.

11. GRIFFITH MINE.

Owned by B. M. Griffith, Steelville, Mo.

S. E. ¼, S. E. ¼, Sec. 14, T. 38 N., R. 4 W.

This mine is located three miles northeast of Steelville and about a quarter of a mile south of the Meramec river. It consists of two open pits, one of which is situated in a ravine and the other on the lower end of a hill not far above the contact of the Roubidoux sandstone and the Gasconade limestone. In many respects the deposit is typical of those common to this district. As shown by the accompanying topographic sketch the filled sink structure is well defined by a rim of dipping Roubidoux sandstone which nearly encircles the mines and encloses an area of about 4½ acres. Where the ravine crosses the rim at the lowest point, the elevation is approximately 720 feet A. T. Within 10 to 15 feet below this point the Gasconade limestone is found outcropping in the bed of the stream and 200 yards further east forms prominent bluffs.

Pit No. 1 is about 80 feet in diameter and 40 feet deep. Its northwest face presents a lense shaped breast of ore about 60 feet long and 20 feet thick. On the left the ore is cut out by a wall of sandstone and clay which forms the south rim of the sink. On the right the ore has not been traced to its limits, but cannot extend much further in that direction before reaching the surface. The ore is overlain by 20 feet of interbedded sandstone, shale, chert, and clay; and underlain by a ledge of ferruginous chert. Its depth in the direction of the dip has not been tested. The whole formation has a dip of 30° to the northwest.

The upper 15 feet of the ore face is a uniform bank of soft, granular, light brown limonite with no bedding or other structure. It represents a nearly solid mass of secondary limonite showing many sulphide pseudomorphs. With depth the brown ore becomes somewhat darker in color and grades into a red hematite. No hard, specular hematite occurs. The whole face, including waste rock and ore, is cut by several nearly vertical seams of red clay filling joints which are widest near the surface and narrow with depth.

Pit No. 2 is composed of several short headings, entering the hillside only a few feet above the level of the ravine. The dip of the ore here is about 30°

toward the interior of the sink. The devlopments have exposed about 15 feet of ore which, in all essentials, is like that at pit No. 1. The overburden, however, is somewhat thinner here than at pit No. 1 and consists chiefly of cherty, residual clay. No red or specular ore has been found.

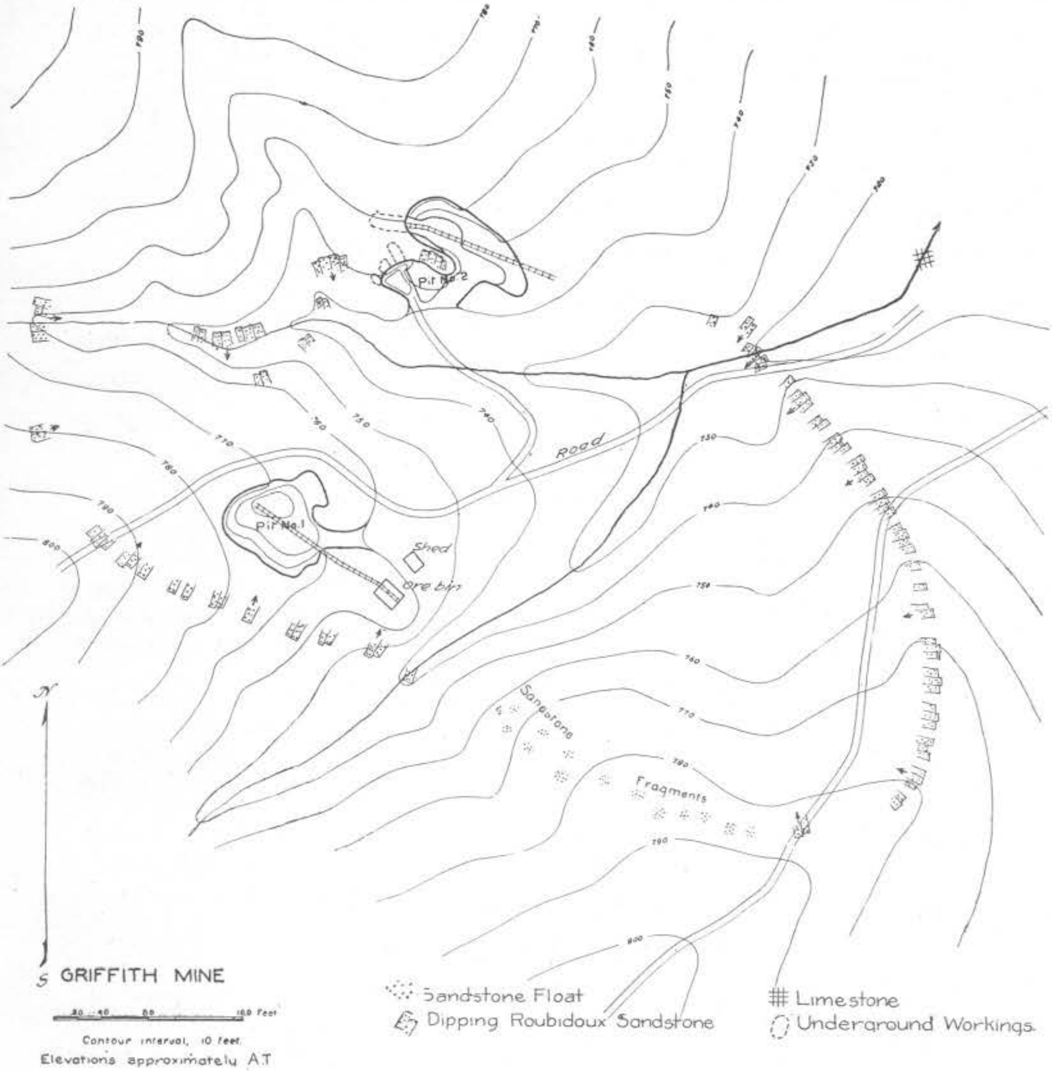


Fig. 21.

Both pits are well within the northwest half of the filled sink area and the dip of the ore indicates that the deposit is confined chiefly to that position. There is no structural evidence to suggest that the ore extends farther to the south. No float ore has been found in that direction.

At the time it was visited, this mine was being worked for developments only, producing about seven tons per day. The ore is hauled two miles by wagon to Griffith siding on the Cherry Valley branch of the Frisco R'y.

The following analyses show the range and average quality of the ore shipped. No. 6 represents the average of five analyses:

Number.	Iron.	Silica.	Sulphur.
1	51.90%	10.95%	0.021%
2	53.10	13.70	0.028
3	53.90	12.10	0.083
4	54.00	12.80	0.021
5	55.60	11.15	0.000
6	53.70	12.14	0.030

(C.—1910.)

12. HART MINE.

Owned by T. R. Gibson, Springfield, Mo.

Sec. 24, T. 37 N., R. 5 W.

According to Nason this mine produced 780 tons of ore prior to 1892. The property was not visited and its present condition is not known.

13. IRON RIDGE MINE NO. 1.

Owned by James Hanlohan.

N. E. ¼, Sec. 29, T. 39 N., R. 5 W.

This mine is located three miles northwest of Fanning. Developments consist of a pit 300 feet long, 200 feet wide, and 100 feet deep, from the bottom of which underground workings were extended on one side of the mine to a distance of 100 feet. The ore dipped from the pit face in such manner that the most remote point reached in the drifts was about 20 feet lower than the bottom of the pit.

The ore body had the shape of a large, inverted cone and was entirely surrounded by massive sandstone and chert. The central part of the ore mass consisted of red hematite separated from the wall rock by a shell of specular ore. A sample taken from the underground workings ran 61.36% iron, 8.37% silica, 0.091% Phos., 1.17% alumina, and 3.09% combined water.

This mine was opened in 1871 and abandoned in the early 80's. It produced about 190,000 tons of ore. (H.—1910.)

14. IRON RIDGE MINE NO. 2.

Sec. 33, T. 39 N., R. 5 W.

Here, on an extensive tract of slightly undulating ground, are found in many places indication of specular ore, and occasionally large boulders of good surface-ore. A number of ditches were made to investigate this tract and disclosed irregular accumulations, mostly of small extent, of rounded ore with red clay, of white clay with pieces of chert and of impregnated sandstone.

(S.—1872.)

15. JAMES MINE.

Owned by Ida M. Anderson, Wesco, Mo.

Center Sec. 12, T. 36 N., R. 5 W.

This mine, located half a mile south of Wesco, produced 2,100 tons of ore prior to 1892. The walls of the pit show only detrital material and the mine has the appearance of having been worked out.

16. KNOX BANK.

Owned by Huzzah Iron Company.

E. ½, S. E. ¼, Sec. 26, T. 38 N., R. 3 W.

This bank is located eight miles east of Steelville and is situated on the crest of a high hill as indicated by the accompanying topographic sketch. The area of the sink is not well defined, but the position of the several ledges of dipping ferruginous sandstone would indicate that it occupied a position immediately beneath the crest of the hill. The outcropping sandstone is Roubidoux and lies 90 feet above the nearest exposed ledge of Gasconade limestone. The ore outcrop consists of limonite and blue specular hematite. The limonite is sandy and occurs as scattered boulders upon the north side of the hill both above and below the rim rock shown at that place. The blue ore consists of a few loose fragments lying below the rim rock on the west side of the hill. Developments consist of several churn drill holes and one shallow pit. One drill hole which is located near the crest of the hill and at what would appear to be near the center of the sink showed no ore. The others, the location of which were not ascertained, are reported to have been equally discouraging. The shallow pit showed only a few boulders of sandy limonite embedded in the surface clay. (C.—1910.)

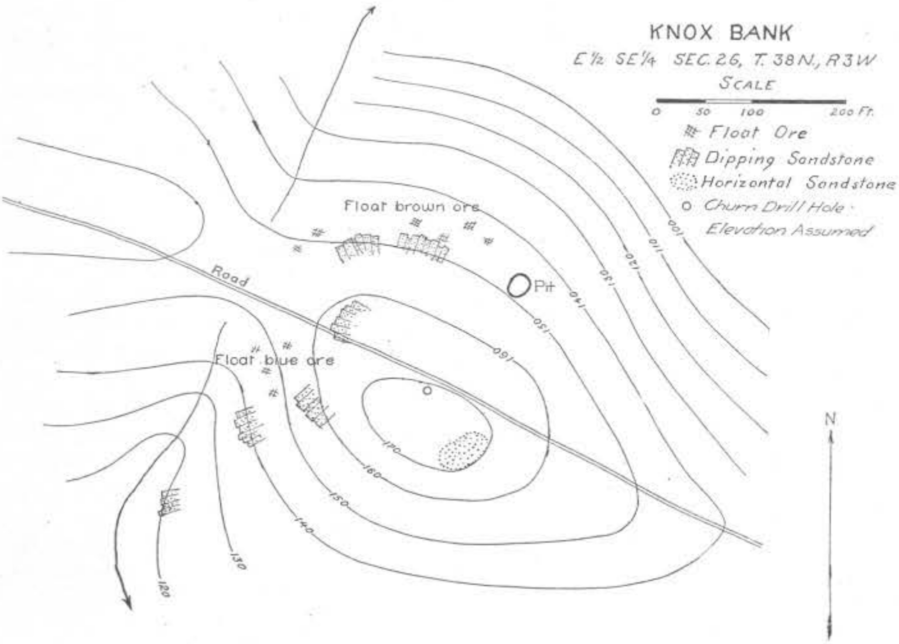


Fig. 22.

17. MARSH MINE.

Owned by J. F. Marsh, Steelville, Mo.

N. E. ¼, N. E. ¼, Sec. 5, T. 37 N., R. 4 W.

This mine is located one mile southwest of Steelville and is connected by a spur to the St. Louis and San Francisco R'y. It consists of an open pit 320 feet long, 200 feet wide, and 90 feet deep which is situated in the trough of a ravine. The evidence of a filled sink at this place is indicated by a rim of dipping Roubidoux sandstone encircling the mine on three sides and by the inclined position of the ore body. The ore originally outcropped at the southeast end of the pit. As it was followed down the incline it was found to occur in several layers or sheets separated by layers of clay and sandstone and to increase in dip with depth. A descending section of the face at the lower end of the incline as it appeared in 1910, is as follows:

Feet.	*Inches.*	
12		Clay and ocher mixed; yellowish brown and very light when dry.
3		Paint ore, red, soft, and greasy; (confined to small area on the right side of the face.
1		Fire clay, variously colored, blue, green, yellow, lavender or red.
12		Sandstone, hard gray, non-ferruginous, except near the paint ore.
7		Clay and broken chert mixed.
9		Brown ore in porous boulders containing some clay. (Shipments run from 51% to 53% iron.)
7		Clay and decomposed chert.
1	6	Clay, red.
1	6	Ore, hard brown hematite.
2	6	Ore, chiefly red hematite, including boulders of hard blue hematite.
15		Quartzitic sandstone, chert and clay.

A few months later the owner reported the mine worked out. During the year 1910 this mine produced 5,000 tons of ore which ranged between 54 and 61% iron. The average of five shipments was 57.24% iron, 0.03% Sul., and 6.77% silica. The mine was abandoned during November of 1910 after having produced a total of about 41,000 tons. (C.—1910.)

18. McGARY MINE.

Owned by E. A. McGary.

S. W. ¼, N. W. ¼, Sec. 29, T. 36 N., R. 4 W.

This mine is located 2½ miles east of Cook Station and is situated on the southeast slope of a high hill capped by Roubidoux sandstone. The mine consists of a single cut 90 feet long, 40 feet wide, and 12 feet deep. It is located near the north end of a filled sink, the presence of which is indicated by a rim of dipping Roubidoux sandstone encircling the mine on three sides. The mine is in an abandoned condition and the faces are badly caved. Very little ore is to be seen. The east face of the cut is composed largely of Carboniferous shale. The west face, however, shows a ledge of ferruginous sandstone dipping to the west. This sandstone appears to have overlain the ore.

The ore consisted of soft red and hard blue hematite, several carloads of which are reported to have been shipped. (C.—1910.)

19. PINNEL MINE.

Owned by Albert Bitza, Cuba, Mo.

S. ½, S. W. ¼, Sec. 27, T. 39 N., R. 5 W.

This mine, located three miles west of Cuba, produced 550 tons of ore prior to 1892. The property was not visited and the present condition of the mine is not known.

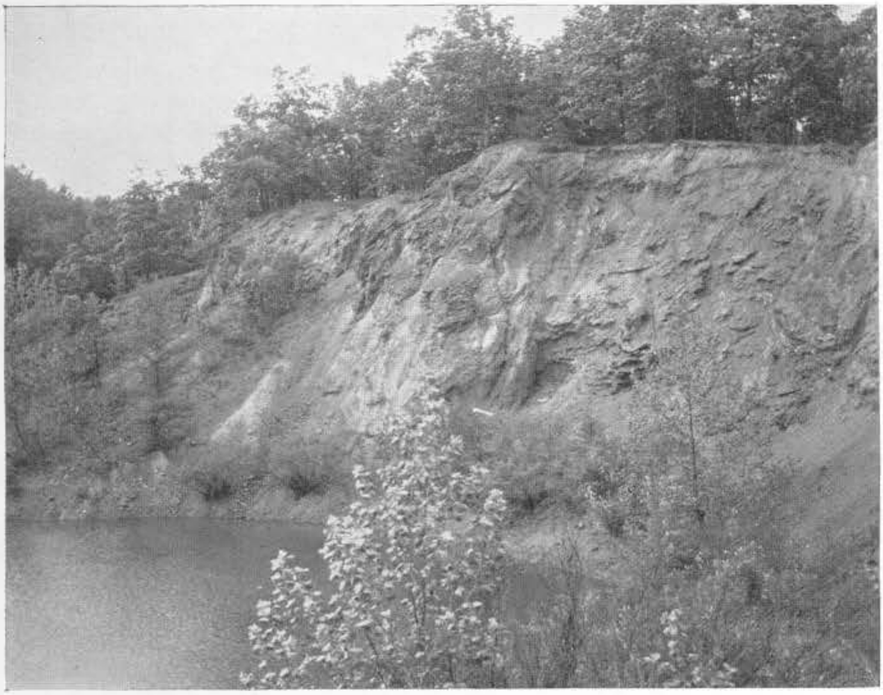


Fig. 1. NORTH WALL OF SCOTIA MINE NO. 1.

Fig. 2. SCOTIA MINE NO. 1, SHOWING DIPPING SANDSTONE ALONG WEST FACE.

20. REES MINE.

Owned by Sligo Furnace Company, St. Louis, Mo.

E. ½, Sec. 27, T. 36 N., R. 4 W.

This mine, located three miles northeast of Sligo, is situated on the east bank of Crooked creek. Developments consist of a pit 90 feet long, 40 feet wide, and about 15 feet deep. There is no outcrop at this place and no structural features from which the extent of the ore deposit can be determined.

The mine produced several hundred tons of soft, red hematite. The property was abandoned due to flooding by Crooked creek. (H.—1910.)

21. SCOTIA MINE NO. 1.

Owned by Adair Brothers, Scotia, Mo.

E. ½, S. E. ¼, Sec. 1, T. 38 N., R. 3 W.

This mine is located 10 miles northeast of Steelville and is situated low on the point of a secondary spur. The pit is typical of the filled sink deposits. It consists of a cone-shaped opening about 300 feet long, 200 feet wide, and 50 feet deep, from which 150,000 tons of ore are reported to have been taken. It has long been abandoned as worked out but is still of some economic importance from the fact that the ore is reported to have bottomed on iron sulphide, the thickness of which has been variously estimated at from 13 to 100 feet.

The pit at present is badly filled with wash and it is not probable that the iron sulphide could be mined without the removal of from 20 to 30 feet of waste materials. (C.—1910.)

22. SCOTIA MINE NO. 2.

Owned by Wm. James, St. James, Mo.

S. E. ¼, Sec. 28, T. 39 N., R. 2 W.

This mine located a quarter of a mile north of Hinch P. O. in the northeast corner of the county, was operated during 1873 and, according to available records, produced 7,000 tons of ore. The ore was smelted at the Scotia furnace, three miles to the southwest.

The mine has been abandoned since the early 70's but is reported to contain workable ore. For a description of the property, at the time it was opened, see Dr. A. Schmidt, Report of the Mo. Geol. Survey, 1872, Part I, p. 131.

23. TAYLOR MINE.

Owned by L. P. Heironimus.

S. ½, S. E. ¼, Sec. 33, T. 40 N., R. 5 W.

This mine, located ten miles northwest of Cuba, produced 2,500 tons of ore prior to 1892. This property was not visited and the present condition of the mine is not known.

24. THOMPSON MINE.

Sec. 26, T. 36 N., R. 4 W.

Considerable specular ore has been taken from this bank and smelted at Sligo furnace. The ore is mingled with chert and sandstone in the same way as at Cherry Valley. There is much secondary calcite present, which is stained by iron so as to resemble jasper. The ore body rests on limestone with broken sandstone as cap rock. The ore is rather lean. (N.—1892.)

25. VARRIS MINE.

Owned by Kate Warren.

S. W. ¼, S. E. ¼, Sec. 33, T. 39 N., R. 5 W.

This mine, located one mile north of Fanning, produced about 400 tons of ore prior to 1892. It was not visited and its present condition is not known.

26. VAUGHN BANK.

Owned by F. E. Vaughn, Wesco, Mo.

N. E. ¼, Sec. 13, T. 36 N., R. 5 W.

This bank, located two miles southeast of Wesco, is situated on a low hill between two small streams, on the extreme western edge of a complexly folded area. Developments consist of two small cuts having a maximum depth of about five feet.

The ore consists of red and specular hematite containing much crystalline quartz. There is little or no outcrop at this place, and the probable extent of the ore deposit can only be determined by prospecting. (H.—1910.)

27. ZANE MINE.

Owned by John Broombaugh, Steelville, Mo.

N. W. ¼, Sec. 13, T. 38 N., R. 4 W.

This mine, located four miles northeast of Steelville, is situated immediately southeast of Meramec river. According to the Tenth Census Report, the ore occupied a crevice in massive chert which was inclined 30° to the south. The ore body was 110 feet long, and 3 feet wide, and was followed to a depth of 30 feet, at which point it suddenly terminated. The ore consisted chiefly of soft, red hematite and a small amount of specular hematite. Analyses of shipments yielded 59.20% iron, and 0.08% Phos.

The mine was operated by the Midland Furnace Company prior to 1880 and produced 700 tons of ore. It is reported to have been exhausted.

SECONDARY LIMONITE.

28. HIBLER BANK.

Owned by C. H. Hibler, Sligo, Mo.

W. ½, Sec. 34, T. 36 N., R. 4 W.

This bank, located two miles north of Sligo, is situated on the crest and higher slopes of a ridge. Developments consist of several shallow test pits sunk at intervals along the crest of the ridge for a distance of a quarter of a mile. The ore consists of secondary limonite, the larger boulders of which often contain cores of unaltered pyrite. It is, however, quite free from chert or other foreign materials.

The outcrop at present is not a promising one. It is reported, however, that 100 tons of surface ore has been hauled to Sligo furnace. The residuum at this place is thin, as indicated by numerous outcrops of dolomite.

(H.—1910.)

29. PEETZ BANK.

Owned by Dr. Zarhosky, Steelville, Mo.

S. E. ¼, N. W. ¼, Sec. 9, T. 37 N., R. 4 W.

This mine is located 1½ miles south of Steelville and is situated near the base of a high hill capped by Roubidoux sandstone. The ore outcropped in scattered boulders and small fragments near the base of the hill. A carload of it, when shipped to the Sligo Furnace, gave good results. With this encouragement a cut 50 feet in diameter and 15 feet deep was made, from which about 6 car loads of ore were obtained. This ore, when shipped, was promptly rejected by the Furnace on account of high sulphur. An examination of the bank shows the ore to be secondary after the sulphide which is in an incomplete state of alteration. Nearly every fragment shows the crystal outlines of pyrite or marcasite, and the larger masses almost invariably contain cores of unaltered sulphide. (C.—1910.)

30. STEELVILLE NO. 2 BANK.

E. ½, S. W. ¼, Sec. 5, T. 37 N., R. 4 W.

This limonite bank presents a very fine show of large surface-ore on the eastern slope of a sandstone hill, near its foot. A brown impregnated sandstone is found above the ore on the same slope. White sandstone forms the summit. The surface over which the ore is spread is about four hundred feet long and thirty-five feet wide. A narrow belt of breccia of gray and green chert, cemented by an indurated clay, encircles the ore above and separates it from the sandstone. Some soft red ore has been found near the bank north of it. (S.—1872.)

CRAWFORD COUNTY.

HEMATITES OF THE FILLED SINKS.

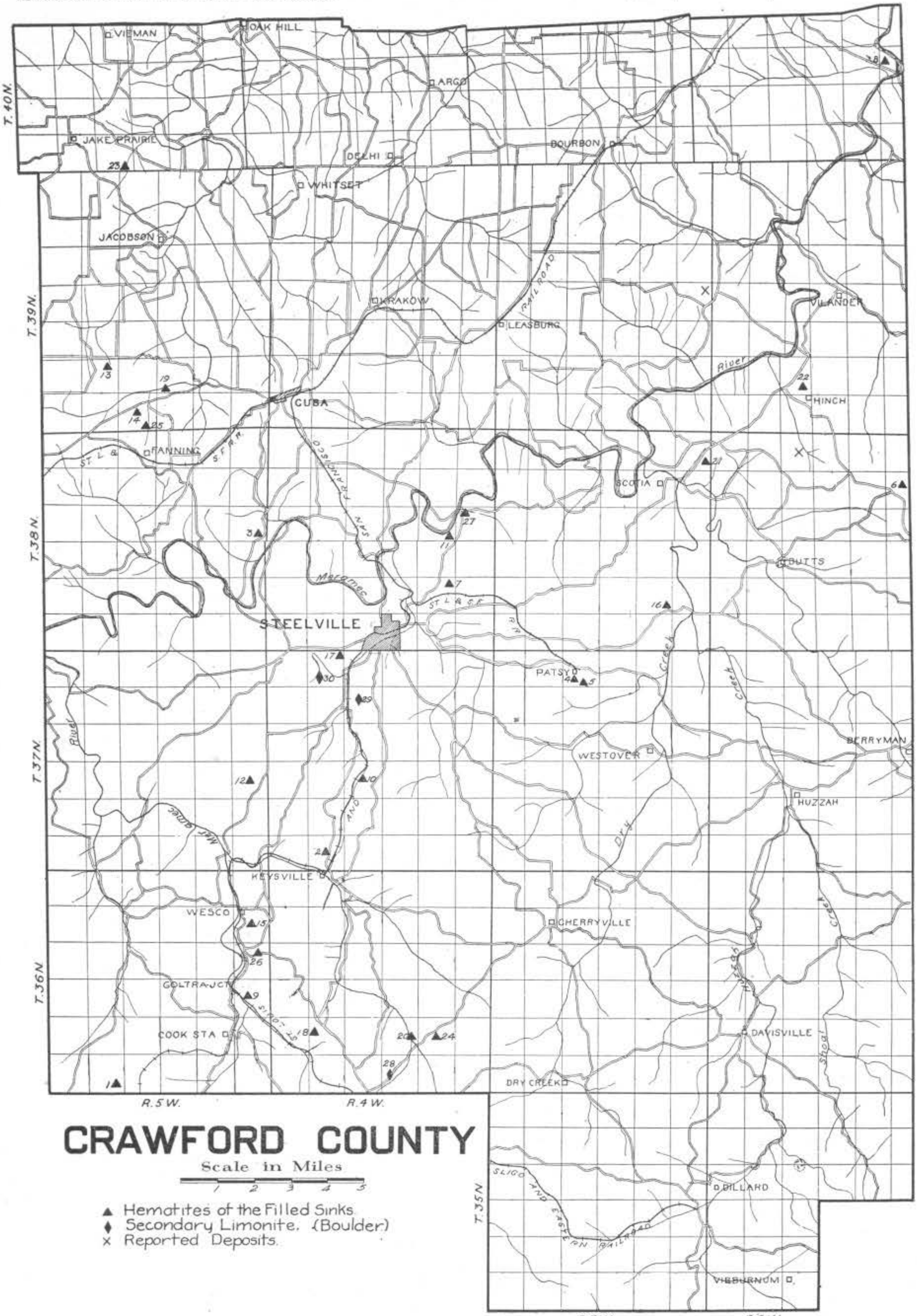
No.	Name of Mine or Owner.	Twp. N.	R.	Sec.	Fractional.
1	Benton Creek Mine	36	5 W.	32	S. E. ¼.
2	Buffum Mine	37	4 W.	32	
3	Card Mine	38	5 W.	13	S. E. ¼.
4	Cherry Valley Mine No. 1	37	3 W.	4	E. ½, S. W. ¼.
5	Cherry Valley Mine No. 2	37	3 W.	4	W. ½, S. E. ¼.
6	Christy Bank	38	2 W.	12	S. E. ¼, N. W. ¼.
7	Clark Mine	38	4 W.	26	N. E. ¼, N. E. ¼.
8	Copper Hill Mine	40	2 W.	24	S. W. ¼, N. W. ¼.
9	Craig Mine	36	5 W.	24	S. E. ¼, N. W. ¼.
10	Ferguson Mine	37	4 W.	21	N. ½, S. E. ¼.
11	Griffith Mine	38	4 W.	14	S. E. ¼, S. E. ¼.
12	Hart Mine	37	5 W.	24	
13	Iron Ridge Mine No. 1	39	5 W.	29	N. E. ¼.
14	Iron Ridge Mine No. 2	39	5 W.	33	
15	James Mine	36	5 W.	12	Center.
16	Knox Bank	38	3 W.	26	E. ½, S. E. ¼.
17	Marsh Mine	37	4 W.	5	N. E. ¼, N. E. ¼.
18	McGary Mine	36	4 W.	29	S. W. ¼, N. W. ¼.
19	Pinnel Mine	39	5 W.	27	S. ½, S. W. ¼.
20	Rees Mine	36	4 W.	27	E. ½.
21	Scotia Mine No. 1	38	3 W.	1	E. ½, S. E. ¼.
22	Scotia Mine No. 2	39	2 W.	28	S. E. ¼.
23	Taylor Mine	40	5 W.	33	S. ½, S. E. ¼.
24	Thompson Mine	36	4 W.	26	
25	Varris Mine	39	5 W.	33	S. W. ¼, S. E. ¼.
26	Vaughn, F. E., Bank	36	5 W.	13	N. E. ¼.
27	Zane Mine	38	4 W.	13	N. W. ¼.

SECONDARY LIMONITE.

28	Hibler Land	36	4 W.	34	W. ½.
29	Peetz Bank	37	4 W.	9	S. E. ¼, N. W. ¼.
30	Steelville No. 2 Bank	37	4 W.	5	E. ½, S. W. ¼.

REPORTED OCCURRENCES.

Smith, G. L. W	38	2 W.	4	Center.
Smith, G. L. W	39	3 W.	13	E. ¼, N. E. ¼.



CRAWFORD COUNTY

Scale in Miles

1 2 3 4 5

▲ Hematites of the Filled Sinks.
♦ Secondary Limonite. (Boulder)
× Reported Deposits.

DADE COUNTY.

PRIMARY LIMONITES.

1. COMPTON (G. A.) MINE.

Sec. 35, T. 30 N., R. 25 W.

This mine, located three miles southwest of Ash Grove, is situated on the south slope of a low hill. Developments consist of several pits having a maximum depth of about ten feet.

The ore consists of fibrous goethite which occurs as geodes (or bombs) embedded in residuum of Burlington limestone. The ore contains scattered fragments of white chert.

The mine was operated in 1905, producing about 40 tons of ore. Shipments showed an analysis of 47.03% iron, 11.00% silica, 0.103% Phos., and 0.86% Mn. (H.—1910.)

DALLAS COUNTY.

SECONDARY LIMONITE.

1. BOOTH LAND.

Owned by Henry Booth, Urbana, Mo.

S. ½, Sec. 2, T. 35 N., R. 20 W.

Several outcrops of massive limonite occur along the southern edge of this property. The ore is much scattered and at no place is there sufficient ore in sight to warrant extensive prospecting. No developments have been made.

The ore is a non-silicious, secondary limonite pseudomorphous after pyrite. It occurs as boulders and fragments embedded in cherty, red clay. The residuum at this place is comparatively thin.

This property is located ten miles north of Buffalo. (H.—1910.)

2. DAY LAND.

Owned by Walter Day, Urbana, Mo.

S. ½, Sec. 1, T. 35 N., R. 20 W.

This prospect, located ten miles north of Buffalo, is situated on the west slope of a low hill. The outcrop consists of boulders of limonite scattered over an area of several acres. Developments consist of one test pit which discloses boulders and fragments of ore to a depth of three feet.

The ore is secondary limonite, containing only a small amount of visible silica. (H.—1910.)

DENT COUNTY.

Dent county ranks fourth in the production of iron ore, having an acredited output of 904,841 tons. With the exception of three deposits of secondary limonite, the commercial ore bodies are chiefly "Hematites of the filled sinks," consisting of both red and specular ores. The distribution of the various known deposits is shown on the accompanying county map.

Although several mines were opened up during the early 70's, no ore was smelted in Dent county until 1880, at which time the Sligo Furnace was put in blast. From 1881 to 1884, the Nova Scotia furnace was also in blast. With the exception of 1904 and 1910, shipments have been made each year since 1892. Practically all of the ore mined in this county since 1884 has been smelted at the Sligo furnace.

HEMATITES OF THE FILLED SINKS.

1. ARNOLD MINE.

Owned by Sligo Furnace Company, St. Louis, Mo.

S. E. ¼, Sec. 4, T. 35 N., R. 5 W.

This mine, located two miles northeast of Bangert, is situated in a small gully on the south slope of a high ridge.

Two cuts, each approximately 60 feet long, 40 feet wide, and from 15 to 18 feet deep, constitute the principal workings. The only exposure of ore occurs near the southwest corner of the west cut, the remainder of the faces showing massive, chert-quartzite breccia or ore covered with detritus.

Dr. A. Schmidt, who visited this property in 1872, reports that a good outcrop of specular ore marked the present site of this mine. There is no rim rock to define the extent of the sink, the adjacent slopes being covered with a mantle of residual chert. Apparently no attempt has been made to follow the ore body below the level of the gully.

The ore consists of soft, red hematite with minor quantities of specular hematite. The mine has produced several hundred tons, an average analysis of which ran 66.66% iron, 4.12% silica, 0.023% Phos., 0.33% lime, and 0.11% alumina, and 0.15% magnesia. (H.—1910.)

2. BLAIR MINE.

S. ½, Sec. 9, T. 35 N., R. 6 W.

Here, across a ravine from the Williams bank, on the lower slope, are located an irregularly shaped, shallow cut and shafts, none more than twenty feet deep. The surface material is a chert and ore breccia mingled with blocks and fragments of hard sandstone and chert. From one shaft little else than sandstone was taken. This shaft is higher on the hill than are the other shafts and the cut. From each shaft clay containing chert and sandstone was removed. This area was but poorly prospected. A considerable amount of fine, soft, red ore with a small amount of blue specular ore has been shipped from this bank; but it is now abandoned. (L.—1892.)

3. CAUSEY MINE.

Owned by A. C. Causey, Salem, Mo.

S. W. ¼, N. E. ¼, Sec. 25, T. 34 N., R. 7 W.

This mine, located seven miles west of Salem, is situated on the north face of a very gentle slope. Developments consist of a pit 50 feet long and 32 feet wide, which is reported to have been worked to a depth of 18 feet.

The discovery of ore at this place was quite accidental, there being practically no outcrop and no structural features indicating a possible sink. In sinking the pit three feet of soil was encountered, then iron-stained clay, followed by masses of limonite and finally masses of specular hematite. From the bottom of the pit three short drifts were driven to the westward, two of which encountered a wall of loosely cemented sandstone at a distance of 30 feet. The third, and shortest drift, stopped in ore.

Neither the depth nor lateral extent of this deposit has been determined. To the east and south of the pit there are good possibilities for a commercial deposit of ore and the property deserves systematic prospecting.

This mine has produced about 100 tons of ore, the most of which consisted of specular hematite. (H.—1910.)

4. CLARK MINE.

Owned by J. M. Taylor, St. Louis, and Clark Heirs.

S. W. ¼, S. E. ¼, Sec. 12, T. 34 N., R. 7 W.

This mine, located eight miles west of Salem, is situated on the north bank of a ravine tributary to Dry Fork. The principal workings consist of a horseshoe-shaped cut which extends 200 feet into the hillside and enclosed an area of barren ground. The "horseshoe" is 200 feet wide at the north and 75 feet at the south. The cut has an average width of 75 feet and a maximum depth of 30 feet. No attempt has been made to follow the deposit below the level of the ravine and the depth to which the ore may extend is not known. Except for an occasional exposure of iron-stained chert breccia, the walls of the cut show only detritus. The enclosed area of barren ground consists of clay, chert, and sandstone.

The original outcrop at this place covered an area 400 feet square. There is no well defined rim-rock, although blocks of sandstone occur across the ravine and 180 feet south of the mine, while fragments of sandstone cover the surface north and east of the cut for a distance of 50 feet.

The ore consisted of soft red and specular hematites of which 16,827 tons were produced prior to 1892. (H.—1910.)

5. FERGUSON MINE.

Sec. 13, T. 34 N., R. 6 W.

This mine, located immediately northwest of Salem, produced 43,500 tons of ore prior to 1892. The property was not visited and the present condition of the mine is not known.

6. FITZWATER MINE.

Owned by Sligo Furnace Company, St. Louis, Mo.

$$\left.\begin{array}{c} \textit{N. E. ¼, Sec. 33} \\ \textit{and} \\ \textit{N. W. ¼, Sec. 34} \end{array}\right\} \textit{T. 35 N., R. 4 W.}$$

This mine, located 4½ miles south of Sligo, is situated on the northwestern slope of a ridge capped by Robidoux sandstone. According to Dr. A. Schmidt, who visited the property in 1872, the main portion of the outcrop covered an area 1500 feet by 800 feet.

The mine was opened in 1880 by the Sligo Furnace Company and subsequently produced 6,000 tons of red and specular hematites. The analysis of an average sample ran 62.95% iron, and 0.035% Phos.

This property was not visited and the present condition of the mine is not known.

7. GROVER MINE.

S. W. ¼, Sec. 2, and N. W. ¼, Sec. 11, T. 35 N., R. 4 W.

This bank is situated on the top of a high ridge, with rather steep slopes, cut by numerous ravines, which descend gradually through lower ranges of hills into the broad valley of Crooked creek.

The ore does not lie thick, either on the slopes or on the hill. It is more concentrated in the ravines. The Third Magnesian limestone and the Second sandstone are met with in going from the valley up to the bank. The sandstone becomes very ferruginous near the bank. Above this is a thin streak of red clay with chert and, finally, the ore on the summit. The succession of rocks and the situation of the bank seems to warrant the presence of a good ore deposit, although the surface ore is not very copious. Six small shafts have been dug on the top of the hill, five of which were too near the outcrop of the ore, and therefore after cutting through five to seven feet of soft red and of specular ore, struck either the underlying white clay or the chert breccia or the impregnated sandstone. The sixth shaft was made nearer the central part of the summit, and struck soft, red hematite immediately below the soil, together with boulders of specular ore up to one foot in diameter. This shaft was discontinued at a depth of six feet, and is all in the ore. (S.—1872.)

This mine lies within 1½ miles of Sligo Furnace and has probably been worked out.

8. HAWKINS MINE.

Owned by Geo. W. Powell, Condray.

Center Sec. 11, T. 35 N., R. 6 W.

This mine, located 2½ miles west of Bangert, is situated on the southern edge of a plateau. The principal workings consist of a crescent-shaped pit 410 feet long, 300 feet wide at the center, and about 200 feet wide at either end. The pit, which lies in a general north-south direction, is 60 feet deep but is reported to have been worked to a depth of 90 feet. The north, west, and south walls of the pit consist, for the most part, of detritus, although ledges of chert and sandstone are exposed at several places dipping towards the center of the pit. The base of the east wall is composed of massive beds of iron-stained chert and quartzite 25 feet thick. It is reported that this ledge was underlain by ore which has been mined out. The ledge is overlain by sandy ocher, sand, and clay.

The only exposure of ore occurs near the northeast corner of the pit. Here a vertical band of low grade, red hematite 30 feet across occurs between nearly vertical beds of chert, quartzite, and stratified clay.

In 1907 the Jewel Iron Company operated two shafts on this property both of which were sunk within the area partly encircled by the pit. From one of these shafts, which is 100 feet deep, two drifts were extended at the 85 foot level. One drift was driven northeast for a distance of 105 feet through dolomite. The other, southward for a distance of 100 feet, penetrating ore throughout its length. It is reported that 800 tons were mined from this and several small side drifts. The second shaft encountered dolomite throughout its depth of 105 feet. A drift, extended southward from its bottom, is reported to have encountered ore at a distance of 20 feet from the shaft.

The ore at this mine consisted of red and specular hematites, shipments of which ran 52.86% iron, 8.28% silica, 0.087% Phos., 0.123% Sul., 2.58% alumina, 0.87% lime, and 0.457% magnesia.

This mine was opened in 1879 and worked intermittently to 1907, producing an estimated total of 200,000 tons of ore. The deposit has the appearance of being practically exhausted. (H.—1910.)

9. HAYES MINE.

Owned by Martha Woodside, Salem, Mo., Mrs. Peck, St. Louis, Mo., and Sligo Furnace Co., St. Louis, Mo.

N. E. ¼, Sec. 20, T. 34 N., R. 5 W.

This mine, located two miles east of Salem, is situated near the crest of a low hill. The main workings consist of a pit 110 feet long, 90 feet wide, and 30 feet deep. The north wall of the pit is composed of iron-stained sandstone containing fragments of chert, while the remainder of the face is covered with detritus. A long cut, at the northwest corner, which forms an egress from the pit to the surface, exposes beds of sandstone dipping sharply towards the pit.

The original outcrop at this mine was extraordinarily heavy, but in working the pit to its present dimensions the ore body has apparently been exhausted. Extensive prospecting in the immediate vicinity has failed to show the presence of more ore.

The ore consisted of specular and red hematites. The total production of this mine is estimated at 8,000 tons. (H.—1910.)

10. HOWE MILL BANK.

Sec. 9, T. 34 N., R. 3 W.

This bank occurs on an isolated hill surrounded on all sides by deep ravines. It is about 90 or 100 feet high. It differs from Simmons mountain in this, that while Simmons mountain rises above a plateau this hill is cut out from the plateau and is surrounded by other hills and ridges. The surface of the hill is covered by broken sandstone with no limestone in sight. Mingled with this surface debris are blocks of more or less altered specular ore. One shaft 50 feet deep has been sunk. This passes through first sandy and decomposed cherty layers, all in position and dipping steeply away from the hill. Beneath this are layers of compact boulder ore with interstitial limonite and soft red hematite. The shaft is reported not to have gone through the ore. Another shaft sunk on another side of the hill shows the strata and ore body in the same relative positions. The same conditions probably exist around the entire body of the hill. The outcrop is very promising. (N.—1892.)

The present condition of this property is not known.

11. HUTCHINS CREEK MINE.

Sec. 15, T. 34 N., R. 4 W.

Good specular ore, from nut size to one foot in diameter, mostly rounded, is here found in four ravines on the west and south sides of a high ridge. But little surface ore is to be seen. The hills are covered with soil and chert. Large and small pieces of white sandstone are found on the lower part of the slope. No ferruginous rocks. (S.—1872.)

This property produced 2,008 tons of ore prior to 1892. Its present state of development is not known.

12. JAMISON MINE.

S. W. ¼, Sec. 1, T. 33 N., R. 6 W.

The mine is on the vast plateau dividing the waters of the Meramec from those of the Current river. This bank occupies the highest point on a rather flat, semi-circular hill which lies around a nearly circular depression, apparently filled with fine detritus of chert, sandstone and specular ore. The ore is in part pure, in part mixed with quartz. Some boulders are two or three feet in diameter.

Another smaller district, with rounded surface ore, is seen about six hundred feet to the northwest, and another in a small ravine to the south.

A shaft in the main bank was sunk to a depth of ten feet through red, sandy loam, with boulders of specular ore. (S.—1872.)

This property produced 22,354 tons of ore prior to 1892. Its present state of development is not known.

13. KERR MINE.

Owned by Mrs. A. P. Kerr, Salem, Mo.

W. ½, N. W. ¼, Sec. 4, T. 33 N., R. 6 W.

This mine, located 5½ miles southwest of Salem, is situated on the north slope of a hill. Developments consist of a pit 55 feet long and 42 feet wide, which is reported to have been worked to a depth of 18 feet. When visited the pit was filled with water.

Residual boulders of specular ore are scattered for some distance down the slope below the pit. There is no rim-rock. The depth and lateral extent of the ore body has not been determined and the property deserves systematic prospecting.

The ore consists of red and specular hematites of which about 1,500 tons have been produced. (H.—1910.)

14. LENOX MINE.

Owned by Sligo Furnace Company, St. Louis, Mo.

N. E. ¼, S. E. ¼, Sec. 17, T. 34 N., R. 6 W.

This mine, located 4½ miles west of Salem, is situated on the west bank of a small stream. Developments consist of a circular pit 105 feet in diameter and 37 feet in maximum depth. On the west side of the pit a shaft was sunk in the bottom to a depth of 8 feet, from which a small drift was driven through ore to the west.

Ledges of quartzite-chert breccia, dipping towards the center of the pit, are exposed on the north and south walls. The west wall is composed of massive quartzite while vertical beds of sandstone are exposed on the east wall, where the pit is of shallow depth. A small exposure of low grade limonite occurs on the west wall of the pit. There is no rim rock and it is probable that the present outlines of the pit represent the lateral extent of the ore body. Apparently the deposit has not been worked to its ultimate depth.

This mine has produced several hundred tons of red and specular hematites. (H.—1910.)

15. NORRIS MINE.

S. E. ¼, N. E. ¼, Sec. 12, T. 34 N., R. 5 W.

This mine, located seven miles northeast of Salem, produced 1,300 tons of ore prior to 1892. This property was not visited and the present condition of the mine is not known.

16. NOVA SCOTIA MINE.

Owned by Harrison Land and Mining Company, St. Louis, Mo.

N. E. ¼, S. E. ¼, Sec. 26, T. 33 N., R. 4 W.

This mine, located 16 miles southeast of Salem, is situated on the crest and south slope of a hill. Mining was restricted to pits and shafts sunk in an area 150 feet by 360 feet. According to the report of the Tenth Census, red and specular hematite occurred interbedded with clay, and occasionally chert, to a depth of 80 feet. The soft, red hematite, on analysis, yielded 63.77% iron, and 0.061% Phos.; the specular ore yielded 67.02% iron and 0.025% Phos.

This mine supplied a portion of the ore treated at the old Nova Scotia furnace, which was located at the base of the hill south of it. Prior to 1892 the mine produced 27,500 tons. It has not been worked in recent years.

17. ORCHARD MINE.

Owned by Milsap Heirs, Steelville, Mo., and Sligo Furnace Company, St. Louis, Mo.

N. W. ¼, Sec. 19, T. 34 N., R. 5 W.

This mine is situated in the southern outskirts of Salem. Developments consist of a pit 150 feet in diameter which, according to the Tenth Census Report, was worked to a depth of 85 feet. The pit is now filled with water. The body of the hill on which the mine is situated is composed of sandstone, exposures of which occur at several places along the rim of the pit.

The ore consisted of specular and earthy, red hematites. The analysis of a sample from the stock pile ran 57.96% iron, and 0.067% Phos.

The mine was opened in the late 70's and abandoned about 1880, producing 41,650 tons of ore.

18. PLANK MINE.

Owned by Plank Heirs, Salem, Mo.

Sec. 33, T. 35 N., R. 6 W.

This mine, located four miles west of Gano, P. O., is nearly encircled by a low ridge. The principal workings consist of a pit 330 feet long, 210 feet wide and at present 50 feet deep. During the last three years of mining activity, operations were confined entirely to underground work. Two shafts, having a maximum depth of 160 feet and located at the southwest and southeast corners of the pit, communicated with the underground workings. The shafts are connected by a drift which is reported to have encountered ore throughout the entire distance. The shaft at the southeast corner was later sunk to a depth of 260 feet, penetrating cherty cotton rock the greater part of the last 100 feet. Mr. F. L. Nason, who visited the property in 1891, reports that the walls of the pit showed ledges of chert, sandstone, and stratified clay, all dipping towards the center. These materials are now exposed only on the west wall, the remainder of the face being covered by detritus.

The sink structure is well defined on the west and north by a rim-rock which occurs at an average distance of 140 feet from the pit. To the east and south, no rim-rock is in evidence and in these directions lie the possibilities of a further extension of the ore body.

The ore consists chiefly of specular and soft, red hematites, although that part of the ore body which occurred near the surface is reported to have consisted of limonite.

This mine was abandoned in 1895 after producing about 65,000 tons of ore. (H.—1910.)

19. POMEROY MINE.

Owned by William James, St. James, Mo.

N. W. ¼, S. W. ¼, Sec. 10, T. 34 N., R. 6 W.

This mine, located four miles northwest of Salem, is situated near the junction of two small ravines. The principal workings consist of a pit 300 feet long, 165 feet wide, and 30 feet deep. Two shafts have been sunk just south and southwest of the pit. Evidently neither of these encountered ore.

Soft, red hematite and ocher is exposed in the northeast corner of the pit. The ore is underlain by bedded chert and is overlain by sandstone and quartzite. The east wall consists of massive iron-stained chert while the remainder of the face is covered with detritus. There is no rim-rock exposed, although the surface north and east of the pit is covered with fragments of sandstone.

The ore consisted chiefly of red and specular hematites with a small quantity of limonite. An average sample ran 59.99% iron and 0.079% Phos.

This property has produced approximately 40,000 tons of ore. It was abandoned several years ago. (H.—1910.)

20. PRESTON MINE.

Owned by M. A. Preston, Pittsburg, Pa.

N. ½, Sec. 27, T. 34 N., R. 6 W.

This mine, located 3½ miles southwest of Salem, is situated near the crest of a low hill. The main workings consist of a pit 155 feet long by 120 feet wide and has a present depth of 22 feet. Four shafts were sunk in the floor of the pit, but no information could be obtained relative to their depths and the character of the material penetrated. Numerous test pits have been sunk in the surrounding area but the dumps show no ore. The walls of the pit are covered with detritus. There is no well defined rim-rock, although a band of sandstone blocks 150 feet north and northwest of the pit mark the possible occurrence of a former rim. The mine produced 15,000 tons of ore prior to 1892.

The ore consisted of red and specular hematite. The waste contains much specular ore in the form of small, rounded pebbles. (H.—1910.)

21. RED HILL MINE.

Owned by J. B. Gordon, L. B. Woodside, and J. E. Organ, Salem, Mo.

S. ½, Sec. 3, T. 32 N., R. 3 W.

This mine, located four miles northwest of Bunker, is situated on the north side of a ravine. It consists of an open cut 210 feet long by 195 feet wide, with a maximum depth of 50 feet. The walls of the pit consist of Roubidoux sandstone, the beds of which dips steeply toward the center. It is underlain by Gasconade dolomite which outcrops in the ravine at a slightly lower elevation than the pit floor.

The ore was mainly red hematite with minor quantities of limonite. The small amount remaining in sight is too silicious to be of value. This deposit produced 27,500 tons of ore during the period of operation of the Nova Scotia furnace in Dent county, and has the appearance of having been nearly exhausted. (B.—1910.)

22. RIVERSIDE-ZIEGLER MINE.

Owned by Harrison Land and Mining Company, St. Louis, Mo.

Sec. 2, T. 33 N., R. 5 W.

This mine, located seven miles southeast of Salem, produced 45,000 tons of ore prior to 1892. According to the Tenth Census Report the main workings consisted of a pit about 150 feet in diameter. The ore consisted chiefly of soft, purple hematite with minor quantities of specular hematite. An analysis of the former ran 64.05% iron, 2.56% silica, 0.063% Phos., and 0.179% Sul. The analysis of the specular ore ran 63.90% iron, 7.15% silica, 0.029% Phos., and 0.020% Sul.

This property was not visited and the present condition of the mine is not known.

23. SIMMONS MOUNTAIN MINE.

Owned by the Sligo Furnace Company, St. Louis, Mo.

W. ½, Sec. 24, T. 34 N., R. 6 W.

Simmons Mountain, located half a mile southwest of Salem, is an isolated hill rising 90 feet above the level of the surrounding plateau. The mine workings consist of a pit 500 feet long by 400 feet wide. It was worked to a depth of 200 feet.

The deposit occurred in the form of an inverted elliptical cone, enclosed by steeply dipping beds of quartzitic sandstone which contains much fragmental chert. The extent of the sink structure at this place is well defined on the north and west by dipping sandstone.

The ore consisted of red and specular hematites. The analysis of an average sample ran 68.69% iron, 1.41% silica, and 0.016% Phos.

This mine was opened in the early 70's and worked continuously until 1892, producing about 250,000 tons of ore. The deposit is practically exhausted. (H.—1910)

24. SLATER MINE.

Owned by L. B. Woodside, J. B. Gordon, and J. E. Organ, Salem, Mo.

S. W. ¼, N. W. ¼, Sec. 3, T. 32 N., R. 3 W.

This mine, located about 21 miles southeast of Salem, produced several thousand tons of ore prior to 1892. The property was not visited and the present condition of the mine is not known.

25. SLIGO BANK.

Owned by Sligo Furnace Company, St. Louis, Mo.

S. E. ¼, Sec. 23, T. 32 N., R. 6 W.

This bank, located 13 miles south of Salem, is situated at the head of a small ravine. No developments have been made. The outcrop covers an area 130 feet by 180 feet within which the surface is thickly strewn with boulders of specular hematite and secondary limonite. The best exposure of ore occurs in the southeast part of the outcrop, where it consists chiefly of specular hematite. In the north and western portions the surface ore consists largely of cherty limonite.

The outcrop is limited on the north and west by blocks of ferruginous sandstone and fragments of chert-sand breccia. On the east and south the exposure is limited by a small ravine, the east and south slopes of which are covered with a thick mantle of residual chert. (H.—1910.)

26. SLIGO MINE.

S. ½, Sec. 2, T. 35 N., R. 4 W.

There has been a good deal of ore taken from this bank but the deposit seems to have been rather "pockety." The surface of the ground is covered with broken sandstone and the ore seems to have laid in lenses in the slaty limestone immediately under the sandstone. The ore body lies on a ridge about 100 feet above the furnace at Sligo. Two drainage streams flow towards the valley from either side of the ore body. Toward these the sandstone dips steeply. On the west side of the ore body, as now known, a shaft is being sunk. It has penetrated almost 50 feet in loose saccharoidal sandstone, with no ore in sight.

It is intended to sink at least 100 feet or until limestone is struck. Drifts will then be run in various directions. This promises to be one of the most thoroughly tested mines of the specular ore region. (N.—1892.)

27. STEPHENS-WOODSIDE MINE.

Center of W. ½, Sec. 4, T. 33 N., R. 5 W.

This mine, located five miles southeast of Salem, is situated on the north face of a gentle slope. The principal workings consist of a pit 210 feet long, 50 feet wide and from 4 to 12 feet in depth. Ore was first encountered at the west end of the pit, and a thin seam followed eastward to within 50 feet of the east end. Here the seam apparently merged into a body of ore 50 feet in diameter which has been worked to a depth of 12 feet. Mr. Stephens, one of the joint owners, states that a shaft sunk in the bottom of the pit at this place penetrated red and specular ore to a depth of 16 feet. The seam worked in the west portion of the pit is reported to have been too thin to be of commercial importance. The ore is underlain by sandstone dipping 20° to the north. Forty feet north of the east end of the pit a shaft 62 feet deep penetrated 20 feet of red and specular ore at the bottom. Sixty feet south of the pit a shallow shaft shows a small amount of red paint ore.

On the crest of the hill 225 feet south of the main workings is a cut which exposes five feet of massive chert-quartzite breccia. A few yards northwest of this cut is a pit 60 feet in diameter and 8 feet deep. A low grade, silicious ore occurs here immediately below the surface. Apparently prospecting has not been carried to a depth of more than 10 feet at this place. There is no apparent rim-rock and the property deserves systematic prospecting.

The ore consists of red and specular hematites, shipments of which show 58.40% iron, 7.43% silica, and 0.112% Phos. The mine was temporarily abandoned in 1906, after producing an estimated total of 4,500 tons of ore. (H.—1910.)

28. THOMAS MINE.

S. E. ¼, N. E. ¼, Sec. 17, T. 34 N., R. 6 W.

This mine, located 4½ miles west of Salem, is situated on the crest of a low hill, about 80 yards northwest of the Lenox mine. Developments consist of a circular pit 105 feet in diameter and 35 feet deep. The east, north, and west walls are vertical and are composed of massive quartzitic sandstone. Near the bottom of the pit the ore body gradually dips beneath the wall rock. The contact between the ore and hanging wall was followed on the northwest to a distance of 40 feet from the pit.

So far as developed, the Thomas mine presents the same structural features as those of the Iron Ridge Mine in Crawford county, which was worked to a depth of 100 feet. Apparently no attempt has been made to determine the depth to which the ore may extend at the Thomas mine. There is no rim-rock.

The ore consists of soft red hematite which often shows stalactitic structures. Analysis of an average sample ran 57.78% iron and 0.127% Phos.

This mine was opened in about 1879 and has produced 6,320 tons of ore. (H.—1910.)

29. WATKINS MINE.

N. W. ¼, N. E. ¼, Sec. 12, T. 35 N., R. 7 W.

This mine is located six miles west of Bangert Sta. According to the Tenth Census Report, the ore is a soft red hematite exhibiting many concretionary forms. Near the surface boulders of limonite were found containing cores of unaltered sulphide. Analysis of the red hematite ran 59.30% iron, 0.079% Phos., and 0.069% Sul.

This mine was opened in 1879 and worked intermittently for several years, producing about 2,000 tons of ore. It was not visited and the present condition of the mine it not known.

30. WILLIAMS MINE.

N. ½, Sec. 16, T. 35 N., R. 6 W.

The Williams mine was owned and was operated by the Midland Blast Furnace Company. The mining was done on the point and western slope of a spur leading off from the main ridge. A cut about fifty yards long, north and south, and sixty yards wide, and several shafts of various depths have been made here. The deepest of these shafts extended to a depth of thirty feet. In this one red clay, a good quality of yellow ocher, a small amount of ore and chert fragments and strata were met with. In the southern end of the main cut which is also about thirty feet deep, a prospect hole ten feet deep was put down and passed through only a small amount of ore.

The walls of the cut now show ocher, irregular strata and blocks of chert, clay, some ore and detrital material. A larger amount of ore extended from the surface to the bottom of the cut.

The greater portion of the ore is of the red variety with a variable amount of hard specular ore mixed with it. This bank is now abandoned. (L.—1892.)

Prior to 1892 this mine produced 1,410 tons of ore. Its present condition is not known.

SECONDARY LIMONITES.

31. BUNKER BANK.

N. E. ¼, Sec. 24, T. 32 N., R. 3 W.

This bank, located half a mile west of Bunker, is situated in a ravine along the bottom of which boulders of limonite are exposed for a short distance. Developments consist of a cut 48 feet long by 15 feet wide which has been driven into the hillside exposing roughly bedded limonite overlain by loosely cemented sandstone.

The ore is a secondary limonite, which, in part, is comparatively free from chert and sand, and, in part, very silicious, due to the presence of druses of quartz and angular fragments of chert. The latter type also frequently contains masses of needle-like pipe ore. The cherty ore cannot be handled commercially. (B.—1910.)

32.

EDDINGTON MINE.

S. ½, Sec. 19, T. 34 N., R. 3 W.

This mine, located 12 miles east of Salem, is situated near the base of the north face of a high ridge. It consists of an open cut, 30 feet wide, and 50 feet long, from which considerable secondary limonite has been mined and shipped. The ore occurred in the form of boulders and fragments, embedded in red clay. Gasconade dolomite and chert are exposed on the side of the cut. No surface ore was observed in the immediate vicinity and the deposit has the appearance of being exhausted. (H.—1910.)

33.

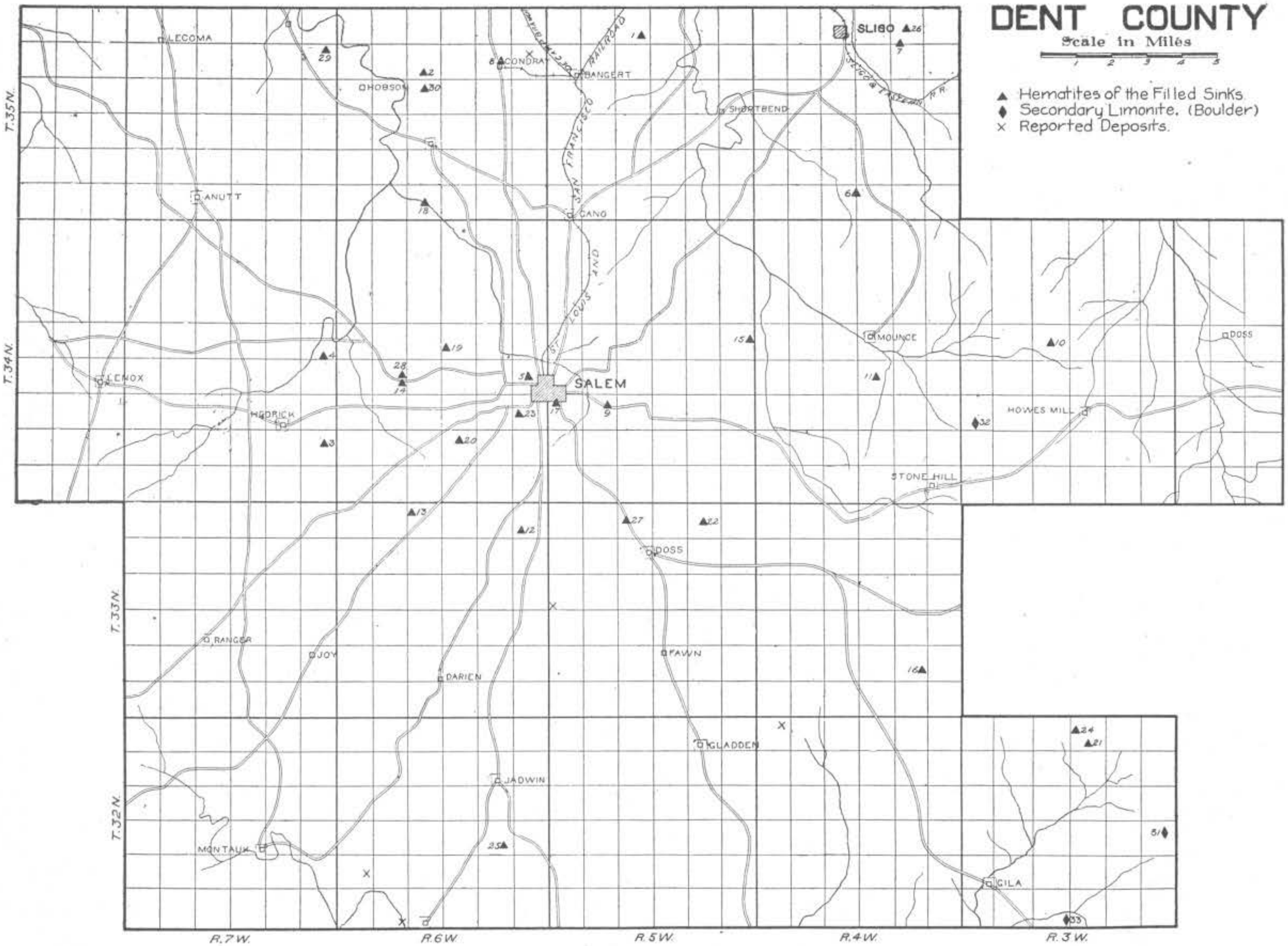
SWINNEY LAND.

Owned by I. N. Swinney, Bunker, Mo.

S. E. ¼, S. E. ¼, Sec. 33, T. 32 N., R. 3 W.

This deposit, located four miles southwest of Bunker, is situated on the crest of a ridge along which boulders of brown ore outcrop for a distance of 100 yards. Over an area 100 feet in diameter the showing is very good.

The ore is a secondary limonite and contains no sand or chert. It is in part porous, the cavities being filled with red clay. No developments have been made. (B.—1910)


DENT COUNTY
Scale in Miles
1 2 3 4 5
Hematites of the Filled Sinks.
Secondary Limonite. (Boulder)
Reported Deposits.
LECOMA
SLIGO
CONDRAY
BANGERT
HOBSON
SHORTBEND
ST. LOUIS AND SAN FRANCISCO RAILROAD
ANUTT
CANO
MOUNCE
DOSS
LENOX
SALEM
HEDRICK
HOWES MILL
STONE HILL
DOSS
RANGER
JOY
DARIEN
FAWN
GLADDEN
JADWIN
MONTAUK
GILA
T.35N.
T.34N.
T.33N.
T.32N.
R.7W.
R.6W.
R.5W.
R.4W.
R.3W.

DENT COUNTY.

HEMATITES OF THE FILLED SINKS.

No.	Name of Mine or Owner.	Twp. N.	R.	Sec.	Fractional.
1	Arnold Mine	35	5 W.	4	S. E. ¼.
2	Blair Mine	35	6 W.	9	S. ½.
3	Causey Mine	34	7 W.	25	S. W. ¼, N. E. ¼.
4	Clark Mine	34	7 W.	12	S. W. ¼, S. E. ¼.
5	Ferguson Mine	34	6 W.	13	
6	Fitzwater Mine	35	4 W.	33 34	N. E. ¼. N. W. ¼.
7	Grover Mine	35	4 W.	2 11	S. W. ¼. N. W. ¼.
8	Hawkins Mine	35	6 W.	11	Center E. ½.
9	Hayes Mine	34	5 W.	20	N. E. ¼.
10	Howe Mill Bank	34	3 W.	9	
11	Hutchins Creek Bank	34	4 W.	15	
12	Jamison Bank	33	6 W.	1	S. W. ¼.
13	Kerr Mine	33	6 W.	4	W. ½, N. W. ¼.
14	Lenox Mine	34	6 W.	17	N. E. ¼, S. E. ¼.
15	Norris Mine	34	5 W.	12	S. E. ¼, N. E. ¼.
16	Nova Scotia Mine	33	4 W.	26	N. E. ¼, S. E. ¼.
17	Orchard Mine	34	5 W.	19	N. W. ¼.
18	Plank Mine	35	6 W.	33	
19	Pomeroy Mine	34	6 W.	10	N. W. ¼, S. W. ¼.
20	Preston Mine	34	6 W.	27	N. ½.
21	Red Hill Mine	32	3 W.	3	S. ½.
22	Riverside-Ziegler Mine	33	5 W.	2	
23	Simmons Mountain	34	6 W.	24	W. ½.
24	Slater Mine	32	3 W.	3	S. W. ¼, N. W. ¼.
25	Sligo Bank	32	6 W.	23	S. E. ¼.
26	Sligo Mine	35	4 W.	2	
27	Stephens & Woodside Mine	33	5 W.	4	E. ½, S. W. ¼, N. W. ¼. E. ½, N. W. ¼, S. W. ¼.
28	Thomas Mine	34	6 W.	17	S. E. ¼, N. E. ¼.
29	Watkins Mine	35	7 W.	12	N. W. ¼, N. E. ¼.
30	Williams Mine	35	6 W.	16	N. ½.

SECONDARY LIMONITE.

31	Bunker Bank	32	3 W.	24	N. E. ¼.
32	Eddington Mine	34	3 W.	19	S. ½.
33	Swinney, I. N., Land	32	3 W.	33	S. E. ¼, S. E. ¼.

REPORTED OCCURRENCES.

Grogan Land	33	5 W.	18	S. W. ¼, S. W. ¼.
Graff-Blackwell Land	35	6 W.	12	Center N. ½.
Owner unknown	32	4 W.	6	N. E. ¼.
" "	32	6 W.	30	N. E. ¼, S. E. ¼.
" "	32	6 W.	32	S. E. ¼, S. E. ¼.

DOUGLAS COUNTY.

The iron ore deposits of this county consist exclusively of secondary limonite which occurs in both the boulder and pipe forms. The deposits are confined to the residuum overlying the Jefferson City and Roubidoux formations which comprise the major portion of the surface rocks. As a general thing these formations outcrop abundantly along the stream courses, indicating that the residuum is relatively thin as compared with that in the southeastern district and that the ore deposits are correspondingly shallow. Very little development work has been done in this county and, up to January 1st, 1911, no ore had been shipped. However, with the completion of the Kansas City, Ozark, and Southern R'y., extending from Mansfield to Ava, the chances for the development of the iron resources are much improved.

SECONDARY LIMONITE.

1. ABLE LAND.

Owned by V. R. Able, Ava, Mo.

W. ½, S. E. ¼, Sec. 29, T. 25 N., R. 15 W.

This prospect, located 12½ miles south of Ava, consists of an outcrop of secondary limonite which is situated on the point of a low, secondary ridge where the surface is thickly strewn with fragments and boulders of ore over an area 85 feet in diameter. There is apparently a fair depth to the residual materials, although dolomite of the Jefferson City formation is exposed along a branch to the eastward approximately 25 feet lower in elevation.

The ore is a secondary limonite showing pseudomorphs after marcasite. A few scattered, altered sulphide pipes, varying from ¼ to ¾ inch in diameter occur in the outcrop. The only silicious material associated with the ore consists of scattered fragments of chert which is included in the larger boulders. (H.—1910.)

2. ALLEN LAND.

Owned by J. B. Allen, Ava, Mo.

W. ½, N. E. ¼, Sec. 4, T. 26 N., R. 15 W.

On the Allen farm five miles northeast of Ava, a belt of residual iron ore, 100 feet in width and 200 feet in length, crosses the crest of a narrow ridge. The deposit occurs high up in the Jefferson City formation and intermingled with the fragments of surface ore, is much residual chert. The ore is a secondary limonite, pseudomorph after marcasite and is silicious, due to the presence of fragmentary chert and quartz. (H.—1910.)

3. BASHER LAND.

Owned by Basher Estate, Basher, Mo.

S. E. ¼, S. W. ¼, Sec. 29, T. 27 N., R. 15 W.

This prospect, located five miles northeast of Ava, consists of an outcrop of secondary limonite which is situated on the south point of a low hill 200 yards west of Basher Post Office. The ore occurs over an area of about one acre within which boulders and fragments are prominently exposed.

The ore shows typical sulphide structures and is somewhat silicious, due to the presence of chert and sand. No developments have been made and the thickness of the ore body is not known.

Alwanda, 3½ miles to the northwest, is the nearest shipping point. (H.—1910.)

4. BEAZLEY (W. R.) LAND.

S. W. ¼, S. W. ¼, Sec. 1, T. 26 N., R. 12 W.

Limonite occurs here, covering an area about one hundred yards square, on the point and gradual slope of a spur of a hill. The point bears the largest and most numerous fragments. These fragments are usually but a few inches across or less. On the slope numerous small particles are found with a few large fragments. The quality of the ore is very fair. The larger masses bear ocherous particles. Only scattered fragments of chert, and no bedded rock are associated with this deposit. This locality is twelve miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

5. BROWNING LAND.

Owned by C. C. Browning, Ava, Mo.

E. ½, S. W. ¼, Sec. 4, T. 26 N., R. 15 W.

This prospect, located four miles northeast of Ava, consists of an outcrop of secondary limonite covering an area of approximately three-quarters of an acre on the south face of a steep hillside. The horizon is the upper portion of the Jefferson City formation and the residuum is apparently of considerable thickness. The surface is thickly strewn with fragments and boulders of ore which consist chiefly of cellular, secondary limonite free from chert or sand, but also in part of arborescent limonite enclosing much angular chert. Several boulders, consisting almost entirely of yellow ocher, were observed. (H.—1910.)

6. HARE LAND.

Owned by Eveline Hare, Kansas City, Mo.

N. W. ¼, N. W. ¼, Sec. 1, T. 35 N., R. 15 W.

This prospect, located 12 miles southeast of Ava, consists of an outcrop of secondary limonite covering an area 275 feet long by 255 feet wide on the crest of a secondary ridge.

The ore shows many pseudomorphs after marcasite and contains a small amount of fragmentary chert. It is embedded in a thick mantle of residuum which is underlain by the Roubidoux formation. (H.—1910.)

7. HENSON LAND.

Owned by Jas. Henson, Coldspring, Mo.

N. E. ¼, N. E. ¼, Sec. 1, T. 26 N., R. 14 W.

This prospect, located 12 miles east of Ava, is situated on the crest of a high knoll. No developments have been made. The outcrop, which covers an area 200 feet in diameter, consists of intermingled boulders of chert and iron ore. The ore is secondary limonite and contains a large amount of chert. The residuum at this place should be of fair thickness, as no outcrops of dolomite or sandstone occur in the immediate vicinity. (H.—1910.)

8. HOFFMAN LAND.

Owned by E. Hoffman, Ava, Mo.

W. ½, S. E. ¼, Sec. 20, T. 26 N., R. 16 W.

This prospect, located four miles west of Ava, consists of an outcrop of secondary limonite covering an area of about three-quarters of an acre on the west point of a hill. Dolomite, of the Jefferson City formation, outcrops on the hillsides, indicating that the residuum at this place is not very thick. The ore occurs in both the pipe and boulder forms which show abundant sulphide pseudomorphs. There is also a small amount of cellular limonite which is highly silicious due to the presence of sand and fragments of chert. (H.—1910.)

9. MAPES LAND.

Owned by Mapes and Spurlock, Squires, Mo.

S. ½, N. E. ¼ & N. ½, S. E. ¼, Sec. 17, T. 25 N., R. 15 W.

This prospect, located 10½ miles south of Ava, consists of an outcrop of secondary limonite covering an area 30 to 120 feet wide and 450 feet long on the crown of a hill. Dolomite, of the Jefferson City formation, outcrops at intervals on the sides of the hill and it is probable that the residuum at this place is relatively thin. The ore occurs in the form of fragments and small boulders intermingled with residual chert. It is compact to cellular in structure and shows the pseudomorphic botryoidal and arborescent forms after the sulphides. A small amount of silica is present in the form of fragments of chert. (H.—1910.)

10. M'CRARY (R. A.) LAND.

W. ½, N. W. ¼, Sec. 14, T. 27 N., R. 11 W.

Here there is an area of perhaps a quarter of an acre, which contains boulders and small masses of limonite. The amount of silica varies, but the greater portion of the ore is only slightly siliceous. The hill upon which the ore occurs is approximately flat. Chert is found scattered over all portions of the hill. (L.—1892.)

11. ROBISON LAND.

Owned by Albert Robison, Squires, Mo.

S. ½ Lot 1, of S. W. ¼, Sec. 19, T. 25 N., R. 15 W.

This prospect, located 11 miles south of Ava, consists of an outcrop of secondary limonite covering an area 100 feet square on the east slope of a ridge. Within this area the surface material consists almost entirely of boulders and fragments of ore. Dolomite is exposed along the bed of the stream 45 feet below the ore outcrop, indicating that the residuum is relatively thin.

The ore occurs chiefly in the form of pipes varying from 1-16 to 3-16 of an inch in diameter and forming large clusters. It also occurs as boulders exhibiting arborescent and botryoidal forms. A small amount of fragmental quartzite associated with the boulder ore is the only form of visible silica. (H.—1910.)

12. TETTRICK (HENRY) LAND.

Sec. 25, T. 26 N., R. 11 W.

Limonite is found here, near the summit, in the form of small boulder-like masses and fragments, scattered over nearly an acre of land. The ore is quite silicious, cementing chert and containing grains of sand. Free chert is found on all portions of the slope. Sandstone is outcropping at the base. This locality is about fifteen miles from Cabool on the K. C., Ft. S. & M. Ry. (L.—1892.)

13. WOOD (D. S.) LAND.

S. W. ¼, Sec. 27, T. 27 N., R. 12 W.

Here we have limonite in two localities, separated by little more than a small stream. The largest surface showing is on a moderately steep slope and is about one hundred yards long and one hundred and fifty yards wide. The surface material within the area is almost wholly brown iron ore. This ore occurs in the form of large and small fragments and rough boulders. It is siliceous, silica occurring as chert fragments and small particles, though the percentage of siliceous material varies greatly. Small scattered fragments of ore, with fragments of chert, are seen further down this slope for a distance of two hundred yards or more. Across the branch, perhaps a little less than three hundred yards from the main deposit, at the base of a rather steep slope, and extending up the slope for about sixty yards and with a width of forty or fifty yards, there lies another deposit exhibited by heavy boulders of limonite. The ore here is much purer than that across the branch, being nearly free from insoluble material. Here again chert in large and small blocks is the only immediately associated rock. Limestone is exposed about two hundred yards away. This locality is about thirteen miles distant from the K. C., Ft. S. & M. Ry. (L.—1892.)

REPORTED OCCURRENCES.

Sec. 28, T. 25 N., R. 14 W.
Sec. 6, T. 26 N., R. 11 W.
Sec. 3, T. 26 N., R. 12 W.
Sec. 11, T. 26 N., R. 12 W.
E. ½, Sec. 34, T. 27 N., R. 12 W.

FRANKLIN COUNTY.

Franklin county ranks sixth in the production of iron ore in this State, having an accredited output of 147,145 tons. The deposits consist chiefly of the hematites of the filled sinks and secondary limonite, with two deposits of red hematite occurring in the Lower Coal Measures. The distribution and locations of the deposits are shown on the accompanying county map.

Iron mining began in this county in the early 50's, when, according to Dr. Litton, the Moselle or Franklin furnace was built and "brown hematite," obtained from the neighboring hills, was smelted. There was not much ore mined, however, until after 1870. Since 1899, shipments have been made each year. Fully half of the total production of the county has come from the Leslie mine which was not opened until 1902.

HEMATITES OF THE CARBONIFEROUS.

1. KLEINSORDE BANK.

Owned by Hannah Kleinsorde, Gerald, Mo.

S. W. ½, N. E. ¼, Sec. 8, T. 42 N., R. 3 W.

This bank is located three miles east of Gerald and is situated near the head of a small ravine draining to the north. Developments consist of 15 small pits, several of which show the occurrence of shaly, red hematite characteristic of the Pennsylvanian. One pit 10 feet deep showed the following section:

1 ft. 6 in.	Red surface clay and soil.
6 ft.	Dark red, soft, ferruginous sandstone.
8 in.	Soft, white sandstone.
2 ft.	Soft, red, shaly hematite.

The ore, when analyzed, showed 50.08% iron, 13.16% silica, 0.17% Sul., and a trace of Phos. The other pits showed ore of a more sandy nature. A ledge of Pennsylvanian sandstone outcrops directly above the pits, while in the valley a short distance below them is an outcrop of cherty dolomite of probable Cambrian age. (C.—1910.)

2. SICKENDICK LAND.

Owned by Wm. Sickendick, Gerald, Mo.

S. E. ¼, S. E. ¼, Sec. 34, T. 43 N., R. 4 W.

This property is located 1½ miles northwest of Gerald and is situated in an open field on a south hill slope. The outcrop consists of fragments of shaly, red hematite scattered over an area 40 feet in diameter. One pit, 3 feet deep,, disclosed the following section:

1 foot.	Surface clay and soil, somewhat flinty.
1 foot.	Shaly, soft, red hematite (which on a test showed 48% iron).
1 foot.	Brown and yellow sandstone, beneath which was reported more iron ore.

Two additional pits within the area of outcrop are reported to have shown materials essentially like the above.

The ore is a soft, laminated, shaly, red hematite of the type common to the Pennsylvanian. It lies just above the contact of the Pennsylvanian with the Jefferson City limestone, which outcrops in the bed of a stream one hundred yards to the east. (C.—1910.)

HEMATITES OF THE FILLED SINKS.

3. BOOTH MINE.

Owned by Julian Pickles, Morrellton, Mo.

N. E. ¼, Sec. 27, T. 41 N., R. 1 W.

This mine, located four miles southeast of Morrellton, produced 10,000 tons of ore prior to 1892. The property has not been visited by a member of this Bureau and the present condition of the mine is not known.

4. HIBBARD MINE.

Owned by Hibbard Brothers, St. Clair, Mo.

S. E. ¼, Sec. 3, T. 41 N., R. 1 W.

This mine, located 1½ miles northeast of Morrellton, is situated on the east bank of a broad, shallow ravine. Developments consist of an open pit 110 feet long, 85 feet wide and 45 feet deep. The pit is at present nearly filled with water and its walls are, for the most part, covered with detrital material. A three foot bed of cotton rock exposed near the south end of the pit dips 18° to the north. Near the north end of the pit several beds of dolomite stand nearly on edge and strike north and south. About 170 feet south of the pit are exposed a few beds of sandstone which dip 2 to 3° toward it. With these exceptions there is no indications of a sink structure at this place. Mr. Hibbard reports the ore body, which consisted of red and specular hematite, to dip perceptibly to the northwest. At a depth of 45 feet a strong flow of water was encountered causing the abandonment of the mine. (H.—1910.)

5. IRON HILL MINE.

Sec. 17, T. 41 N., R. 1 W.

This mine, located one mile west of Morrellton, produced 5,000 tons of ore prior to 1892. The property has not been visited by a member of this Department and the present condition of the mine is not known.

6. JUDITH SPRING MINE.

Owned by Julian Pickles, Morrellton, Mo.

N. W. ¼, Sec. 18, T. 41 N., R. 1 W.

This bank was worked prior to 1887 by the Missouri Blast Furnace Company, during which time it was connected by spur with the St. Louis and San Francisco R'y., half a mile to the north.

The mine is located on the west bank of a ravine and is at present about 200 feet in length and 150 feet in width with the west rim about 15 feet higher than the east. Originally worked to a depth of about 70 feet below the western rim, the pit at present is but 40 feet in depth. The walls of the excavation are covered with detrital material and nothing could be learned concerning the wall rock.

A shaft sunk by Mr. Pickles in the northeast corner of the pit shows red hematite of good quality to a depth of 40 feet below the present floor level. In the southeast corner a pit six feet in depth was driven entirely through red paint ore. This ore is overlain by decomposed and partly decomposed chert, the beds of which dip towards the pit.

Fifty feet northeast of the pit rim a shaft has recently been sunk to a depth of 104 feet. Mr. Pickles states that red ore was encountered between 62 to 79 feet below the collar of the shaft. The ore is immediately overlain by dense, crystalline dolomite and underlain by decomposed chert or dolomite. Solid rock was struck at the 100 foot level and recent developments are reported to have shown a bed of blue, specular ore occurring beneath this ledge.

In an old shaft 150 feet east of the pit, horizontally bedded sandstone and slightly cherty dolomite were penetrated from top to bottom and no traces of ore were apparent. Fifty feet west of this shaft a more shallow shaft encountered gray to reddish dolomite which, Mr. Pickles states, dipped sharply towards the pit to the westward.

Five hundred feet east of the pit and in the bed of the ravine a drill hole was sunk to a depth of 175 feet. The upper 145 feet penetrated clay and sand containing boulders, presumably of chert. Between 145 and 175 feet the drill penetrated a 30 foot thickness of marcasite. Immediately northwest of the drill hole are several exposures of dolomite standing approximately on edge. Similar dolomite with a similar dip has been encountered in two shallow pits northwest of these exposures. Several hundred yards to the eastward of the drill hole and near the crest of the hill are several exposures of sandstone dipping to the westward. (H.—1910.)

7. LESLIE MINE.

Owned by Aug. Remmert, Leslie, Mo.

S. E. 1/4, N. W. 1/4, Sec. 15, T. 42 N., R. 3 W.

This mine is located about 2½ miles south of Leslie and is connected by a narrow gauge railroad to the Chicago, Rock Island and Pacific Railroad at a point about two miles west of that town. It is situated at the mouth of a small ravine, draining into Big creek, which joins the Bourbeuse river one mile to the east.

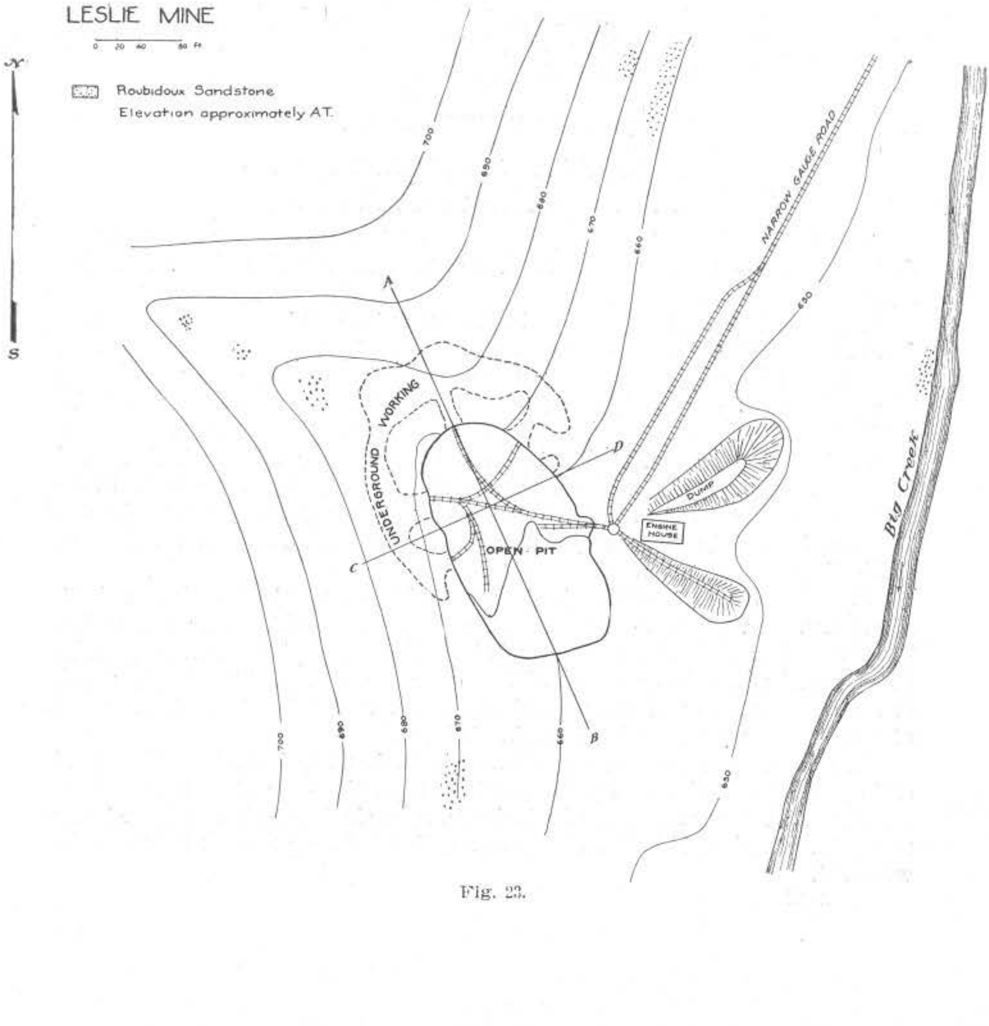


Fig. 23.

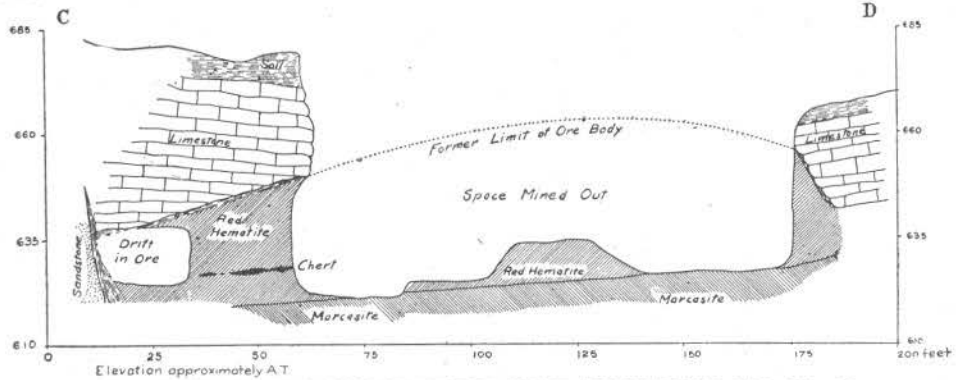


Fig. 1. CROSS SECTION OF LESLIE MINE ALONG LINE C-D, Fig. 23.

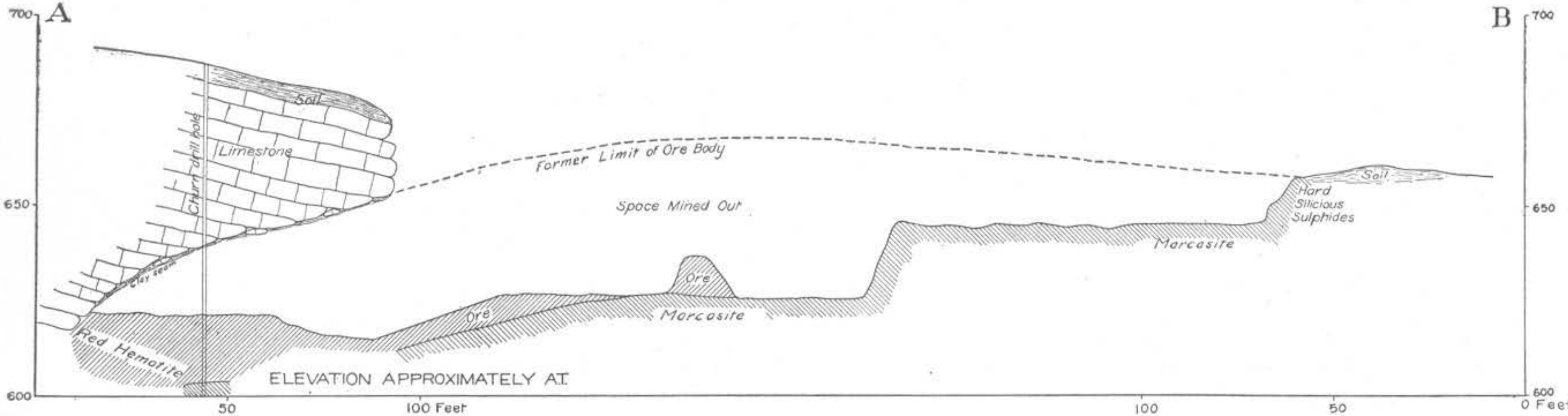


Fig. 2. LONGITUDINAL SECTION OF THE LESLIE MINE ALONG LINE A-B OF TOPOGRAPHIC SKETCH, FIG. 23.

Geologic Relations:—The adjoining hills are underlain by nearly flat lying Roubidoux sandstone which also forms the bed of Big creek and neighboring streams. The nearest known exposure of the Gasconade occurs on the Bourbeuse river, one mile to the east, and it would appear that the deposit is relatively high in the Roubidoux formation. Numerous outliers of Pennsylvanian shale and sandstone occur upon the higher ridges in this locality, though none were observed in the immediate vicinity of the mine.

The ore body was opened in 1902 and operations have been almost continuous up to the present time. The average daily production, during 1909, was 75 tons, and the total production, up to Dec. 31st, 1910, approximates 75,000 tons.

Developments consist of an open pit, 240 feet long, 120 feet wide, and 60 feet deep, beyond the limits of which underground workings have been extended 80 feet to the north and 50 feet to the west. The accompanying topographic sketch, figure 23, shows the position of the mine relative to the surface features; also its shape and dimensions.

Figure 1, Plate XXXIV, is a photograph of the west face of the cut, showing a pillar of ore and the character of the materials in the overburden. Figure 2, Plate XXXIV, shows the limestone in the cap rock dipping toward the pit.

The outcrop at this mine was very small and occurred at the extreme southeast end of the pit where a hog-wallow exposed soft, red hematite.

The ore body is roughly lense shaped and has an average dip of 10° to the northwest. It has been mined for a distance of 320 feet along the dip, and 170 feet along the strike, and has a maximum thickness of 40 feet. So far as is known, it is everywhere underlain by marcasite, the depth of which has not been determined. The overburden consists chiefly of heavy bedded limestone and residual clays.

Figures Nos. 1 and 2, Plate XXXIII, show the shape of the ore body and its relation to the wall rock, along lines A-B and C-D on the topographic sketch.

On the east side of the mine, the limestone of the overburden forms an overhanging wall and appears to cut out the ore in that direction. On the west side the ore is cut out by a seam of light colored clay, varying from one to three feet in thickness, behind which a wall of soft Roubidoux sandstone was encountered. On breaking through the clay into the sandstone, a continuous flow of ground water entered the mine. Faulting is indicated at this point by the manner in which the limestone beds lie directly opposite those of sandstone, and that it is normal faulting with the down-throw on the limestone side, is indicated by the direction of the hade and the upward inclination of the limestone beds nearest the contact. The strike of the fault plane is northwest in the direction of the dip of the ore body. Its lateral extent is not shown but, judging from the occurrence of Roubidoux sandstone in the ravine immediately west of the pit and similar outcrops on the north and east, the faulting is confined to the immediate vicinity of the mine.

A vertical section of the west face of the open pit, as shown in section C-D, is as follows, in descending order:

8 ft.	Clay and soil containing chert and sandstone pebbles.
1 ft.	Clay without pebbles.
6 ft. 8 in.	Limestone in two beds; fine grained silicious; light pea green on fresh fracture but weathers to a light buff.
8 ft. 10 in.	Limestone in thin broken beds; otherwise like the above.
8 in.	Shale, white to pea green in color, resulting from decomposition of the limestone.
21 ft. 6 in.	Ore, soft red hematite without bedding; containing scattered patches of limonite near the upper contact; also numerous small joints filled with white calcite.

6 in.	Chert, fresh, green, incased in light colored clay; in an irregular layer extending across the face.
7 ft.	Ore; like that above, but containing more calcite in joints.
10 + ft.	Marcasite, dark colored and soft; forming bottom of pit.

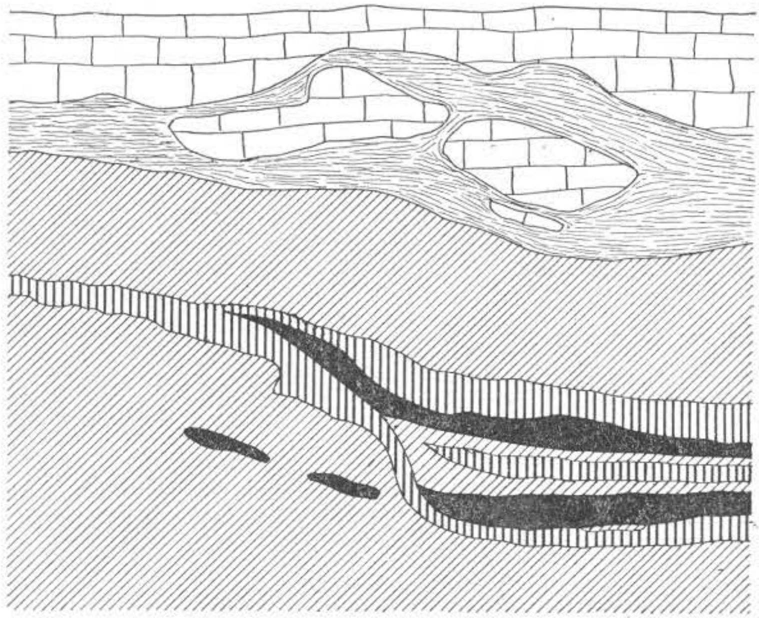


Fig. 24. Hanging Wall Contact, Leslie Mine. Scale 1 in.=3 ft.

Figure No. 24 shows the character of the contact of the ore with the overlying limestone, as exposed at the north end of the underground workings, and represents the usual succession. The cap rock consists of heavily bedded, fine grained, pea green limestone, like that described in the section of the western face of the pit. It differs both in texture and color from any, so far observed, in the Cambrian, and appears to be peculiar to this deposit. When analyzed, it shows 27.28% silica, 29.46% calcium carbonate, 2.0% magnesium carbonate and 35.87% ferric oxide and alumina. The lower surface of this limestone is irregularly rounded and uneven, the line of contact cutting diagonally across the beds. Between the limestone and the ore, there is from two inches to two feet of spotted, banded clay enclosing small lenses of partly decomposed limestone like that above and of which it appears to be a decomposition product. Below, and in sharp contact with this clay, occurs two feet of soft red hematite having a rougly stratified structure, and consisting almost entirely of hematite pseudomorphs after marcasite. Beneath the ore is a layer of finely banded clay, enclosing fragments of banded cherts of which it is an alteration product. Beneath the banded clays is the main ore body.

The ore consists almost entirely of soft, red hematite. Specular hematite and brown ore occur locally, but in very small quantities. The red hematite is, in part, coarsely granular with a structure that of a coarsely crystalline limestone. Much of it is ocherous and shows the feather and arborescent pseudomorph structures after marcasite.

The chief impurities are quartz, calcite, and iron sulphide. Quartz is an original constituent of the altered sulphides, and occurs in small transparent crystals lining cavities in the ore. Calcite occurs chiefly as a secondary mineral, cementing fractures and joints in the ore but also with quartz lining cavities, in

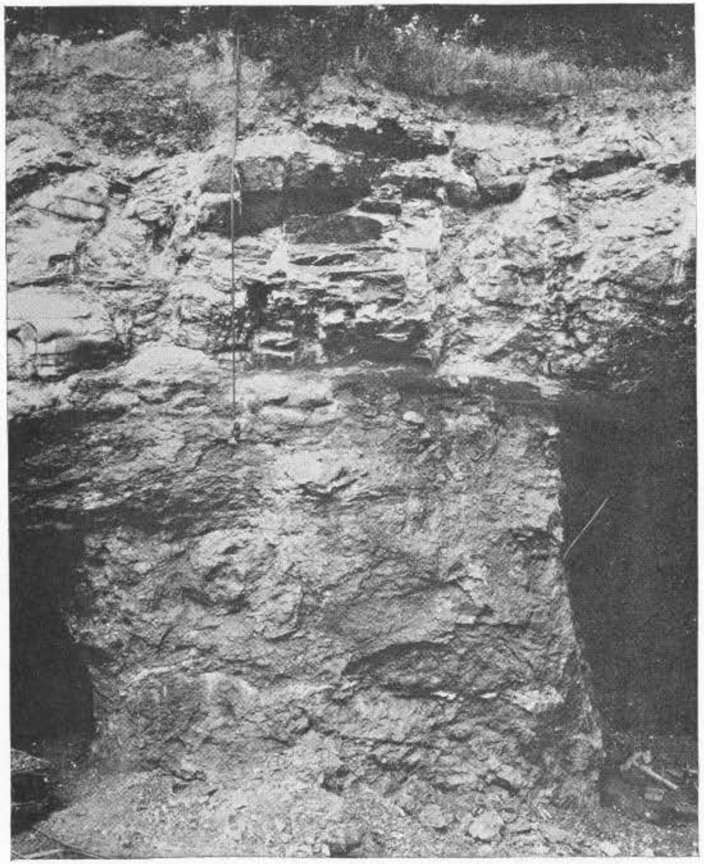


Fig. 1. Pillar of Red Hematite west face of Leslie Mine.

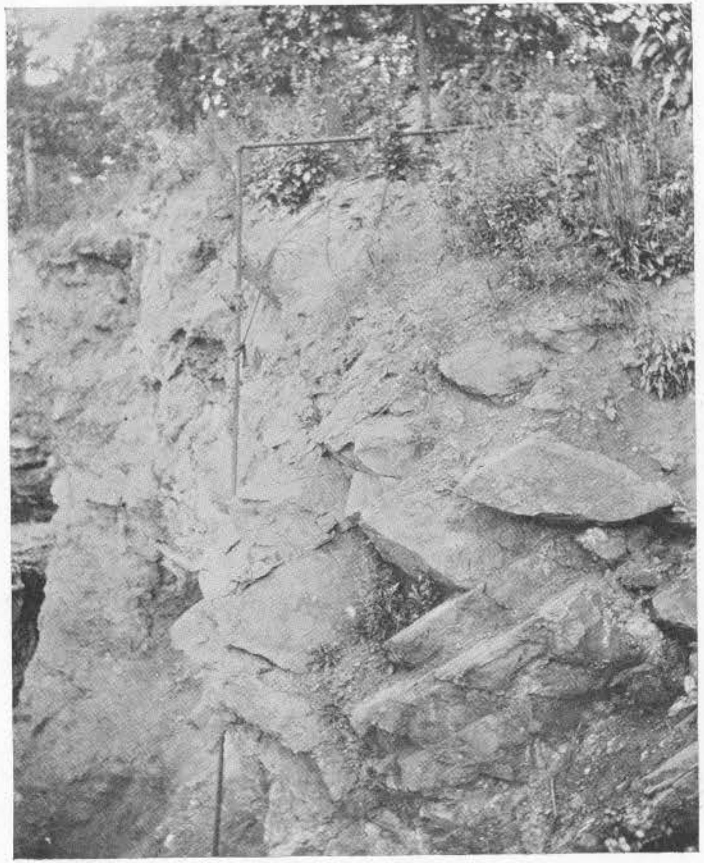


Fig. 2. Dipping Limestone in hanging wall, Leslie Mine.

which case it always coats the surface of the quartz. However, the coarsely crystalline ore is usually the more calcareous and it is probable that it contains some original lime. The sulphide of iron, chiefly as marcasite, occurs abundantly underlying the ore and locally in small patches in the ore, but is usually so well segregated as to be easily separated in mining. The ore, however, is uniformly high in sulphur, due to incomplete alteration of the original sulphides.

The only waste materials associated with the ore are the occasional lenses of chert, mentioned above, and the clay, which separates the ore from the wall rock, so that practically the only material to be removed is that in the overburden.

The ore rates as a low grade, non-bessemer hematite and is quite remarkable for its high percentage of calcium carbonate and sulphur. Iron ranges from 42 to 47%, and averages about 44%; silica ranges from 4 to 7%; lime from 6.8 to 12.0%; alumina from 1.3 to 2.5%; sulphur from 0.20 to 0.38%; and phosphorus is present in quantities varying from 0.066 to 0.100%.

The following analyses show the range and average quality of the ore shipped during the interval between Jan. 1st, 1911, and August 1st, 1911: No. 7 represents the average of 24 analyses:

Number.	Iron.	Silica.	Alumina.	Lime.	Sulphur.	Phos.	Moisture.	Mn.	Magnesia.
1	43.90	4.30	2.50	7.58	....	0.076	7.00	0.05	0.65
2	42.03	4.60	2.20	8.60	0.260	0.067	3.8	....	....
3	41.96	6.30	2.14	10.60	0.261	0.074	6.0	....	....
4	44.08	6.60	1.30	8.27	0.380	0.086	5.0	....	....
5	46.68	5.35	2.52	6.80	0.230	0.066	5.0	....	....
6	43.27	5.60	2.50	7.70	....	0.080	8.2	....	....
7	44.49	5.17	2.15	7.94	0.274	0.074	5.31	....	....

(C.—1910.)

8. SILVER HOLLOW BANK.

Owned by Julian Pickles, Morrellton, Mo.

N. E. ¼, N. W. ¼, Sec. 8, T. 40 N., R. 1 W.

The Silver Hollow bank is situated on a low point of land between Silver Hollow on the northwest and a tributary ravine on the northeast. The point at the area of outcrop is about 100 yards in width and is, at its highest point, about 25 feet above the level of Silver Hollow. The area in which surface ore occurs is about 500 feet in length and 225 feet in width.

The bank was worked on a small scale in 1875 by the Hamilton Iron Works, who mined ore occurring at and near the surface by means of several trenches, the maximum depth of which was about 10 feet. The only work done on the property since that time has been confined entirely to prospecting, that work comprising two shafts and several open cuts.

Ore was penetrated in both shafts, one shaft, however, showing a much better developed ore body than the other. This shaft is located in the northwestern portion of the area in which ore outcrops, and shows the following section:

Feet.	
26 to 29	Yellow ochre.
29 to 35	Dirt.
35 to 41	Red and blue ore.
41 to 47	Dirt.
47 to 73	Red ore analyzing 62%.
73 to 81	Red ore analyzing 48%.
81 +	Red ore of good quality.

Both the red and blue ore show pseudomorphous structures after marcasite. Twenty feet east of the shaft a ledge of sandstone, dipping sharply to the southeast, is exposed for a short distance. Immediately northwest of the shaft and on the south bank of the tributary ravine a series of shallow pits have been sunk. These pits apparently followed a thin ledge of sandstone which is exposed on the bank of the ravine and which dips gently to the southeastward. Red hematite and some copper-stained chert were taken from these pits.

About 40 yards southeast of the shaft described above, a second shaft has been recently sunk to a depth of 85 feet. Mr. Pickles reports that ore was encountered at the 80 foot level. Above that depth occurred clay, chert, and sandstone.

A semi-circular cut has been made facing Silver Hollow in the southwest portion of the area. The cut is from one to ten feet in depth and was driven through sandstone and light red hematite. At its deepest part a shaft was sunk to a depth of 14 feet below the floor of the cut. Red and blue ore is reported to have been encountered from top to bottom. The ore contains scattered fragments of quartzite. The east wall of the shaft shows ferruginous sandstone apparently on edge. Between this cut and the first described shaft,—a distance of about 60 yards,—red hematite is exposed at intervals over the surface.

Blocks of sandstone containing irregular seams of iron-cemented sand occur scattered over the southern portion of the area of outcrop. There is no rim rock in evidence from which the lateral extent of the ore could be determined.

This deposit occurs in the Gasconade formation. It is located three-quarters of a mile south of the Meramec river.

Ore at this bank extends 60 feet below the level of the adjoining streams.

(H.—1910.)

9. ST. CLAIR MINE.

Owned by Hibbard and Sons, St. Clair, Mo.

S. E. ¼, Sec. 28, T. 42 N., R. 1 W.

This mine is located 2½ miles west of St. Clair. According to the Tenth Census report, the ore consisted of soft hematite and occasional boulders of specular hematite interstratified with layers of sandy, chert, and brown shale, all much contorted. An average sample showed an analysis of 60.13% iron and 0.058% Phos. Apparently little development work has been done on this property.

10. THURMOND MINE.

N. ½, N. W. ¼, Sec. 19, T. 41 N., R. 1 W.

This mine is situated in a rather rough country, with steep, high hills, separated by narrow ravines and valleys. The soil is mixed with and in some places covered by broken, white chert. The surface indications consist of a number of large pieces of limonite, and of some small, sharp fragments of a very hard and siliceous specular ore. They are scattered over a surface about fifty feet wide and two hundred feet long, over a slight rise of the ground extending down the slope of a moderately steep hill. A shaft was sunk here years ago in search for copper, and it is said this shaft passed through thirty-seven feet of red iron ore. (S.—1872.)

SECONDARY LIMONITES.

11. BARTLE MINE.

Owned by J. H. Bartle, St. Clair, Mo.

N. E. ¼, N. W. ¼, Sec. 20, T. 42 N., R. 1 E.

This mine, located three miles northeast of St. Clair, was not visited by a member of this Bureau but, according to records submitted by the St. Louis Blast Furnace Company, it was operated during 1900 and 1901, producing 150 tons of ore. The ore is a secondary limonite, shipments of which showed an average analysis of 52.64% iron, 11.50% silica, and 0.089% Phos.

12. BOWLEN BANK.

N. W. ¼, Sec. 5, T. 41 N., R. 2 E.

Here there is the following succession of rocks, beginning with the lowest: solid and uniform mass of pure, hard, chocolate brown limonite, porous; then clayish limonite, with irregular masses of yellow ocher, soft and friable; red loam, with green and gray broken chert; then sandstone colored and impregnated with oxides of iron, in disturbed and broken layers; then dry soil with some chert. (S.—1872.)

13. DRAKE MINE.

Owned by W. F. Drake, Robertsville, Mo.

N. E. ¼, S. E. ¼, Sec. 30, T. 42 N., R. 2 E.

This mine, located six miles southwest of Robertsville, was not visited by a member of this Bureau, but according to records submitted by the St. Louis Blast Furnace Company, it was operated during 1899 and 1900, producing 222 tons of ore. The ore is secondary limonite.

14. IRON HILL BANK.

Sec. 17, T. 42 N., R. 1 E.

What is known as the Iron Hill deposit seems to consist of numerous smaller cracks and cavities on the surface of the Third Magnesian limestone, which cavities are in part or wholly filled with brown limonite and with yellow ocher. In the deepest of these cavities we find deposited a loose, coarse-grained and ferruginous, thinly stratified sandstone, which has afterwards been broken up again and partly destroyed. The point of the cavity is filled with white clay and with broken white chert. All the rest of the cavity is nearly filled with limonite, in irregular, botryoidal and stalactitic forms, mixed with yellow ocher and some chert. The lower part is mostly ocher; above are found pieces of heavy spar. The thickest and least porous forms of the limonite enclose sometimes a core of pyrites. (S.—1872.)

15. PLETZ MINE.

Owned by Henry Wolf, Leslie, Mo.

N. E. ¼, S. W. ¼, Sec. 15, T. 43 N., R. 3 W.

This mine, located four miles northwest of Leslie, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace

Company, it was operated in 1902, producing 171 tons of ore. The ore is secondary limonite, shipments of which showed an average analysis of 57.85% iron and 4.19% silica.

16. STANTON HILL BANK.

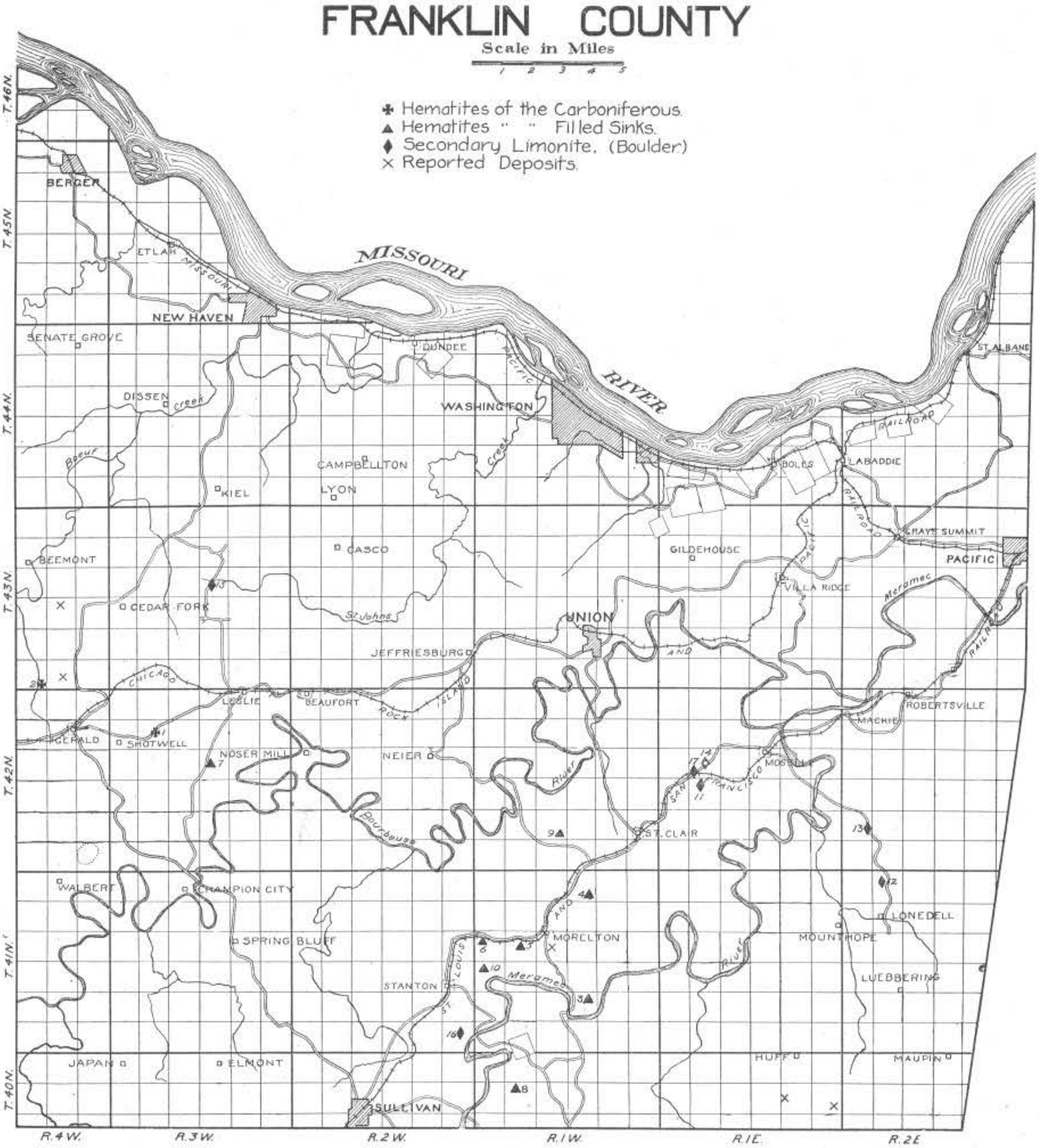
S. W. ¼, N. E. ¼, Sec. 36, T. 41 N., R. 2 W.

Here there is a circular depression of about fifty feet diameter, in a dark colored sandstone which crops out all around, and toward the center grows very ferruginous, where it has almost the appearance of crystalline specular ore. The only pure ore found is limonite. (S.—1872.)

17. WILDY (ISAAC) MINE.

S. W. ¼, S. W. ¼, Sec. 17, T. 42 N., R. 1 E.

Limonite is dug here from open pits, three to ten feet deep. A number of car loads have been shipped to St. Louis. This is said to contain 53 per cent or more or iron. A copy of analysis seen by the writer showed 0.15 per cent of phosphorus. The deposit is located immediately adjacent to the St. Louis & San Francisco Ry., on the north side, and about two miles east of Moselle. Another deposit is exposed in the railway cut, about two hundred yards east of Wildy's, which shows very plainly the relation of the ore to the magnesian limestones; it occurs in a chimney or cavity in these rocks. Blocks of limonite are found strewn over the surface of many other localities of this neighborhood. (N.—1892.)


FRANKLIN COUNTY
Scale in Miles
1 2 3 4 5
✚ Hematites of the Carboniferous.
▲ Hematites " " Filled Sinks.
♦ Secondary Limonite. (Boulder)
× Reported Deposits.
MISSOURI
RIVER
T. 46N.
T. 45N.
T. 44N.
T. 43N.
T. 42N.
T. 41N.
T. 40N.
R. 4 W.
R. 3 W.
R. 2 W.
R. 1 W.
R. 1 E.
R. 2 E.
BERGER
ETLAH
NEW HAVEN
SENATE GROVE
DUNDEE
DISSEN
WASHINGTON
CAMPBELLTON
LYON
KIEL
BOLES
LABADDIE
ST. ALBANS
GRAYS SUMMIT
PACIFIC
BEEMONT
CASCO
GILDEHOUSE
VILLA RIDGE
CEDAR FORK
St. Johns
UNION
JEFFRIESBURG
LESLIE
BEAUFORT
ROBERTSVILLE
MACKIE
SHOTWELL
NOSER MILL
NEIER
MOSELLE
Bourbeuse
River
ST. CLAIR
Meramec
WALBERT
CHAMPION CITY
SPRING BLUFF
MORELTON
MOUNT HOPE
LONEDELL
LUEBBERING
STANTON
JAPAN
ELMONT
HUFF
MAUPIN
SULLIVAN
PACIFIC
RAILROAD
CHICAGO ROCK ISLAND AND
ST. LOUIS AND SAN FRANCISCO
Creek
Boeuf

FRANKLIN COUNTY.

HEMATITES OF THE CARBONIFEROUS.

No.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
1	Kleinsorde, H., Bank	42	3 W.	8	S. W. ¼, N. E. ¼.
2	Sickendick, Wm., Land	43	4 W.	34	S. E. ¼, S. E. ¼.
	HEMATITES OF THE FILLED SINKS.				
3	Booth Mine	41	1 W.	27	N. E. ¼.
4	Hibbard Mine	41	1 W.	3	S. E. ¼.
5	Iron Hill Mine	41	1 W.	17	
6	Judith Spring Mine	41	1 W.	18	N. W. ¼.
7	Leslie Mine	42	3 W.	15	S. E. ¼, N. W. ¼.
8	Silver Hollow Mine	40	1 W.	8	N. E. ¼, N. W. ¼.
9	St. Clair Mine	42	1 W.	28	S. E. ¼.
10	Thurmond Mine	41	1 W.	19	N. ½, N. W. ¼.
	SECONDARY LIMONITE.				
11	Bartle, J. H., Mine	42	1 E.	20	N. E. ¼, N. W. ¼.
12	Bowlen Bank	41	2 E.	5	N. W. ¼.
13	Drake, W. F., Mine	42	2 E.	30	N. E. ¼, S. E. ¼.
14	Iron Hill Bank	42	1 E.	17	
15	Pletz, F., Mine	43	3 W.	15	N. E. ¼, S. W. ¼.
16	Stanton Hill Bank	41	2 W.	36	S. W. ¼, N. E. ¼.
17	Wildy, Isaac, Mine	42	1 E.	17	S. W. ¼, S. W. ¼.
	REPORTED OCCURRENCES.				
	Anaconda Tract	41	1 W.	16	
	Gordeke, Chas	43	4 W.	35	N. E. ¼, S. E. ¼.
	Temme, August	42	3 W.	1	N. E. ¼, N. W. ¼.
	Owner unknown	40	1 E.	11	W. ½.
	" "	40	1 E.	12	S. E. ¼.
	" "	43	4 W.	23	N. ½.

GREENE COUNTY.

Greene county ranks eleventh in the production of iron ore, having an accredited output of 19,150 tons. The deposits consist of both secondary and primary limonite, the relative abundance, distribution, and locations of which are shown on the accompanying map of the Southwest Limonite District, p. 254.

Iron mining began in this county in 1903, since which time shipments have been made each year. Of the total production, 4,382 tons were secondary, and 14,768 tons primary limonite.

SECONDARY LIMONITE.

1. HELM MINE.

Owned by Henry and A. W. Graham.

N. ½ Sec. 26, T. 29 N., R. 24 W.

This mine, located 4½ miles south of Bois D'Arc, is situated on the west face of a low hill. It is composed of two cuts, one of which is 120 feet long, 12 to 40 feet wide, and has a maximum depth of 10 feet, while the other is 150 feet long, 30 to 40 feet wide, and has a maximum depth of 12 feet.

The ore consists entirely of secondary limonite, which shows excellent pseudomorphs after marcasite. Near the top of the face it occurs as boulders embedded in red clay, while near the bottom the ore apparently occurs cementing chert conglomerate.

During the years 1904 to 1907, inclusive, this mine produced 3370 tons of ore, 12 shipments of which averaged 56.28% iron, 5.63% silica, 0.160% Phos., 0.26% Mn., and 4.00% moisture.

In a field about 150 feet northwest of the Helm mine occurs considerable float ore consisting of fibrous goethite. No attempt has been made to determine the extent of this deposit. (H.—1910.)

2. JENNINGS (R. H.) BANK.

Owned by R. H. Jennings, Cave Spring, Mo.

N. W. ¼, N. E. ¼, Sec. 9, T. 30 N., R. 23 W.

This property is located one mile east of Pearl. Prospecting has been conducted over the entire quarter section. The chief outcrops occur near the Jennings residence and in a field about 400 yards south of the house. At both places boulders of brown ore are thickly strewn over an acre or more of ground. About 100 yards west of the house a pit shows the subsoil to contain a large amount of small fragmental ore.

The ore is secondary limonite, a portion of which consists of altered sulphide-pipe ore. It contains little or no chert. Several small pits in the field, south of the Jennings house, show the subsoil to contain much fragmental ore which could be recovered by washing. (H.—1910.)

3. POLLACK MINE.

Owned by C. Pollack, Cave Spring, Mo.

S. E. ¼, S. E. ¼, Sec. 4, T. 30 N., R. 23 W.

This mine, located 1½ miles east of Pearl, consists of several open pits which have a maximum depth of eight feet. Brown ore outcrops over an area of about three acres in the vicinity of the pits, the walls of which show a large amount of fragmental ore embedded in clay.

The ore is secondary limonite, showing excellent pseudomorphs after both pyrite and marcasite. It contains little or not chert and no unaltered sulphide was encountered.

One hundred tons of ore have been shipped from this deposit. An average analysis shows 56.25% iron, 5.99% silica, 0.063% Phos., 0.177% Mn., and 3.83% moisture. (H.—1910.)

PRIMARY LIMONITE.

4. BAYLISS LAND.

Owned by Wm. Bayliss, Republic, Mo.

W. ½, S. W. ¼, Sec. 16, T. 28 N., R. 23 W.

This prospect, located one mile northeast of Republic, is situated in a field immediately south of the St. Louis and San Francisco R'y. The outcrop is confined to an area of about half an acre and consists of small fragments of goethite. An old open cut, now nearly filled, shows fragments of ore embedded in clay to a depth of four feet.

The ore is typical, fibrous goethite and is quite free from chert. No attempt has been made to determine its depth.

The deposit is apparently on the northern edge of an area underlain by Pennsylvanian sediments which are exposed in a shaft a quarter of a mile to the south. (H.—1910.)

5. CLUTTER MINE.

Owned by J. E. Clutter, Willard, Mo.

N. E. ¼, Sec. 23, T. 30 N., R. 23 W.

This mine, located three-quarters of a mile north of Willard, consists of a pit 35 feet long, 10 feet wide, and 8 feet deep, the walls of which show a nearly solid mass of ore embedded in red clay.

The ore is fibrous goethite occurring for the most part as "bombs" and small fragments. It is quite free from impurities. There has been produced about one car load of ore which remains in stock at the mine. The surface showing is very light and is confined to the immediate vicinity of the pit. An analysis shows 47.65% iron, 13.40% silica, 0.450% Phos., 1.67% Mn., and 4.00% moisture.

(H.—1910.)

6. JACKSON BANK.

Owned by Geo. Jackson, Republic, Mo.

N. E. ¼, S. E. ¼ and S. W. ¼, S. E. ¼, Sec. 11, T. 28 N., R. 24 W.

This property, located three miles northwest of Republic, has been opened by two 8-foot pits which show a nearly solid mass of fragmental brown ore embedded in red clay.

The ore is fibrous goethite containing but little chert, many of the massive boulders being particularly free from impurities. Boulders and fragments of goethite, intermingled with fragments of chert, are thickly strewn over an area of several acres in the vicinity of the workings.

On the northeast quarter of the same quarter-section, boulders and fragments of goethite occur scattered over an area of about 40 acres. A few shallow cuts expose much ore immediately beneath the surface. The ore is similar to that occurring in the S. W. ¼, S. E. ¼ of this section and at the Jackson mine half a mile east. (H.—1910.)

7. JACKSON MINE.

Owned by John Jackson, Republic, Mo.

N. W. ¼, S. E. ¼, Sec. 12, T. 28 N., R. 24 W.

This mine, located 2½ miles northwest of Republic, has been opened by two cuts situated in an open field. The larger cut is 140 feet long, 15 feet deep, and from 20 to 60 feet wide. The east, north, and a portion of the west walls expose broken layers of chert overlain by a variable thickness of clay which contains small fragments of ore, locally termed "shot ore." The layers of chert exposed on the east and west dip precipitously into the cut while those on the north dip away from it. The south wall is composed of clay containing fragments of ore and chert. The smaller cut is 90 by 35 feet and is reported to have been worked to a depth of 14 feet. At the time it was visited it was filled with water.

Two hundred feet west and southwest of these cuts are several shallow pits which show fragments of ore and chert embedded in clay. The surface exposure in the vicinity is not extensive.

The ore on this property consists of fibrous goethite and is quite free from impurities. Some of the larger boulders contain fragments of undecomposed chert, but these are not numerous. It occurred as fragments embedded in red clay and is also reported to have formed layers between the chert noted above. A small amount of "bomb" ore is also reported to have been mined.

During the years 1905, 1906, and 1907, this mine produced 7882 tons of ore, eleven shipments of which gave average returns of 51.03% iron, 10.97% silica, 0.279% Phos., 0.51% Mn. and 5.00% moisture. (H.—1910.)

8 NOBLE MINE.

Owned by F. M. Haynie, Bois D'Arc, Mo.

S. ½, N. E. ¼, Sec. 1, T. 29 N., R. 24 W.

This deposit, located a quarter of a mile east of Bois D'Arc, has been mined by several openings which are scattered over an area of about one acre. The largest opening is a cut 45 feet in diameter and about 15 feet deep, on the dump of which are many tons of good wash dirt. The smaller openings expose fragments and boulders of ore embedded in clay to a depth of several feet.

The ore consists of dense limonite and fibrous goethite. The major portion of it occurs as small fragments of what were originally "bombs" and can be recovered only by washing. Boulders and fragments of ore occur scattered over the surface in the immediate vicinity of the several openings.

This mine was opened during 1907. Three shipments, totaling 206 tons, averaged 51.71% iron, 8.53% silica, 0.238% Phos., 0.86% Mn., and 4.00% moisture. (H.—1910.)

9. STUDLEY MINE.

Owned by James Studley, Brookline, Mo.

S. E. 1/4, Sec. 4, T. 28 N., R. 23 W.

This mine, located two miles southwest of Brookline, is situated on the west bank of a wide, shallow ravine. It consists of two open cuts, the northern and larger of which is 60 feet long, 20 feet wide, and 12 feet deep. The walls of the cut are badly caved and ore is exposed at but one or two points. Sandy shale and coarse grained sandstone, apparently of Pennsylvanian age, were encountered in mining. The smaller pit, which has a diameter of 15 feet and a depth of 12 feet exposes boulders and fragments of good ore and some very cherty ore embedded in red clay. A few boulders of coarse grained sandstone were also encountered in this pit. Over a space of about 85 feet between the two pits the surface is covered by small fragments of ore of the primary type consisting in part of fibrous goethite and in part of amorphous limonite.

During 1905 and 1907 this mine produced 112 tons, two shipments of which averaged 50.82% iron, 11.46% silica, 0.172% Phos. 0.66% Mn., and 6.00% moisture. (H.—1910.)

10. WELSH MINE.

Owned by J. H. Bean and H. Suckow.

N. 1/2, N. W. 1/4, Sec. 6, T. 29 N., R. 23 W.

This mine, located 1 1/2 miles northeast of Bois D'Arc, consists of a partly filled open cut 35 feet long, 30 feet wide, and 15 feet deep, the bottom of which is reported to be in good ore.

The ore is a porous, irregularly banded limonite and fibrous goethite. It carries very little chert and occurred as small boulders embedded in clay. The outcrop at this place consists of fragments of ore strewn over an area of about one acre.

A quarter of a mile farther south, near the Welsh residence, are several small pits which expose similar ore, although the surface outcrop is small. The ore, however, is much more cherty than that at the pit described above. In the county road, immediately west of the house, occurs scattered fragments of goethite intermingled with boulders of sandstone.

During 1904 this mine produced 61 tons of ore which gave returns of 54.29% iron and 7.90% silica. (H.—1910.)

SOUTHWEST LIMONITE DISTRICT.

CHRISTIAN COUNTY.

PRIMARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Angus, Thos., Mine	27	23 W.	18	E. ½, S. W. ¼.
2	Arnt Mine	27	24 W.	24	S. E. ¼, S. E. ¼.
3	Frisco Mine	27	24 W.	4	Center.

GREENE COUNTY.

SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Helm Mine	29	24 W.	26	N. ½.
2	Jennings, R. H., Bank	30	23 W.	9	N. W. ¼, N. E. ¼.
3	Pollack, C., Mine	30	23 W.	4	S. E. ¼, S. E. ¼.

PRIMARY LIMONITE.

4	Bayliss Land	28	23 W.	16	W. ½, S. W. ¼.
5	Clutter Mine	30	23 W.	23	N. E. ¼.
6	Jackson, Geo., Bank	28	24 W.	11	S. W. ¼, S. E. ¼. N. E. ¼, S. E. ¼.
7	Jackson, John, Bank	28	24 W.	12	N. W. ¼, S. E. ¼.
8	Noble Mine	29	24 W.	1	S. ½, N. E. ¼.
9	Studley, Jos., Mine	28	23 W.	4	S. W. ¼, S. E. ¼.
10	Welsh Mine	29	23 W.	6	N. ½, N. W. ¼.

POLK COUNTY.

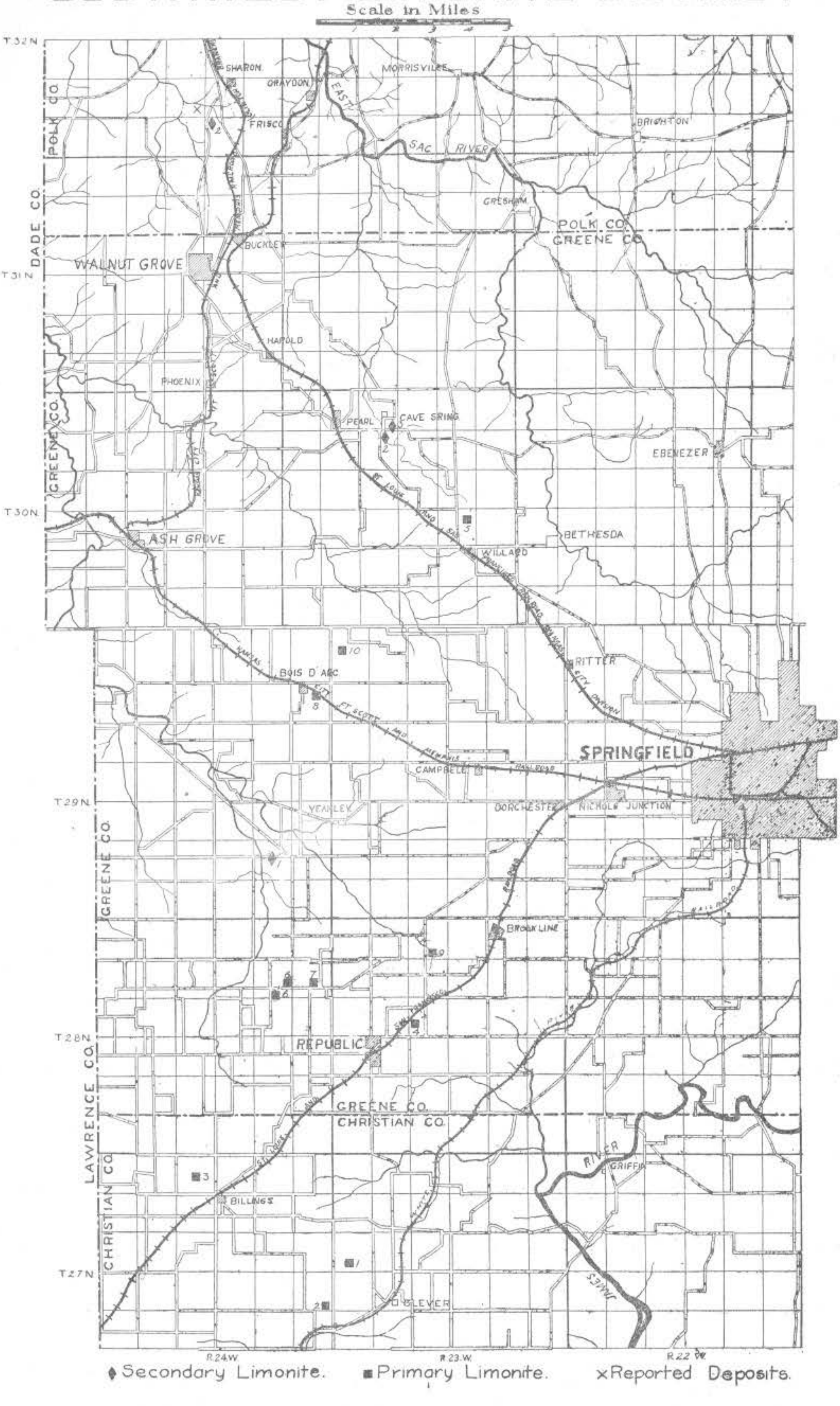
SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Akard, J. P., Land	33	24 W.	5	S. W. ¼, N. E. ¼.
2	Henney Land	32	24 W.	35	N. W. ¼, N. W. ¼.

REPORTED OCCURRENCE.

	Cable Land	32	24 W.	27	S. E. ¼.

SOUTHWEST LIMONITE DISTRICT



HENRY COUNTY.

HEMATITES OF THE CARBONIFEROUS.

1. BROWN BANK.

Sec. 25, T. 43 N., R. 25 W.

This bank is situated on the dividing ridge between Osage and Grand rivers. Red, earthy hematite, partly changed into brown and yellow limonite, is found on the surface here over a very large area, associated with ferruginous sandstone. (S.—1872.)

2. BROWNINGTON BANK.

Sec. 20, T. 41 N., R. 25 W.

This bank is located one mile east of Brownington. At first sight this deposit looks very promising but an examination of the ore shows it to be very siliceous. Several holes have been dug five to ten feet in depth but no change in the quality of ore was found. Exposures of highly ferruginous sandstone occur in many localities in this portion of Henry county. (N.—1892.)

PRIMARY LIMONITE.

3. CLINTON DEPOSIT.

City of Clinton. T. 41 N., R. 24 W.

This deposit, located in Clinton, is situated on the brow of a hill which is capped by ferruginous sandstone and shale of Pennsylvanian age. The ore is "bog iron" and contains very little sand, but considerable clay. It occurs in a lenticular mass with a maximum thickness of four feet, thinning rapidly towards the edges, as though formed in a small basin shaped pool. (N.—1892.)

HOWELL COUNTY.

Howell county ranks seventh in the production of iron ore, having shipped a total of 91,684 tons. The iron ore deposits are exclusively secondary limonite, the distribution and locations of which are shown on the accompanying county map. The ore occurs chiefly in the boulder, but in part in the pipe form. It is confined to the residuum which in this county has a great thickness, the underlying Jefferson City and Roubidoux formations outcropping only along the main streams. The great thickness of the residuum at the Kingsbury mine is indicated by a well which penetrated 200 feet of residual material without encountering the underlying rock formation.

Mining operations began in 1889 and with the exception of the period between 1893 and 1902, shipments have been made each year. Although seven mines have been opened, all but a few thousand tons of the total production was derived from the Carson and Kingsbury mines.

SECONDARY LIMONITE.

1. ANDERSON MINE.

N. E. 1/4, Sec. 23, T. 24 N., R. 8 W.

This mine, located two miles east of West Plains, is situated near the south base of a long, gentle slope. Developments consist of a pit 132 feet long and 81 feet wide having a present depth of 25 feet. The ore occurred here as boulders and fragments embedded in stratified clay, similar to the occurrence of the ore at the Kingsbury mine. The mine occurs on the southern edge of an area underlain by Tertiary pebbles.

The ore is secondary limonite containing very little chert or other impurities. A small amount of unaltered sulphide ore is in evidence on the dump, but this form of ore was apparently present in very small amount.

Several hundred tons of good wash ore occur in the dump of this mine and much ore of similar character is exposed at several places in the walls of the pit. There is no available water supply in the immediate vicinity except such as could be obtained from a deep well. It is reported that the bottom of the pit was still in ore when operations ceased, but this statement could not be verified at the time of a recent visit, owing to the caved condition of the mine.

This mine was operated during 1904, 1905, and 1906, producing 4,687 tons of ore. Shipments show an average analysis of 55.72% iron, 6.66% silica, 0.113% Phos., 0.06% Mn., and 3.00% moisture. (H.—1910.)

2. CARSON MINE.*

Owned by D. Carson, West Plains, Mo.

E. 1/2, Sec. 35, T. 24 N., R. 8 W.

This mine, located two miles southeast of West Plains, is situated on the northwest slope of a gentle hillside. It was opened in 1889 and, up to date, Jan. 1st, 1911, has produced a total of 61,754 tons. Developments consist of three irregular pits occurring at different elevations on the hillside and ranging from 200 to 400 feet in diameter and from 20 to 40 feet in depth. With the exception of one or two places, the faces of the openings show very little ore which probably accounts for the cessation of mining operations.

The ore is secondary limonite showing many pseudomorphs after marcasite and occurs in thin plates and boulders disseminated through a red, cherty clay. It became more sulphurous with depth for which reason deeper mining has not been attempted, though more ore is reported to occur in the bottom of the cuts.

An average of 33 analyses of shipments made during 1904 to 1909 inclusive, showed 53.83% iron, 9.85% silica, 0.115% Phos., 0.124% Mn., and 5.30% moisture. (C.—1910.)

3. FRUITVILLE BANK NO. 1.

Owned by Fruitville Farms Company, Fruitville, Mo.

N. E. 1/4, Sec. 12, T. 22 N., R. 8 W.

This prospect, located five miles southwest of Brandsville, consists of an outcrop of secondary limonite, in the form of boulders and fragments which are

*For a detailed description of this mine, as it existed in 1892, see Iron Ore Report of 1892, p. 165.

thickly strewn over an area of approximately three-quarters of an acre. Developments consist of two 3-foot pits which encountered ore throughout their depth.

The ore shows many sulphide pseudomorphs and is slightly silicious due to the presence of small quantities of chert. No rock outcrops occur in the vicinity and it is evident that the area is covered by a heavy mantle of residual material. (H.—1910.)

4. FRUITVILLE BANK NO. 2.

N. W. ¼, Sec. 7, T. 22 N., R. 7 W.

This prospect, located six miles west of Koshkonong, consists of an outcrop of secondary limonite in the form of boulders and fragments which are scattered over an area of about one-third of an acre on the east bank of a small stream. Developments consist of two shallow pits which disclose ore to a depth of three feet. Silica, in the form of chert fragments, is abundant. A large part of the ore body shows considerable unaltered marcasite. The silicious and sulphurous nature of the ore threatens its market value. (H.—1910.)

5. FRUITVILLE BANK NO. 3.

N. E. ¼, Sec. 30, T. 23 N., R. 7 W.

This prospect, located about five miles west of Brandsville, consists of an outcrop of secondary limonite in the form of boulders which comprise about half of the surface material over an area 100 feet square.

The ore is highly pseudomorphous after the sulphide, and carries very little silica other than an occasional fragment of chert. (H.—1910.)

6. FRUITVILLE BANK NO. 4.

N. W. ¼, Sec. 11, T. 22 N., R. 8 W.

This prospect, located six miles west of Koshkonong, consists of an outcrop of small fragments of secondary limonite completely covering an area 50 feet wide by 100 feet long situated on the crest of a low ridge. The ore is compact, dark brown limonite, containing very little chert. The adjoining area is covered by a thick mantle of residual material. (H.—1910.)

7. GILMOUR MINE.

Owned by J. T. Gilmour, Pomona, Mo.

N. W. ¼, S. W. ¼, Sec. 32, T. 26 N., R. 9 W.

This mine, located four miles northwest of Pomona, was not visited by a member of this Bureau but, according to records submitted by the St. Louis Blast Furnace Company, it was operated in 1903, producing 95 tons of ore. The ore is secondary limonite, shipments of which show an average analysis of 57.09% iron, 5.44% silica, and 0.105% Phos.

8. GODSEY (D.) LAND.

Sec. 26, T. 27 N., R. 9 W.

Stalactitic or pipe ore is found here in fragments of various sizes, scattered over an area of several square yards. The ore occurs on the slope of a hill the surface of which shows many blocks of sandstone and some chert. Here a shallow hole has been dug and some pieces with a sandy clay were taken out. (L.—1892.)

9. HARDEN BANK.

Owned by J. C. Harden, Bakersfield, Mo.

S. W. ¼, Sec. 19, T. 22 N., R. 10 W.

This prospect, located six miles southwest of Amy P. O., consists of an outcrop of secondary limonite in the form of loose boulders and fragments occurring abundantly over an area of two acres situated on a west slope of a hill. Developments consist of three 50 foot pits which are reported to show fragments of limonite embedded in cherty clay throughout their depth.

The ore varies in texture from compact to slightly porous and occasionally contains small quantities of unaltered marcasite. It is, in part, slightly silicious due to small admixtures of chert.

West Plains, 19 miles to the northeast, is the nearest shipping point. (B.—1910.)

10. HOUSE BANK.

Owned by James House, Grimmet, Mo.

N. W. ¼, Sec. 5, T. 24 N., R. 9 W.

This property, located four miles southwest of Pomona, bears an outcrop of secondary limonite which is situated on the crest of a broad, low hill in an area of gentle topography. The outcrop covers an area 450 feet long by 300 feet wide, within which fragments of ore constitute practically all the surface material. Several shallow pits show excellent wash dirt.

The major portion of the ore is compact and shows many sulphide pseudomorphs. There is also some banded, cellular ore, which is slightly silicious, due to inclusions of fragments of chert. A typical sample, when analyzed, showed 56.70% iron, and 4.70% insoluble material. (H.—1910.)

11. KINGSBURY BANK.

Owned by J. C. Kingsbury, West Plains, Mo.

N. ½, Sec. 7, T. 22 N., R. 8 W.

This prospect, located nine miles south of West Plains, is situated on the point of a low hill. The outcrop consists of boulders and fragments of secondary limonite, thickly strewn over an area of several acres. It has been developed by 15 test pits, the deepest of which is 15 feet. Thirteen of these pits show throughout their depth small boulders of ore embedded in red clay; the other two show no ore.

The ore is of good quality, containing no sand and only a small amount of chert. One pit, near the center of the area, encountered ore containing unaltered marcasite. The surrounding area is enveloped in a comparatively heavy mantle of residual materials. (H.—1910.)

12. KINGSBURY MINE.

Owned by J. C. Kingsbury, West Plains, Mo.

N. E. ¼, N. E. ¼, Sec. 23, T. 23 N., R. 8 W.

This mine, located five miles south of West Plains, is situated at the head of a small ravine in an area of gentle topography. The outcrop covered an area of one acre, the surface of which was densely covered with boulders of iron ore. Developments consist of an open pit 150 feet long, 90 feet wide, and 70 feet deep, from which about 16,500 tons of ore have been mined and shipped.

The ore is a secondary limonite of excellent quality, carrying no visible silica other than a few fragments of chert. It occurs as fragments and boulders embedded in semi-stratified, residual clay which has suffered much disturbance through slumping. At the 35 foot level, about 60 tons of unaltered iron sulphide was encountered, but subsequent mining, below this level, has developed ore low in sulphur.

A well sunk to a depth of 200 feet, at a point 60 feet northwest of the pit, penetrated residual materials throughout its depth. The depth to which the iron ore extends, however, has not been determined.

This mine was opened in 1908 and has been operated almost continuously up to the present time, the total production to Jan. 1st, 1911, being 15,015 tons. The ore is mined by hand and hoisted to the surface by means of a derrick and bucket, from which it is loaded on small cars and transported to a log washer located just northwest of the pit. The washed product is hauled a distance of 3½ miles by narrow gauge tram to the St. Louis and San Francisco R'y.

The average of the analyses of six cars of boulder ore shipped during 1908, ran 55.35% iron, 7.02% silica, 0.179% Phos., 0.126% Mn., and 3.00% moisture.

The average analysis of 10 cars of boulder and wash ore, mixed, shipped during 1909 and 1910, showed 53.49% iron, 9.04% silica, 0.159% Phos., and 3.5% moisture. (H.—1910.)

13. LIVINGSTON MINE NO. 1.

Owned by A. H. Livingston, West Plains, Mo.

N. E. ¼, N. E. ¼, Sec. 6, T. 25 N., R. 9 W.

This mine, located three miles west of Pomona, is situated on the point of a low hill. Developments consist of three large pits, one shaft, and several shallow test pits. The largest pit is situated near the eastern edge of the area and is 105 feet long, 50 to 75 feet wide, and about 12 feet deep. The two smaller pits, which are 33 feet apart, are situated a few yards southwest of the larger one. One is 70 feet long and 45 feet wide, and the other 70 feet long and 30 feet wide.

The ore at this mine occurred in the form of a broken ledge, with residual clay and chert above and below it. In the largest pit the ore face showed the following descending section:

Feet.	*Inches.*	
2	0	Hard, pseudomorphous ore.
1	6	Chert.
0	8	Dense, silicious limonite.

The ledge outcropped along the south edge of the pit and dipped gently to the northward. A shaft sunk 20 feet south of the pit, to a depth of 60 feet, encountered dolomite at 40 feet, but no ore. Between the largest pit and the two smaller ones, the ore occurred as residual boulders. At the site of the smaller pits, the ore ledge formed a sharp anticline, occurring at the surface between the pits and dipping sharply either way into the two excavations. Here the ledge was followed to a depth of 20 feet.

The limonite, comprising the upper two feet of the ore ledge, is of excellent quality, containing little or no silica, and very little sulphur. The ore of the lower eight inches, occurring beneath the chert, is silicious and has the appearance of replaced chert.

Numerous test pits have been sunk in the vicinity of the pits in expectation of encountering the ore ledge, but apparently the attempts have proven fruitless.

A sink hole, 175 feet in diameter and 15 feet deep, occurs 120 feet south of the two small pits.

One thousand tons of ore have been produced from this mine. The ore was hauled by wagon to Pomona. (H.—1910.)

14. LIVINGSTON MINE NO. 2.

Owned by A. H. Livingston, West Plains, Mo.

S. E. ¼, Sec. 31, T. 26 N., R. 9 W.

This mine, located three miles west of Pomona, is situated on the east face of a gently sloping hill. It consists of a cut 50 feet long, 12 feet wide, and 10 feet deep, from which about 50 tons of ore have been taken. The ore at this place consists of soft, earthy limonite.

Several shallow pits, which were sunk about 100 yards northeast of the cut, also disclosed considerable ore. The ore is a good quality of secondary limonite and occurs as fragments and boulders embedded in cherty clay. A few scattered boulders of pipe ore occur in the immediate vicinity of the pits. (H.—1910.)

15. PEARSON MINE.

S. W. ¼, Sec. 23, T. 26 N., R. 9 W.

This mine, located two miles north of Pomona, is situated on the crest of a low ridge. Developments consist of a pit 90 feet by 75 feet by 15 feet deep, and a shaft 40 feet deep located 55 feet east of the pit. Little or no ore was encountered in the shaft.

The ore is secondary limonite and occurred embedded in red clay. A small amount of stratified clay, similar to that at the Kingsbury and Anderson mines, is exposed in the pit but apparently carries no ore. The ore contains a small amount of chert but no unaltered sulphide was observed.

Small fragments of ore occur thickly strewn over an area of about an acre around the pit. Except for the one shaft, the surrounding area has not been prospected. The dumps of the mine consist of small fragments of ore and clay, the ore being present in sufficient amount to make a good wash dirt. A deep well, however, would be required for the necessary water supply.

Several hundred tons of ore have been shipped from this mine. It was hauled by wagon to Pomona. (H.—1910.)

16. RED RANCH BANK.

Owned by the Red Ranch Company.

N. E. ¼, Sec. 26, T. 22 N., R. 8 W.

This prospect, located seven miles southwest of Koshkonong, consists of an outcrop of secondary limonite covering an area of about one acre which is situated at the head of a small drainage system in a flat, upland area. Developments consist of two shallow pits which show a nearly solid mass of ore to a depth of five feet.

The ore is a compact to slightly cellular limonite of good quality and, except for a small amount of chert, carries no visible silica. (H.—1910.)

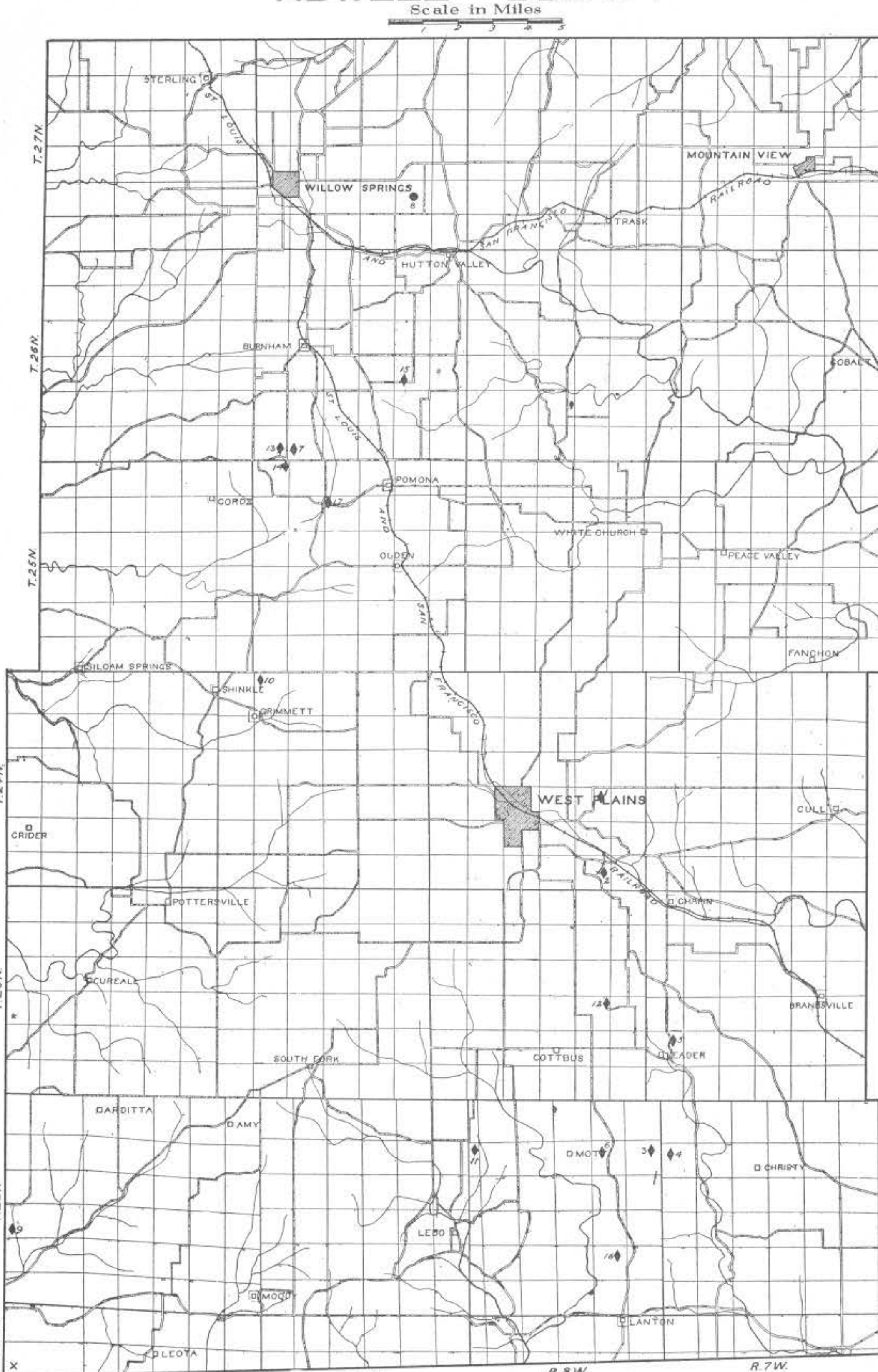
17. WOOD MINE.

Owned by William Wood, Pomona, Mo.

N. W. ¼, N. W. ¼, Sec. 9, T. 25 N., R. 9 W.

This mine, located two miles west of Pomona, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace

HOWELL COUNTY



♦Secondary Limonite, (Boulder) •Secondary Limonite, (Pipe) ×Reported Deposits

Company, it was operated during 1902 and 1903, producing 91 tons of ore. The ore is secondary limonite, shipments of which showed an average analysis of 50.84% iron, 10.20% silica, and 0.137% Phos.

HOWELL COUNTY.

SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Anderson Mine.................	24	8 W.	23	N. E. ¼.
2	Carson Mine....................	24	8 W.	35	E. ½.
3	Fruitville Bank No. 1...........	22	8 W.	12	N. E. ¼.
4	Fruitville Bank No. 2...........	22	7 W.	7	N. W. ¼.
5	Fruitville Bank No. 3...........	23	7 W.	30	N. E. ¼.
6	Fruitville Bank No. 4...........	22	8 W.	11	N. W. ¼.
7	Gilmour, J. T., Mine............	26	9 W.	32	N. W. ¼, S. W. ¼.
8	Godsey, D., Land................	27	9 W.	26	
9	Harden, J. G., Bank.............	22	10 W.	19	S. W. ¼.
10	House, James, Bank..............	24	9 W.	5	N. W. ¼.
11	Kingsbury, J. C., Bank..........	22	8 W.	7	N. ½.
12	Kingsbury, J. C., Mine..........	23	8 W.	23	N. E. ¼, N. E. ¼.
13	Livingston, A. H., Mine No. 1...	25	9 W.	6	N. E. ¼, N. E. ¼.
14	Livingston Mine No. 2..........	26	9 W.	31	S. E. ¼.
15	Pearson Mine....................	26	9 W.	23	S. W. ¼.
16	Red Ranch Bank................	22	8 W.	26	N. E. ¼.
17	Wood, Wm., Mine..............	25	9 W.	9	N. W. ¼, N. W. ¼.

REPORTED OCCURRENCE.

	Owner unknown................	21	10 W.	7	S. W. ¼.

IRON COUNTY.

Iron county ranks second in the production of iron ore, having an accredited output of 1,689,619 tons. Of this amount 1,580,640 tons were mined at Pilot Knob.

Aside from a few secondary limonite deposits in the vicinity of Des Arc, and three as yet undeveloped red ore banks in the extreme western end of the county, the known deposits consist of specular hematite in porphyry of which Pilot Knob and Shepherd Mountain are the most important.

Iron mining began in this county in 1816 when the Ashebran Furnace was erected at the Shut-In. The ore was obtained from Shepherd Mountain and from a small deposit near the furnace. Not much work was done, however, until 1848 when the first Pilot Knob furnace was built. From that date there was more or less activity until 1893 when the mine at Pilot Knob was shut down. Recently deposits of conglomerate ore have been re-opened and this property is at present one of the largest producers in the State.

SPECULAR ORES IN PORPHYRY.

1. BUFORD MOUNTAIN.

Sec. 26, T. 35 N., R. 3 E.

This mountain, located two miles west of Iron Mountain, is reported by Nason to bear several small veins of specular hematite in porphyry which were discovered by the presence of "float ore". He describes the ore as soft, inclined to be earthy, dull in color and to bear distinct traces of stratification. An average sample of the ore, collected by R. Pumpelly, and analyzed by Mr. Chauvenet, showed 47.81% iron, 8.54% insoluble matter, 12.32% Mn., 0.017% Sul., and 0.044% Phos. Nason reports the property to have produced about 3,000 tons of ore. No work has been done during the last twenty years.

2. CEDAR HILL MINE.

Owned by the Big Muddy Coal and Iron Company; leased by the Puxico Iron Company, Pilot Knob, Mo.

S. W. ¼, Sec. 19, T. 34 N., R. 4 E.

This mine is described in full on pages 136-137. (C.—1910.)

3. CUTHBERTSON'S HILL.

Sec. 19, T. 33 N., R. 4 E.

According to R. Pumpelly, at this place, located three miles southwest of Arcadia, the surface is strewn with large and small fragments of manganese ore and specular hematite. A cut exposes a bedded deposit of tabular masses of manganese ore, separated by a red, ocherous clay. Analysis of this ore showed 52.47% manganese, 2.31% iron, and 0.44% insoluble silicious matter.

An analysis of the hematite showed 68.49% iron, 2.45% insoluble material, and a trace of manganese.

4. LEWIS MOUNTAIN.

S. ½, Sec. 6, T. 33 N., R. 4 E.

According to Nason, an occurrence of specular ore in porphyry at this place showed when analyzed—59.22% iron, 0.027% Phos., 14.45% silica, 0.51% alumina, 0.06% lime, and 0.04% magnesia.

This property was not visited during the field work incident to the preparation of this report.

5. PILOT KNOB.

Owned by the Big Muddy Coal and Iron Company; leased by the Puxico Iron Company, Pilot Knob, Mo.

W. ½, Sec. 29, T. 34 N., R. 4 E.

This mine is described in full on pages 121-131. (C.—1910.)

6. RUSSELL MOUNTAIN.

Owned by the Big Muddy Coal and Iron Company; leased by the Puxico Iron Company, Pilot Knob, Mo.

S. E. ¼, Sec. 3, T. 33 N., R. 3 E.

This mine is described in full on page 137. (C.—1910.)

7. SHEPHERD MOUNTAIN.

Owned by the Big Muddy Coal and Iron Company; leased by the Puxico Iron Company, Pilot Knob, Mo.

Sec. 31, T. 34 N., R. 4 E.

This mine is described in full on pages 131-136. (C.—1910.)

8. SHUT-IN MINE.

Owned by the Big Muddy Coal and Iron Company; leased by the Puxico Iron Company, Pilot Knob, Mo.

N. ½, Sec. 2, T. 33 N., R. 4 E.

This deposit, located two miles east of Arcadia, was one of the first to be worked in Missouri. According to Prof. Swallow, a furnace was erected at this place in 1815-16, at which time some ore was mined. The ore occurs in narrow, nearly vertical, north-south veins having a thickness of one foot. It is specular hematite and is reported to be of excellent quality. The property is credited with a production of about 600 tons.

HEMATITES OF THE FILLED SINKS.

9. BURT BANK.

Sec. 2, T. 34 N., R. 1 W.

This bank occurs on the slope of a ravine, not on the summit of a hill. Two trenches have been cut out in the slope and each has struck a body of soft red specular ore, and has followed it up the slope for fifty feet or more. The trenches show that the ore body dips regularly with the slope of the ravine. The whole of the ore body is soft and greasy to the feel, even the harder and less decomposed lumps. These are "slickensided," and, in fact, the whole ore body shows slickensides. There are masses of jaspery ore which is not, of course, so badly decomposed. There are also "vugs" of quartz and amethyst crystals. The whole bank presents the appearance of a specular ore deposit which has been undermined and has been caused to slide bodily down the hill-side. There have been comparatively few openings made but these seem to show signs of a very promising deposit of specular ore. (N.—1892.)

10. RED POINT LAND.

Secs. 14 and 15, T. 34 N., R. 2 W.

Here the top of the ridge is broad, the slopes dip very gradually and over the surface, blocks and fragments of hard bright sandstone with scattered pieces of chert occur. On the slope in two or three localities, fragments and boulders of specular ore are found. The largest would weigh seventy-five or one hundred pounds. The ore is hard and portions of it contain grains of white quartz. On the whole the ore is of a very good quality. No work has been done here to prove the occurrence or non-occurrence of underground ore.

No bedded rock is exposed near the surface ore. (S.—1872.)

11. ROGERS BANK.

Sec. 2, T. 34 N., R. 1 W.

This bank is situated on the summit of a high divide between two forks of Black river. The only rocks in sight are blocks of broken sandstone. Fragments of specular ore occur on the surface and also imbedded in the clayey soil. Limestone is found in horizontal beds in the ravines. Several small openings have been made. All of them show regular deposits of specular ore. The ore occurs in layers which are broken into boulders and these boulders have been almost entirely changed into a soft red crystalline ore. The openings show that the sandstone and decomposed chert beds dip steeply down the slopes of the hill. The openings are not deep enough, nor are they made in such a manner as to expose the deposits in a favorable light. Yet from the extent of the deposit as indicated by the openings, from the fine quality of the ore, its soft nature showing that it has been little disturbed, it is quite probable that the deposit is a valuable one. (N.—1892.)

SECONDARY LIMONITE.

12. GRAVES MINE.

Owned by E. W. Graves, Des Arc, Mo.

S. E. ¼, N. E. ¼, Sec. 10, T. 30 N., R. 3 E.

This mine, located four miles west of Des Arc, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Company it was operated during 1905 and 1906, producing 511 tons of ore. The ore is a secondary limonite, 12 shipments of which showed an average analysis of 52.85% iron, 9.86% silica, 0.03% Phos., and 0.12% Mn.

REPORTED OCCURRENCES.

S. E. ¼, S. E. ¼, Sec. 2, T. 30 N., R. 3 E.
Sec. 7, T. 34 N., R. 1 E.
Sec. 15, T. 34 N., R. 1 E.
Sec. 1, T. 34 N., R. 1 W.
Sec. 12, T. 34 N., R. 1 W.
Sec. 27, T. 34 N., R. 1 W.
Sec. 34, T. 34 N., R. 1 W.
Sec. 1, T. 34 N., R. 2 W.
Sec. 14, T. 34 N., R. 2 W.
Sec. 20, T. 35 N., R. 1 E.
Sec. 32, T. 35 N., R. 1 E.
Sec. 35, T. 35 N., R. 1 W.

JEFFERSON COUNTY.

SECONDARY LIMONITE.

1. PRENTISS BANK.

N. E. ¼, Sec. 4, T. 39 N., R. 4 E.

This bank, located half a mile from De Soto, occurs in the Jefferson City formation. B. F. Schumard, who visited the property during the 60's, reports that the surface at this place is thickly strewn with large botryoidal and irregular masses of secondary limonite. The ore is reported to be very free from foreign material and the surface indications to be decidedly favorable for a commercial body of ore.

REPORTED OCCURRENCE.

Sec. 13, T. 39 N., R. 6 E.

LACLEDE COUNTY.

REPORTED OCCURRENCE.

Sec. 25, T. 36 N., R. 14 W.

LINCOLN COUNTY.

The iron ore deposits of this county consist of red hematite of the Carboniferous and secondary limonite. With the exception of the Morris bank, described below, no developments have been made. According to Prof. W. B. Potter*, who described these deposits in the report of 1872, the Carboniferous ore is "a hard, compact, red hematite, found in pieces, more or less flat in shape, from one to three inches thick and weighing from one to one hundred pounds. These fragments lie scattered over the surface in broad, imperfectly defined streams, generally independent of the present topography, though a larger amount is often found accumulated in the ravines and beds of streams. In such places the fragments are generally smaller and more or less completely smoothed and rounded, while on the ridges larger pieces occur, with well-defined edges and angles, on the top of the ground or distributed through the soil and gravel down to the limestone, but in no case in the latter. The underlying limestone is generally the Archimedes (Warsaw), though it is frequently the Encrinital (Burlington). There is no direct connection between the ore and the limestone. Many pits have been sunk where the ore is most thickly scattered, and it is found to give out on reaching the limestone."

"The ore, though in some cases rather too silicious, is generally of excellent quality, as appears in an analysis made by Mr. Chauvenet of an average sample:

(No. 1.)

Insoluble silicious matter	7.55%
Peroxide of iron	91.95
Sulphur	0.017
Phosphorus	0.010
Metallic iron	64.36

*Potter, W. B., Geology of Lincoln County: Missouri Geol. Survey Rept. 1872, pp. 283 and 284.

Two other samples from different localities afforded—

	(No. 2)	(No. 3)
Insoluble silicious matter	11.66	4.10
Peroxide of iron	86.56	92.32
Metallic iron	(60.59)	(66.72)"

"This ore is spread over many square miles of surface, and in varying quantities; at some places a few scattered masses occur, and at others the yield would be over a hundred tons to the acre. The greater part occurs within five or six miles of the St. Louis and Keokuk R'y (St. Louis and Hannibal) and much of it considerably nearer. At some time it may be found profitable to gather this ore and ship it to neighboring iron-works, and this could be done with but little expense. A large outlay for the utilization of this material would not be justifiable."

SECONDARY LIMONITE.

1. MORRIS BANK.

Sec. 36, T. 50 N., R. 1 W.

This bank, located three miles east of Davis, is situated on a ridge north of Fort Spring branch and in the Kimmswick limestone. According to Prof. W. B. Potter*, who visited it sometime prior to 1872, it had been opened by a large cone shaped pit, 20 feet in diameter at the top, 20 feet in depth, and about 8 feet in diameter at the bottom. The ore is a secondary limonite with some barite and hematite intermixed.

A vertical section of the materials passed through is as follows:

Feet.	
1½	Barite, the lower portion of which is heavily charged with iron oxide and some galena.
3½	Ochery, compact limonite, running 44.18% iron, and containing small amounts of barite.
12	Hard and somewhat cellular limonite, intermixed with patches of bright red hematite; the mixture ranging from 55.74% to 59% in iron.
5 +	Limestone.

Nearly half of the ore has been removed from the pit, but none has been shipped. Brown ore outcrops at intervals for a distance of 1½ miles along the crest of the ridge on which this deposit is situated.

MADISON COUNTY.

This county ranks fourteenth in the production of iron ore, having an accredited output of 10,424 tons. It was one of the first to mine brown ore, activities beginning in the early 70's at which time all but about 400 tons of the total production was mined. No shipments have been made since 1908. The ore is exclusively secondary limonite and

*Potter, W. B., Geology of Lincoln county, Missouri: Missouri Geol. Survey Report, 1872, pp. 272-273.

occurs for the most part embedded in the residual clay overlying the Bonneterre limestone. There are abundant outcrops of the underlying formations, indicating that the residual materials are comparatively thin.

SECONDARY LIMONITE.

1. ### CLAY MINE.

Owned by J. H. Clay, Cornwall, Mo.

E. ½, N. W. ¼, Sec. 25, T. 33 N., R. 7 E.

This mine, located 2½ miles northwest of Cornwall, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Co., it was opened in 1910 producing 18 tons of ore which ran 51.25% iron, 9.10% silica, 0.038% Phos., 0.12% Mn., and 2.80% moisture. The ore is probably a secondary limonite, in all respects similar to that produced at the Ford mine. (C.—1910.)

2. ### FORD MINE.

Owned by C. H. Gregoyre, Des Moines, Iowa.

S. ½, N. E. ¼, Sec. 25, T. 33 N., R. 7 E.

This mine, located two miles northwest of Cornwall, is situated on the south slope of a hill. It consists of a pit 230 feet long, 50 feet wide, and in some places 30 feet deep. The faces are covered with detritus and no ore is exposed. Bonneterre limestone was encountered with depth and is exposed at several places in the bottom of the pit. It contains numerous seams and joints cemented with marcasite, about a ton of which was mined from a shaft sunk in this rock. The depth and thickness of the deposit of marcasite was not determined. The presence of the sulphide filling cavities and crevices in the dolomite indicates that the ore is a secondary limonite. Several thousand tons have been shipped from this mine but no work has been done in recent years; the deposit being apparently worked out. (C.—1910.)

3. ### FORSYTH BANK.

Owned by P. J. Forsyth, Cornwall, Mo.

S. E. ¼, N. W. ¼, Sec. 25, T. 33 N., R. 7 E.

This bank, located half a mile west of the Ford mine, is situated on the south slope of a gentle hillside which is now under cultivation. In the early 70's it produced considerable limonite from shallow pits which were sunk over an area of about one acre.

The ore is a secondary limonite similar to that of the Ford bank. It was hauled by wagon to Mine Lamotte, where it was used in the smelting of lead ores. (C.—1910.)

4. ### FOSTER MINE.

Owned by North American Lead Company, Fredericktown, Mo.

N. E. ¼, S. E. ¼, Sec. 16, T. 33 N., R. 7 E.

This mine is located one mile east of Fredericktown and is situated on the west face of a high hill. Developments consist of three large, badly caved cuts from which considerable ore was mined and utilized as a flux in the lead furnaces at Mine Lamotte. The ore is a somewhat cherty, secondary limonite occurring as fragments and boulders embedded in a residual cherty clay overlying the Bonneterre limestone. Mr. P. N. Moore, who visited this property during the summer of 1873, soon after the pits were opened, described it as follows:

"At the time of examination, three cuts had been made at different places in this quarter section. The upper cut was made near the end of a tramway, constructed to carry the ore down to the Iron Mountain R'y. about half a mile distant. This cut was about 80 feet long, running into the hill near the summit in an easterly direction. Considerable ore had been obtained, but it was all found as broken pieces or boulders lying in the clay and chert, and no solid mass was found. The ore was very cherty. About 250 to 300 yards north, by the side of the tramway, another small excavation was made without reaching any solid ore, but much ore in small pieces, mostly of small size, was found in the clay. This was a much better quality than in the upper cut, being dense, dark colored, often stalactitic, and quite free from chert. At still another point, west of the last described, an excavation about ten feet deep had disclosed a mass of ore of irregular shape, the extent of which could not be seen. It was lying in the clay, mixed with much yellow ochre and ferruginous chert. The ore itself was dense, cherty, and very silicious. No rock was visible near the ore save the associated chert, which was found in abundance, both lying with the ore and scattered over the surface of the hill." (C.—1910.)

5. MATHEWS MOUNTAIN BANK.

Owned by N. Scott and Company.

S. E. ¼, N. W. ¼, Sec. 3, T. 32 N., R. 6 E.

This bank, located seven miles southwest of Fredericktown, is situated near the base of the northwest slope of a high poryhyry mountain. It has been opened by a shaft and several small pits, from each of which some ore was obtained. The shaft is reported to have been sunk to a depth of 80 feet but is now filled to within 15 feet of the surface. From it was taken boulders of soft, red hematite and brown limonite mixed with soft yellow ocher and red clay. From a ten foot pit was taken a reddish brown limonite mixed with fragments of porphyry and clay. The outcrop consists of large angular fragments of porphyry among which occur smaller boulders of limonite.

The opposite hillside consists of horizontal beds of Bonneterre dolomite which also forms the bed of the intervening stream. This dolomite originally covered the sides of the porphyry mountain, and the ore was deposited as the sulphide at the contact of the dolomite and poryhyry. Upon the erosion of the dolomite, the sulphides were oxidized to limonite which is now confined to the detrital material upon the surface. The development work was done during the early 70's, when one car load was shipped. The ore was hauled by wagon to Fredericktown, the nearest shipping point on the Iron Mountain and Southern R'y. (C.—1910.)

6. MINE LAMOTTE BANK NO. 2.

Owned by the Mine Lamotte Lead Co., Fredericktown, Mo.

S. W. ¼, S. E. ¼, Sec. 35, T. 33 N., R. 7 E.

This bank is located three miles west of Cornwall and is situated on the north bank of a ravine. Mining has been carried on by means of a pit about 100 feet in diameter and 10 feet deep. Bonneterre limestone was encountered in depth. The ore is a secondary limonite and occurs as boulders and small fragments embedded in a cherty, residual clay. No work has been done here since the early 70's and the property appears to be worked out. (C.—1910.)

7. PARKIN BANK.

Owned by F. J. Parkin, Fredericktown, Mo.

N. W. ¼, N. E. ¼, Sec. 14, T. 33 N., R. 7 E.

This bank, located three miles east of Fredericktown, is situated in an old field near the head of a small ravine, in which boulders of secondary limonite outcrop in the residual clay and, at one point, lie strewn over the surface of the Bonneterre dolomite. Developments consist of several shallow pits which were made during the early 70's. The pits are scattered over an area of about half an acre. No prospecting has been done to develop the extent of the deposit, and the only prominent surface showings are in the immediate vicinity of the old workings.

The ore mined was hauled by wagon to Mine Lamotte and used as a flux in smelting lead ore. (C.—1910.)

8. VALLE BANK.

Owned by Laura L. Keyes, Fredericktown, Mo.

N. E. ¼, S. E. ¼, Sec. 21, T. 33 N., R. 7 E.

This bank, located 2½ miles southeast of Fredericktown, it situated on the west bank of a small ravine. It was opened in the early 70's by several shallow cuts from which a porous, brown limonite and some soft, red hematite were obtained. The ore occurs embedded in a non-cherty, dark red clay and was probably originally deposited as a sulphide at the contact of the Bonneterre dolomite and the porphyry. Boulders of the latter rock occur in the immediate vicinity of the pits. The ore was used as a flux by the Mine Lamotte Company. (C.—1910.)

REPORTED OCCURRENCES.

S. E. ¼, S. E. ¼, Sec. 36, T. 31 N., R. 5 E.
Sec. 29, T. 31 N., R. 7 E.
Lot 3, N. W. ¼, Sec. 6, T. 33 N., R. 6 E.
W. ½, N. W. ¼, Sec. 34, T. 33 N., R. 6 E.

MARIES COUNTY.

HEMATITES OF THE FILLED SINKS.

1. McNAMARA BANK.

Owned by John McNamara, Bland, Mo.

S. W. ¼, N. E. ¼, Sec. 2, T. 39 N., R. 8 W.

This bank, located 14 miles southwest of Belle, is situated along a small ravine. Developments consist of two cuts, one situated near the south edge of the forty and the other near the northwest corner. The former is seven feet deep and shows lenses of red and specular hematites in broken sandstone and chert. The other cut exposes about three feet of red and specular hematites, overlain by a thin mantle of clay and residual chert. Very ferruginous clay-shales are exposed at intervals along the sides of the ravine between the two cuts. In some respects this material resembles the shale of the Carboniferous, while in others it differs materially.

There is no rim-rock. The surface on either side of the ravine is strewn with fragments of chert and fossiliferous sandstone. The property deserves systematic prospecting. (H.—1910.)

REPORTED OCCURRENCES.

Sec. 28, T. 38 N., R. 9 W.
Sec. 30, T. 38 N., R. 9 W.
Sec. 5, T. 39 N., R. 11 W.
Sec. 2, T. 40 N., R. 9 W.

MILLER COUNTY.

The iron deposits of this county consist of red and specular hematite of the filled sinks and secondary limonite. With the exception of a few scattered boulders of secondary limonite, these deposits are confined to that part of the county south of the Osage river.

According to Ball and Smith*, the southern portion of the county was thoroughly prospected during the early 70's but in not more than a dozen localities were the deposits found to be important enough to work. Statistics as to the output of the various banks could not be obtained. It is known, however, that some of the ore was carried by wagon to the railroad at Hancock and Dixon and some was hauled to Capps and shipped by boat down the Osage river. Considerable of the ore mined was not shipped and may be seen on the dumps at the old mines and at the boat landing at Capps. Mining was carried on more or less spasmodically for a period of five years after which it was entirely abandoned. Since that time scarcely any attempt has been made to develop these properties, although several new ore bodies have been located.

The following are a few of the more important deposits as described in the Miller County Report:

HEMATITES OF THE FILLED SINKS.

1. BOLIN CREEK BANK.

This iron bank is located in the S. W. ¼ of sec. 15, T. 39 N., R. 12 W. The ore consists of residual boulders of hard siliceous hematite embedded in the greasy, red clay of a sink hole in the Bolin creek sandstone. The clay is sometimes used by neighboring farmers as a substitute for paint. The sandstone in which the deposit occurs is deeply stained by limonite.

2. BOND IRON BANKS.

These banks consist of two pits located in carboniferous sandstone on the N. E. ¼ of sec. 15, T. 39 N., R. 13 W. The ore is a soft red; greasy hematite, some of which is suitable for mineral paint. The hematite in some cases has a radiating structure, and all of it is so impregnated with calcite that it effervesces

*Ball and Smith, Geology of Miller county: Missouri Bureau of Geology and Mines Report, vol. 1, 2nd Series, 1903, p. 155.

freely. In the center of some of the pieces of soft red hematite were found small pieces of hard blue specular ore. Minute cavities in the ore are commonly lined with tiny crystals of quartz or hematite.

These iron banks in Carboniferous sandstone are surrounded with beds of sandstone, chert and dolomite, belonging to the St. Elizabeth formation. Except south of the banks, where there is a dip of 30°, N. 25° E., the beds of the St. Elizabeth formation are horizontal.

3. LAMBERT IRON BANK.

This bank is located on Brushy Fork, in the W. ½ of lot 1 N. W., sec. 5, T. 37 N., R. 13 W. The ore is massive mamillary or soft hematite and underlies about an acre of ground. It occurs near the bottom of the St. Elizabeth formation and is associated with steeply dipping beds which are suggestive of faulting. Crystals of quartz and calcite are scattered abundantly through the ore.

SECONDARY LIMONITE.

4. McDONALD BANK NO. 1.

This bank includes a number of small pits in a large sink hole in the upper part of the Gasconade limestone, in the southeast corner of S. W. ¼, sec. 15, T. 40 N., R. 13 W. The ore is mainly limonite, although some hematite was observed. The limonite occurs either as a cement binding the brecciated chert beds, or as small beds or lenses. Very little ore was observed except what was exposed on the dump pile. This consisted of limonite, some pyrite and occasional boulders of pipe stem ore.

5. McDONALD BANK NO. 2.

This bank is located in the S. W. ¼ of sec. 23, T. 40 N., R. 13 W., at the contact of the Gunter sandstone and the Gasconade limestone. The pit is 60x45x8 feet. The limonite occurs as a horizontal ledge having a maximum observed thickness of 5 feet. In places it is apparently much thicker. The limonite is porous and the cavities contain soft yellow rust and thin streaks of marcasite. The surface of the limonite often shows the crystal forms of marcasite, of which it is probably an alteration product.

REPORTED OCCURRENCES.

N. E. ¼, Sec. 14, T. 38 N., R. 12 W.
S. ½, Sec. 11, T. 38 N., R. 14 W.
Lot 1, Sec. 5, T. 39 N., R. 12 W.
N. W. ¼, N. E. ¼, Sec. 7, T. 39 N., R. 12 W.
N. E. ¼, Sec. 26, T. 39 N., R. 12 W.
N. E. ¼, N. W. ¼, Sec. 31, T. 39 N., R. 12 W.
S. W. ¼, Sec. 12, T. 39 N., R. 13 W.
N. W. ¼, Sec. 26, T. 39 N., R. 15 W.
S. W. ¼, S. E. ¼, Sec. 1, T. 40 N., R. 12 W.
N. E. ¼, Sec. 2, T. 40 W., R. 12 W.
S. W. ¼, Sec. 24, T. 40 N., R. 12 W.
N. E. ¼, Sec. 25, T. 40 N., R. 12 W.
N. E. ¼, S. E. ¼, Sec. 25, T. 40 N., R. 12 W.
N. W. ¼, Sec. 6, T. 40 N., R. 13 W.
S. W. ¼, Sec. 17, T. 40 N., R. 13 W.
N. W. ¼, Sec. 18, T. 40 N., R. 13 W.

S. E. ¼, S. W. ¼, Sec. 18, T. 40 N., R. 13 W.
S. W. ¼, Sec. 33, T. 40 N., R. 13 W.
S. W. ¼, Sec. 13, T. 40 N., R. 14 W.
N. W. ¼, Sec. 32, T. 40 N., R. 15 W.
N. E. ¼, Sec. 29, T. 41 N., R. 12 W.
N. W. ¼, Sec. 29, T. 41 N., R. 12 W.
S. W. ¼, Sec. 31, T. 41 N., R. 13 W.

MONTGOMERY COUNTY.

HEMATITES OF THE CARBONIFEROUS.

1. RED HILL BANK.

Sec. 17, T. 50 N., R. 3 W.

Boulders of specular ore are mingled with fragments of sandstone, chert, and limonite, and all these, embedded in red clay, lie on the summit of a hill 130 feet above the level of a brook. The outcrop is not extensive and no development work has been done. (N.—1892.)

MORGAN COUNTY.

The iron deposits of this county consist exclusively of secondary limonite of which only four occurrences are known. According to Marbut* "fragments of iron ore occur scattered over the surface in a few places in the southeastern part of the county. The deposits are usually small, however, and not abundant. They consist of limonite, no hematite being found. Iron ore has never been mined in Morgan county profitably. The fragments now found have formed in small cavities in the limestone and, in all cases, the conditions indicate a very small quantity. The massive chert breccia of the lower part of the Roubidoux is sometimes cemented with iron but not abundantly enough to make an iron ore. There is no evidence to lead one to suspect that the iron mining industry will ever become important in Morgan county."

SECONDARY LIMONITE.

1. COUT'S BANK.

Sec. 14, T. 40 N., R. 19 W.

Limonite lies here on the eastern slope of a hill, in a zone about thirty feet wide, extending one hundred and fifty feet down the hill-side. The ore is massive but frequently mixed with fine, broken chert. A large amount of broken chert is seen on the surface, but there is no bedded rock exposed. (S.—1872.)

2. GRAVOIS BANK.

N. W. ¼, S. W. ¼, Sec. 27, T. 41 N., R. 17 W.

Limonite outcrops at this place on the face of a hill at an elevation of 100 feet above Gravois Creek. F. B. Meek, who visited the property during the 60's,

*Marbut, C. F., Geology of Morgan County: Missouri Bureau of Geol. and Mines, vol. VII, 2nd Series, 1907, p. 78.

reports the deposit to consist of pipe iron ore, some boulders of which are 8 to 10 feet in diameter. Considerable quantities of barite occur associated with the ore.

3. PALM BANK.

N. W. ¼, Sec. 12, T. 40 N., R. 19 W.

Limonite is found here in a ravine upon the western slope of the hill, near the base. It seems to occur in place and is about four feet thick. Around the outcrop, within a radius of thirty feet, is a large amount of surface-ore, which extends in smaller quantities to a distance of fifty or sixty feet up the slope. The soil is mixed with chert. No other rocks are visible. (S.—1872.)

4. WIGWAM BANK.

Sec. 10, T. 40 N., 19 W.

Here limonite is found on the western slope of a cherty hill, the lower portion of which seems to consist of a sandy, magnesian limestone. The ore extends about one thousand feet along the slope and sixty feet vertically. Some sandstone is formed on the surface of the upper part of the hill, a short distance from the ore and apparently above it. The ore is very largely mixed with chert so much so as to form breccia in some places. There are, however, portions of it which are pure. (S.—1872.)

OREGON COUNTY.

With the exception of one primary limonite deposit, located near Thomasville, the ore deposits in this county consist of secondary limonite which occurs in both the boulder and pipe form. The deposits are widely scattered over the county as shown on the accompanying map. They occur in the residuum overlying the Jefferson City and Robidoux formations which underlie the greater portion of the county. The residuum has considerable thickness along the main divides but is relatively thin in the areas adjacent to the main streams where the underlying rocks outcrop abundantly. Very little development work has been done and up to January 1st, 1911, but two deposits have been opened, with a total production of only 83 tons. This inactivity is due primarily to the lack of adequate transportation facilities.

SECONDARY LIMONITE.

1. BOYD (T. J.) LAND.

N. W. ¼, N. W. ¼, Sec. 29, T. 22 N., R. 5 W.

Limonite is found here covering an area nearly two acres in extent, on a moderate slope. It first appears near the lowest portion of a spur and continues up the slope. On the surface here, ore was found in the form of boulders and smaller fragments. This surface ore was shipped five or six years ago. Two excavations have been made a few yards apart near the center of the area. One of these is about ten feet in length, six feet in width and nine feet deep; the other is not so deep, but is longer. From both a considerable amount of ore was removed. The ore in these cuts was found occurring with red clay. It is of a fair quality. It contains soft ocherous particles but is only very slightly siliceous. There are fragments of white chert on this range of hills and, here and there, are found traces of scattered ore. This locality is located less than two miles distant from the K. C., Ft. S. & M. Ry. (L.—1892.)

2. BROCIUS LAND.

Owned by S. T. Brocius.

Sec. 20, T. 24 N., R. 3 W.

This prospect, located six miles northeast of Alton, is situated upon the crest and upper slopes of a high hill. The outcrop, which covers an area of 180 by 70 yards, consists of secondary pipe and boulder limonite embedded in cherty clay. No developments have been made. (B.—1910.)

3. BURGESSER MINE.

Owned by Drew Whitten, Alton, Mo.

N. W. 1/4, Sec. 28, T. 24 N., R. 2 W.

This mine, located 11 miles east of Alton, is situated upon the brow of a very high southwest hill overlooking the valley of the Eleven Point river. The outcrop, which consists of large, irregular boulders of cherty, brown ore, covers an area 200 feet in diameter. A number of test pits, which have been sunk to a depth of from 6 to 8 feet, indicate that the ore occurs near the surface and is replaced with depth by boulders of chert. At a point just below the main outcrop the deposit has been opened by a long cut reaching 100 feet or more across the face of the hill. This cut varies from three to ten feet in depth and shows an abundance of boulder ore embedded in red, cherty clay. Near the base of the cut large masses of chert appear to replace the ore.

The ore is a cherty, secondary limonite showing feather and arborescent sulphide forms. Much of it occurs in boulders which occasionally show an unaltered sulphide core. An average sample, taken from a stock pile of about 25 tons, gave the following analysis: 52:07% iron, 11.83% silica; 0.069% Sul., 0.051% Phos., and 11.025% combined water. Twenty-three tons shipped from this mine to the St. Louis Blast Furnace Company during 1907 gave returns of 52.84% iron, 8.50% silica, 0.026% Phos., 0.05% Mn., and 3.0% moisture. The mine lies about a quarter of a mile from a logging branch of the Ozark Land and Lumber Company railroad which joins the St. Louis and San Francisco R'y. at Winona. (C.—1910.)

4. HEISKELL LAND.

Owned by Wade Heiskell.

S. W. 1/4, S. E. 1/4, Sec. 4, T. 23 N., R. 4 W.

This prospect, located one mile south of Alton, consists of an outcrop of brown ore extending over an area 100 feet wide, by 300 feet long. Developments consist of three shallow pits, which, though partly filled at present, show small boulders of limonite embedded in red, sandy clay.

The ore is a somewhat sandy and cherty, secondary limonite, occurring for the most part in small fragments. A washing plant would be required in order to work this bank on a commercial scale.

Thayer, 13 miles to the southwest, is the nearest shipping point. (B.—1910.)

5. HUFF BANK.

Owned by L. S. Huff, Koshkonong, Mo.

S. E. ¼, N. E. ¼, Sec. 18, T. 22 N., R. 6 W.

This deposit, located two miles south of Koshkonong, is situated on the crest of a ridge. Developments consist of two test pits, one of which is three, and the other, forty feet in depth. The upper 15 feet of the deeper pit showed boulders of ore embedded in red clay. The lower 25 feet penetrated cotton rock, containing fissures and joints filled with limonite. The shallow pit showed conditions similar to the upper portion of the deeper shaft.

The ore is a slightly porous, secondary limonite, containing but little chert. The outcrop covers an area of one acre in the vicinity of the pits. At the base of a south slope, 400 yards to the north, is a somewhat smaller outcrop. A test pit here is reported to have encountered secondary limonite near the surface and unaltered iron sulphide below. The ore occurs as boulders, embedded in clay.

(B.—1910)

6 MOSER LAND.

Owned by Georgia Moser.

N. W. ¼, N. E. ¼, Sec. 36, T. 24 N., R. 4 W.

This prospect, located 2½ miles east of Alton, consists of an outcrop of brown ore in the form of boulders scattered over an area of 15 acres on the western slope of a low hill. Of this area, only four acres shows good exposures of ore.

The ore is secondary limonite which is in part silicious, due to the presence of enclosed, angular fragments of chert and occasional small lenses of secondary quartz.

Thayer, the nearest shipping point on the St. Louis and San Francisco R'y., lies 17 miles to the southwest. (B.—1910.)

7. MT. NEBO BANK.

Owned by J. B. Johnson.

S. E. ¼, S. W. ¼, Sec. 8 and

N. E. ¼, N. W. ¼, Sec. 17, T. 23 N., R. 3 W.

Mt. Nebo, located five miles southeast of Alton, is a small conical hill rising approximately 150 feet above the surrounding bottom land. The outcrop, at the crest of the knoll, consists of scattered boulders of limonite, while about half way up the slope a belt of residual ore, having a maximum width of 300 feet, nearly encircles the hill.

Developments consist of several shallow pits which are now badly caved A 16 foot pit, on the crest of the hill, penetrated six feet of cherty clay and 10 feet of cotton rock. A similar opening, 150 feet to the northwest, encountered cherty clay containing small boulders of limonite to a depth of 40 feet. At the base of the south slope of the hill, a 30 foot pit is reported to have bottomed in dolomite. The upper ten feet of the pit penetrated residual, cherty clay while the lower 20 feet encountered cherty clay in which were embedded small boulders of limonite.

The ore is dense, secondary limonite of the boulder and pipe varieties. The boulder ore contains a small amount of fragmental chert.

Thayer, 15 miles to the southwest, is the nearest shipping point. (B.—1910.)

8. MURRAY LAND.

N. E. ¼, S. W. ¼, Sec. 33, T. 22 N., R. 5 W.

Limonite is found here. There is but little surface ore shown and much chert. A shaft was sunk, by Mr. T. J. Boyd, to a depth of eighteen feet. The upper ten feet is made up of a dark red clay, portions of which is cherty and to this depth but few pieces of ore were discovered. The lower eight feet is principally iron ore intermixed with a small amount of red clay. Mr. Boyd reports the bottom of the shaft as being an almost solid bed of iron ore. Many of the masses of ore are coated with small and large crystals of limonite, pseudomorphous after pyrite, and the surfaces of some of the masses are ribbed with veins of ore, in relief, which once filled crevices in the adjacent wall-rock. The ore is of a good quality. Some yellow ocherous matter occurs with the ore. This deposit is situated less than one mile from the K. C., Ft. S. & M. Ry. at Thayer. (L.—1892.)

9. NORMAN AND MARTIN BANK.

Owned by E. P. Norman and Albert Martin.

S. W. ¼, N. E. ¼, Sec. 16, T. 23 N., R. 4 W.

This property, located three miles south of Alton, bears an outcrop of brown ore occurring at intervals for a distance of 300 yards along the crest of a ridge. Seven pits have been sunk near the south end of the outcrop, five of which are shallow and show only red clay and partly decomposed cotton rock of the Jefferson City formation. The remaining two are each 20 feet deep and expose ore embedded in residual clay throughout their depth.

The ore is secondary limonite and occurs as rough, irregular boulders, which contain a small amount of fragmental chert.

Thayer, 12 miles to the southwest, is the nearest shipping point. (B.—1910.)

10. OLD BANK.

Owned by Heirs of J. B. Old.

N. W. ¼, N. W. ¼, Sec. 25, T. 25 N., R. 6 W.

This bank, located two miles northwest of Thomasville, is situated 100 feet from the mouth of a narrow gorge which enters the valley of Eleven Point river from the north. The ore occurs as a massive ledge 10 feet high, jutting from the east bank of the ravine and covering an area 100 feet long by 100 feet wide. The hillside above and on either side of the outcrop is covered with fragments of chert, while between the outcrop and the bottom of the ravine the surface is covered by massive boulders of ore. On the opposite bank of the ravine horizontal beds of dolomite are exposed.

The ore consists entirely of the pipe form of secondary limonite. The pipes vary from one-eighth to one-half inch in diameter, the smaller pipes generally filling cavities between the larger ones. The average sample of the ore showed the following analysis: 59.02% iron, 2.49% silica, 0.077% Phos., 0.066% Sul., 0.78% alumina, and 12.16% combined water.

Koshkonong, 15 miles to the south, is the nearest shipping point. (B.—1910.)

11. RAGAN MINE.

Owned by T. B. Ragan.

N. E. ¼, N. W. ¼, Sec. 33, T. 22 N., R. 5 W.

This property, located one mile east of Thayer, is situated on a gentle southwest slope. The outcrop covers an area of two acres within which boulders of slightly porous limonite are thickly strewn over the surface. Developments consist of an open cut and a 24-foot test pit. Both of these openings show the ore to occur in the form of rough beds and as veins in decomposed cotton rock. The bottom of the pit is in cotton rock, the joints of which are often filled with thin seams of limonite.

The ore is secondary limonite free from chert or sand. The cavities in the porous ore are filled with red and yellow clay.

Four car loads of ore are reported to have been shipped from this mine in 1906. It was hauled by wagon to Thayer, a distance of one mile. (B.—1910.)

12. RIDINGTON BANK.

Owned by A. Blain Ridington.

N. W. ¼, Sec. 32, T. 24 N., R. 4 W.

This prospect, located two miles west of Alton, consists of an outcrop of limonite covering an area 200 yards long by 100 yards wide, on the north point of a hill. Developments consist of two pits which show boulder ore in the underlying clay.

The ore is massive, secondary limonite, carrying but little silica. A portion of it contains lenses of ocherous limonite, enclosed by a thin coating of chalcedony, which, on weathering, imparts a honeycombed appearance to the ore.

Koshkonong, located 14 miles to the southwest, is the nearest shipping point. (B.—1910.)

13. SIMPSON BANK.

Owned by S. M. Simpson.

N. W. ¼, Sec. 4, T. 24 N., R. 4 W.

This prospect, located five miles north of Alton, consists of an outcrop of secondary limonite covering an area 200 yards long by 50 yards wide on the crest of a ridge.

Three shallow test pits sunk near the west end of the outcrop encountered boulders and small fragments of ore embedded in yellow clay. The ore consists of boulder and pipe limonite, the former predominating. The massive ore is porous and contains some fragmental chert; the pipe ore is free from silicious impurities.

Koshkonong, located 18 miles to the southwest, is the nearest shipping point. (B.—1910.)

14. SIMPSON LAND.

Owned by L. W. Simpson.

W. ½, S. E. ¼, Sec. 23, T. 24 N., R. 4 W.

This prospect, located 2½ miles northeast of Alton, consists of an outcrop of brown ore which covers an area 50 yards long by 30 yards wide on the point of a secondary ridge. No developments have been made.

The ore is secondary limonite, of which both the massive and pipe forms are shown in the outcrop. The latter occurs as single pipes or clustered in boulder form, in which case the pipes are generally attached to a slab or layer of massive ore. The ore is free from chert and sand.

Thayer, located 17 miles to the southwest, is the nearest shipping point.

(B.—1910.)

15. ST. JOE MINE.

Owned by St. Joe Lead Company, Bonneterre, Mo.

S. W. ¼, S. W. ¼, Sec. 22 } *T. 22 N., R. 5 W.*
N. W. ¼, N. W. ¼, Sec. 27 }

This property, located two miles northeast of Thayer, bears two outcrops of brown ore, 250 yards apart. The southern outcrop covers an area 170 yards long by 130 yards wide on the south face of a secondary ridge. It has been developed by three shallow cuts and one 18 foot pit, all of which encountered fragments of ore embedded in cherty red clay. The 18 foot pit bottomed in cotton rock of the Jefferson City formation.

The northern outcrop, covering an area of about one acre on the crest of a ridge, has not been developed.

The ore, at both outcrops, consists of boulders and fragments of somewhat cherty, secondary limonite having a porous structure. The smaller fragments can be recovered only by washing.

Several car loads of surface ore are reported to have been shipped from this property. (B.—1910.)

16. THAYER BANK.

Owned by the Bank of Thayer.

N. W. ¼, S. W. ¼, Sec. 34, T. 24 N., R. 4 W.

This prospect, located at Alton, consists of an outcrop of brown ore covering an area of one acre on the south slope of a hill. Although the surface exposure of ore is very good, a 6 foot pit showed very little ore and bottomed in cotton rock.

The ore is secondary limonite and occurs for the most part as small fragments, with only a few massive boulders which are composed of an aggregate of rough pipes. The ore contains little or no chert.

Thayer, 14 miles to the southwest, is the nearest shipping point. (B.—1910.)

17. WARD LAND.

Owned by W. M. Ward.

S. ½, S. W. ¼, Sec. [illegible], T. 24 W., R. 4 W.

This prospect, located four miles northeast of Alton, consists of an outcrop of limonite, covering an area of about one acre, on the north slope of a ridge. No development work has been done.

The ore is slightly porous, secondary limonite which is somewhat sandy and contains fragmental chert.

Thayer, 19 miles to the southwest, is the nearest shipping point. (B.—1910.)

18. WHITTEN LAND.

Owned by Drew Whitten, Alton, Mo.

N. W. ¼, N. W. ¼, Sec. 19, T. 24 N., R. 3 W.

This prospect, located four miles northeast of Alton, consists of an outcrop of brown ore in the form of boulders and fragments thickly strewn over an area of ten acres, at the junction of two small streams. The outcrop is restricted on the east by boulders of chert, immediately south of which ore is exposed in a solid ledge for a distance of 50 yards along the bed of the stream.

The ore is a secondary limonite containing fragments of chert, occasional thin seams of quartz and chalcedony, and, where exposed in the stream bed, contains considerable porous, yellow ochre.

Thayer, 18 miles to the southwest, is the nearest shipping point. (B.—1910.)

19. WILKERSON LAND.

Owned by W. B. Wilkerson.

N. W. ¼, N. W. ¼, Sec. 34, T. 23 N., R. 6 W.

This prospect, located two miles northeast of Koshkonong, consists of an outcrop covering an area of about one acre on the west slope of a ridge. The exposure consists of small boulders of ore scattered over the surface near the head of several small ravines. The adjoining hill slopes are thickly strewn with fragments of chert and quartzitic sandstone. No developments have been made.

The ore is secondary limonite and contains some fragmental chert. In texture it varies from compact to slightly porous, the former having a dark brown color and the latter a yellow, due to the presence of ocherous limonite.

(B.—1910.)

20. WINNER BANK.

Owned by Albert Winner.

N. W. ¼, N. W. ¼, Sec. 1, T. 23 N., R. 6 W.

This prospect, located seven miles northeast of Koshkonong, consists of an outcrop of brown ore in the form of boulders and fragments thickly strewn over the surface of an area of about ten acres. Developments consist of one test pit, the dump of which shows boulders and small fragments of ore embedded in clay.

The ore is a dense to slightly porous, secondary limonite, which, with the exception of occasional seams of secondary quartz, is comparatively free from silicious materials. (B.—1910.)

PRIMARY LIMONITE.

21. RUSSELL BANK.

Owned by J. Russell, Alton, Mo.

S. E. ¼, Sec. 36, T. 25 N., R. 6 W.

This prospect, located 1½ miles west of Thomasville, consists of an outcrop of brown ore which covers an area of about two acres, situated on the crest and east slope of a high, secondary ridge. Developments consist of two 10 foot pits, sunk 50 feet apart, both of which disclose a bed of solid ore.

The ore is a cellular, primary limonite, containing chalky, decomposed chert.

Thayer, located 14 miles to the southwest, is the nearest shipping point.

(B.—1910.)

OREGON COUNTY.

SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Boyd, T. J., Land	22	5 W.	29	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
2	Brocius, S. T., Land	24	3 W.	20	
3	Burgesser Mine	24	2 W.	28	N. W. $\frac{1}{4}$.
4	Heiskell, Wade, Land	23	4 W.	4	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
5	Huff, L. S., Bank	22	6 W.	18	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
6	Moser, Georgia, Land	24	4 W.	36	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
7	Mt. Nebo Bank	23	3 W.	8	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
				17	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
8	Murray Land	22	5 W.	33	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
9	Norman and Martin Bank	23	4 W.	16	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
10	Old, J. B., Bank	25	6 W.	25	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
11	Ragan, T. B., Mine	22	5 W.	33	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
12	Ridington, A. B., Bank	24	4 W.	32	N. W. $\frac{1}{4}$.
13	Simpson, S. M., Bank	24	4 W.	4	N. W. $\frac{1}{4}$.
14	Simpson, L. W., Land	24	4 W.	23	W. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
15	St. Joe Mine	22	5 W.	22	S. W. $\frac{1}{4}$. S. W. $\frac{1}{4}$.
				27	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
16	Thayer Bank	24	4 W.	34	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
17	Ward, W. M., Land	24	4 W.	12	S. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
18	Whitten, Drew, Land	24	3 W.	19	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
19	Wilkerson, W. B., Land	23	6 W.	34	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
20	Winner, Albert, Bank	23	6 W.	1	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.

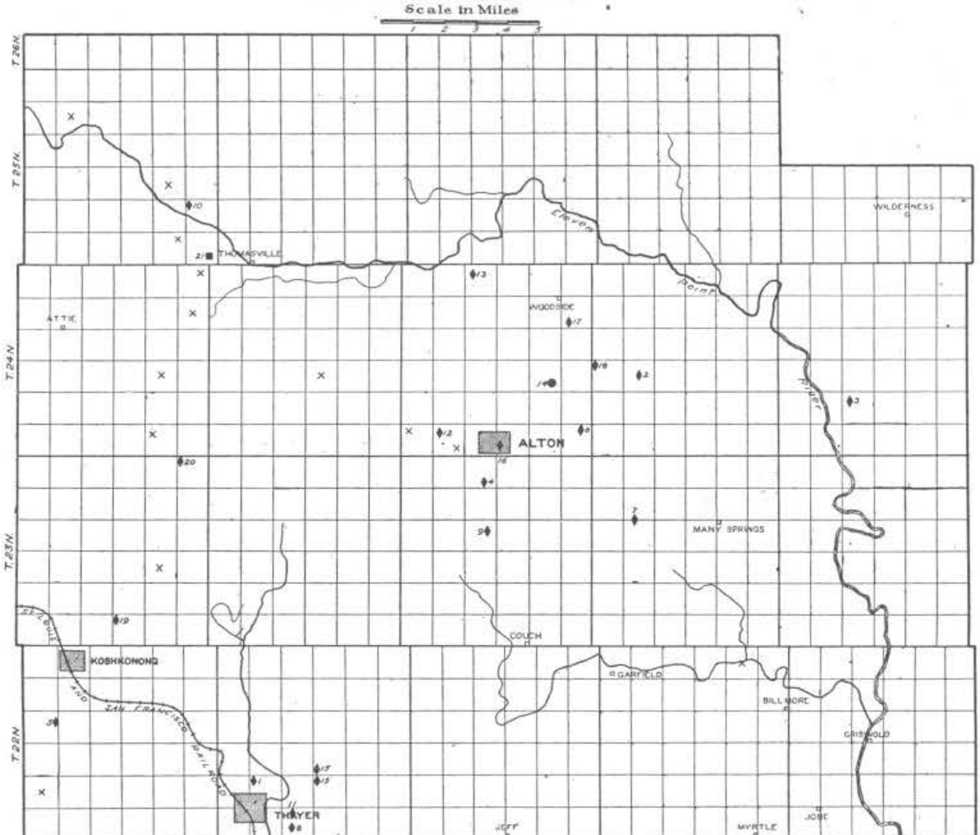
PRIMARY LIMONITE.

21	Russell, J., Bank	25	6 W.	36	S. E. $\frac{1}{4}$.

REPORTED OCCURRENCES.

Owner unknown	22	3 W.	2	
" "	22	6 W.	30	
" "	23	6 W.	23	
" "	24	4 W.	31	N. W. $\frac{1}{4}$.
" "	24	4 W.	32	S. E. $\frac{1}{4}$.
" "	24	5 W.	22	
" "	24	6 W.	1	N. E. $\frac{1}{4}$.
" "	24	6 W.	12	
" "	24	6 W.	23	
" "	24	6 W.	35	N. W. $\frac{1}{4}$.
" "	25	6 W.	8	
" "	25	6 W.	23	
" "	25	6 W.	35	N. E. $\frac{1}{4}$.

OREGON COUNTY



♦Secondary Limonite. (Boulder) ●Secondary Limonite. (Pipe) ■Primary Limonite. ×Reported Deposits.

OSAGE COUNTY.

REPORTED OCCURRENCES.

Sec. 4 & 5, T. 41 N., R. 7 W.
Sec. 17, T. 41 N., R. 11 W.
Sec. 20, T. 42 N., R. 11 W.
Sec. 33, T. 43 N., R. 7 W.
S. E. ¼, Sec. 34, T. 43 N., R. 7 W.
Sec. 7, T. 43 N., R. 8 W.
Sec. 34, T. 43 N., R. 8 W.
Sec. 12, T. 43 N., R. 9 W.
Sec. 15, T. 44 N., R. 7 W.

OZARK COUNTY.

The known iron ore deposits of this county consist exclusively of secondary limonite which occurs in both the boulder and pipe form. The deposits are confined to the residuum overlying Jefferson City and Roubidoux formations, which comprise the major portion of the surface rocks. These formations outcrop abundantly along the stream courses, indicating that the residuum is thin and that the ore deposits are correspondingly shallow. Very little or no development work has been done and no ore has been shipped. The known deposits are remote from railroad transportation and the chances for an early development of the iron resources of the county are very poor.

SECONDARY LIMONITE.

1. BRADLEY LAND.

N. E. ¼, N. W. ¼, Sec. 5, T. 23 N., R. 16 W.

This property, located 17 miles south of Ava, has been prospected by two test pits sunk on the east slope of a ridge. The pits, which have a depth of three feet, encountered an almost solid body of boulder ore. The depth of the deposit was not determined.

The ore is secondary limonite showing pseudomorphs of marcasite. It is somewhat silicious due to the presence of occasional fragments of flint and crystals of secondary quartz. (H.—1910.)

2. BUTTROM LAND NO. 1.

Owned by Freeman Buttrom.

S. E. ¼, Sec. 9, T. 21 N., R. 11 W.

This prospect, located 2 miles southwest of Bakersfield, consists of an outcrop of secondary limonite covering an area of about one acre, at the base of a gentle hillside. The ore is in part cellular and in part compact and contains no visible silicious materials.

West Plains, 30 miles to the northeast, is the nearest shipping point. (B.—1910.)

3. BUTTROM LAND NO. 2.

Owned by Freeman Buttrom.

N. W. ¼, Sec. 9, T. 21 N., R. 11 W.

This prospect, located two miles southwest of Bakersfield, consists of an outcrop of secondary limonite in the form of a three foot ledge near the crest of a steep slope. Boulders of ore occur upon the slope below the ledge. A 12 foot pit, sunk immediately below the outcrop, encountered ferruginous sandstone and some very cherty limonite. The ore in the ledge is also very cherty.

West Plains, 30 miles to the northeast, is the nearest shipping point. (B.—1910.)

4. CHILTON LAND.

Owned by Henry Chilton.

S. W. ¼, Sec. 9, T. 21 N., R. 11 W.

This prospect, located two miles southwest of Bakersfield, consists of an outcrop of secondary limonite covering an area of three acres on the southwest slope of a ridge. No development work has been done.

The ore occurs chiefly in boulder form and contains no visible sand or chert.

West Plains, thirty miles to the northeast, is the nearest shipping point. (B.—1910.)

5. COBB (H. C.) LAND.

N. W. ¼, Sec. 23, T. 23 N., R. 12 W.

This deposit of limonite is found on the slope of a low hill and in a small ravine. The ore is in the form of rough boulder-like masses and fragments. Such ore-masses are found covering an area nearly an acre in extent. Within this area and on adjoining portions of this slope, chert fragments occur. The general quality of the ore is good, though a few of the fragments show some chert particles. This is about thirty miles distant from the Gulf Ry. (L.—1892.)

6. COLLINS (LOWELL) LAND.

Sec. 30, T. 24 N., R. 11 W.

Limonite occurs here on the slope of a hill in the form of a few scattered boulders on the surface. Within this area a hole two feet deep was dug, from which lumps of ore were removed, and at the bottom an almost solid deposit was exposed. The ore in the pit is of the species limonite and turgite. Some chert fragments are disseminated with the surface ore. This deposit is about the same distance as the last from the same railroad. (L.—1892.)

7. GARRETT BANK.

S. E. ¼, S. E. ¼, Sec. 14, T. 22 N., R. 12 W.

This prospect, located about one mile southeast of Tecumseh, consists of an outcrop of boulder limonite scattered over an area of four acres on the southwest slope of a ridge.

Three test pits have been sunk upon the hillside. The one near the crest shows considerable good ore; the second opening encountered only fragments of limonite embedded in clay; and the third opening encountered only clay and chert. The presence of quartz and chalcedony makes the ore somewhat silicious. A large proportion of the ore can be recovered only by washing.

West Plains, located 32 miles to the northeast, is the nearest shipping point. (B.—1910.)

8. GLAZIER BANK.

Owned by L. E. Glazier.

S. E. ¼, Sec. 1, T. 21 N., R. 11 W.

This property, located one mile east of Bakersfield, is marked by a strong outcrop of secondary limonite covering an area 16 yards wide by 150 yards long, situated on the crest of a ridge. Developments consist of two 50 foot shafts which show fragments of ore embedded in clay throughout their depth. One of these is situated on the crest of the ridge, the other 150 feet west of the first and at a slightly lower elevation.

The ore is somewhat silicious due to inclusions of fragments of partly decomposed chert. Much of the ore occurs as small fragments and can only be recovered by washing. This deposit is in the residual material overlying the Jefferson City formation.

West Plains, 28 miles to the northeast, is the nearest shipping point. (B.—1910.)

9. GLAZIER LAND.

Owned by L. E. Glazier.

S. W. ¼, Sec. 1, T. 21 N., R. 11 W.

This prospect, located half a mile east of Bakersfield, consists of an outcrop of secondary limonite covering an area 540 feet long by 390 feet wide, on the crest of the same ridge as the Glazier Bank. No developments have been made.

The ore occurs as fragments and small boulders, the maximum diameter of which is about six inches. The larger boulders show many sulphide pseudomorphs and enclose occasional fragments of chert.

West Plains, 28 miles to the northeast, is the nearest shipping point. (B.—1910.)

10. JAMES (WM.) LAND.

Secs. 27 and 34, T. 24 N., R. 11 W.

Limonite occurs in several localities in these sections, extending over three hundred and twenty acres. The extent of the individual deposits varies from one-fourth of an acre to more than an acre. These deposits are usually on the gradual slopes, though some do occur on steeper slopes. At one place scattered fragments are seen which extend from the gradual slope at the base nearly to the point of the spur. The ore is non-silicious and the fragments are mingled with loose chert. This locality is about twenty-five miles from West Plains.

(L.—1892.)

11. LAMB (JOHN) LAND.

Sec. 25, T. 23 N., R. 12 W.

Limonite is found here on a moderate slope, covering an area one hundred and twenty-five yards long and thirty yards wide. The upper limit is quite near the summit of the hill. The portion of the area nearest the summit of the hill is made up almost wholly of small boulders and fragments. The remaining portions contain chert fragments and blocks mingled with small pieces of ore. The quality of the ore is fair, most of the ore being non-siliceous or nearly so. This locality is nearly thirty miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

12. LUNA (RICHARD) LAND.

Sec. 21, T. 24 N., R. 12 W.

A limonite bank occurs here on a very gradual slope, in the form of scattered fragments and boulders covering an acre or more. It is a fair quality of ore. These boulders of ore are mingled with scattered fragments and large masses of chert. This locality is about 25 miles distant from the Kansas City, Ft. Scott & Memphis R. R. (L.—1892.)

13. MAHAN LAND.

N. ½, Sec. 1, T. 23 N., R. 12 W. and

S. ½, Sec. 36, T. 24 N., R. 12 W.

Limonite is found here in three localities, each area being about thirty yards square. The first is near the summit of the hill. Here the ore boulders and fragments bear grains of sand and small particles or spalls of chert, mingled with them. About seventy-five yards westward, on a gentle slope, is another similar deposit; and northward, about one hundred yards, very small fragments of good, dark brown limonite are thickly strewn over the surface. This area also bears fragments of chert. This deposit extends over a low crest and down a moderate slope. This ore is about twenty-five miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

14. MARTIN (ANDREW) LAND.

Sec. 1, T. 23 N., R. 12 W.

Here, near the foot of a rather steep slope bearing much sharp chert gravel, large fragments of chert and scattered small blocks of sandstone, is found an area, ten yards square, covered with limonite boulders and fragments. The greater portion of the ore is non-siliceous, though some pieces are seen to contain small particles of chert. Bedded limestone is outcropping just beneath the area. About one-third of a mile from this deposit, on the northern point of a spur leading off from the same hill, is an area, about three-fourths an acre in extent, containing rough masses and fragments of good, non-siliceous limonite. Within this area are found a few fragments of chert and "cotton rock." Again, about one hundred yards westward, on a low, rather flat slope, are found masses of limonite scattered over several square yards. At this locality limestone is again exposed. These deposits are about twenty-five miles distant from the K. C., Ft. S. & M. Ry. (L.—1892.)

15. MATTNEY (JAMES) LAND.

Sec. 6, T. 23 N., R. 11 W.

Limonite is found here on the slope of the hill near the foot, covering, perhaps, one-fourth of an acre. It occurs in the form of boulders and fragments, mingled with chert. It is a good quality of ore, being non-siliceous and firm. Much chert is found on adjacent portions of the hill. This locality is about twenty-four miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

16. MORE LAND.

Sec. 35, T. 23 N., R. 11 W.

Limonite is found here on the gradual slope at the base of a hill, and extending up the steeper slope, about two hundred yards west of a branch of Big North

Fork of White river. The boulders and fragments are strewn over about one acre. Some of these boulders occur in masses forming a reef-like deposit; others are smaller and more scattered. Large and small white chert boulders occur mingled with and above the ore boulders. This locality is about thirty-five miles distant from the K. C., Ft. S. & M. Ry. (L.—1892.)

17. NEWTON MINING COMPANY LAND.

N. E. ¼, N. W. ¼, Sec. 17, T. 24 N., R. 15 W.

This prospect, located 20 miles south of Ava, consists of an outcrop of secondary limonite in the form of boulders and fragments thickly strewn over an area of about two acres along the north base of a low ridge. Jefferson City dolomite outcrops on the hill side at an elevation slightly above that of the ore, indicating that the residuum is thin.

The ore is a compact limonite showing pseudomorphs after marcasite. It is slightly silicious, due to the presence of small lenses of milky white quartz and occasional fragments of chert. (H.—1910.)

18. OWENS (JOSEPH) LAND.

Sec. 6, T. 23 N., R. 11 W.

Here, on the southern slope of a broad hill, limonite occurs in fragments and small boulders, covering an area an acre or more in extent. It is non siliceous and heavy. Some pieces of chert are found within this area and on the adjacent portions of the hill. This locality is about thirty-four miles distant from the K. C., Ft. S. & M. R. R. (L.—1892.)

19. PENNSYLVANIA LAND.

E. ½, Lot 2, N. W. ¼, Sec. 5, T. 24 N., R. 16 W.

This prospect, located 15 miles southwest of Ava, consists of an outcrop of secondary limonite covering an area 275 feet wide by 375 feet long on the east bank of a small stream. Within this area boulders and fragments of ore constitute the entire surface material. Jefferson City dolomite outcrops on the slopes of the hill above the ore bank, indicating that the residuum at this place is probably not over 20 feet in depth.

The ore is a dark brown, cellular limonite containing a few fragments of chert and occasional crystals of quartz. No developments have been made.

(H.—1910.)

20. PETECOCK LAND.

N. W. ¼, Sec. 36, T. 24 N., R. 12 W.

Limonite occurs here in two localities on the point of one and near the point of another short hill. These localities are only a few yards across, about one-eighth of a mile apart and separated only by a slight depression. It is reported that fragments of ore could be seen in the now cultivated field between the two areas. The ore in the eastern area is somewhat siliceous, more so than that in the western area. These localities are about twenty-five miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

21. PRATT (WALLACE) LAND.

Sec. 17, T. 24 N., R. 11 W.

Only a few fragments and boulders of limonite are found here on a gradual hill slope. Some excavating has been done and a deposit of iron was met with at a depth of from four to nine feet under the surface. The surface material, such as clay, chert and soil, has been removed from over the ore and has exposed the deposit, which shows an almost solid body for ten yards or more. No work has been done to prove the thickness of the deposit, but several slabs of ore which were taken out show the thicknesses of the individual layers to range from three to six inches. Other, more massive pieces were also obtained. The general mass shows little or no silica and, on the whole, the ore is of very fair quality. This deposit is about twenty-six miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

22. PRICE LAND.

Owned by T. L. Price.

N. W. ¼, Sec. 9, T. 22 N., R. 11 W.

This prospect, located three miles west of Wetherill, consists of an outcrop covering an area of two acres on the northeast slope of a ridge. A shallow pit shows fragments of ore embedded in red, sandy clay. The ore is slightly porous and contains practically no chert or sand.

West Plains, 28 miles to the northeast, is the nearest shipping point. (B.—1910.)

23. SOUTH MISSOURI LAND COMPANY LAND NO. 1.

Sec. 29, T. 24 N., R. 11 W.

Here we have but slight surface indications of iron ore, in the form of small fragments scattered over the ground. Two shafts seven feet deep were sunk about one-half of a mile apart on a rather flat top of a ridge, next to Big North Fork or White river.

In the easternmost shaft, where only chert chips and soil might be seen on the surface, small boulders of good ore were met with from near the top to the bottom. This shaft was near the brink of the hill. At the other shaft, sixteen inches of soil and clay were passed through, then clay was penetrated containing ore boulders such as were found in the former shaft. The ore is non-siliceous. These shafts are about one-fourth of a mile from a spur, whose bluff-like side next to the Big North Fork of the White river, shows stratified limestone and sandstone. This locality is 30 miles or so from the K. C., Ft. S. & M. R'y.

(L.—1892.)

24. SOUTH MISSOURI LAND COMPANY LAND NO. 2.

Sec. 34, T. 24 N., R. 11 W.

Limonite is shown here, on the surface, in a few small fragments. Four holes have been dug. One is on the point of the hill, another about one hundred yards northwards on the slope, another two hundred yards further northward and one more about the same distance in the same direction. The depths of these holes range from four to ten feet and, in each, a solid body of limonite was struck just beneath a deposit of rather fair, broken ore, cementing angular fragments of hard and decomposed chert. Underneath this deposit the ore proves to be more free from insoluble material. Scattered chert fragments are seen on the surface. This deposit is about thirty-miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

25. STEEL BANK.

Owned by Wm. Steel.

E. ½, S. W. ¼, Sec. 3, T. 21 N., R. 11 W.

This bank, located one mile southwest of Bakersfield, is situated on the east side, and near the crest, of a high hill. The outcrop, consisting of boulders and fragments of secondary limonite, covers an area 210 feet long by 120 feet wide. Developments consist of four pits, the deepest of which was 40 feet. The dumps indicate that each pit encountered boulder ore and chert for a few feet beneath the surface and bottomed in cotton rock of the Jefferson City formation.

The ore shows abundant sulphide pseudomorphs and varies in structure from dense to slightly porous. The larger boulders contain numerous lenses of ochre.

West Plains, thirty miles to the northeast, is the nearest shipping point.

(B.—1910.)

26. TANNER LAND.

Sec. 34, T. 24 N., R. 12 W.

Limonite occurs here in widely scattered fragments and boulders on a steep slope covering an area seventy-five yards long and about ten yards wide. The quality of the ore is very fair. Much chert, in fragments and in larger rough masses, is found within the area and over the hill. This locality is about twenty-eight miles distant from the K. C., Ft. S. & M. Ry. (L.—1892.)

27. WARREN (JUDGE PINKNEY) LAND.

Sec. 36, T. 24 N., R. 12 W.

Limonite is found here again in the form of large and small fragments in scattered deposits over four or five acres, usually on the slope. The quality of the ore is good. The fragments of ore are mingled with fragments of white chert. The surface exposure in one of the deposits within this large area is more than one acre in extent. This deposit is between thirty and thirty-five miles distant from the K. C., Ft. S. & M. Ry. (L.—1892.)

28. WELLS LAND.

Sec. 5, T. 23 N., R. 11 W.

Massive limonite is found here on a cherty slope in the shape of large boulders and chips, covering an area twenty yards long and fifteen yards wide. The ore is hard and quite or nearly as pure. This locality is about thirty-three miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

REPORTED OCCURRENCES.

Sec. 16, T. 22 N., R. 11 W.
Sec. 17, T. 22 N., R. 11 W.
Sec. 8, T. 22 N., R. 12 W.
S. E. ¼, Sec. 36, T. 22 N., R. 12 W.
Sec. 2, T. 22 N., R. 13 W.
Sec. 34, T. 22 N., R. 15 W.
Sec. 23, T. 23 N., R. 12 W.

Sec. 29, T. 23 N., R. 12 W.
Sec. 3, T. 23 N., R. 13 W.
Sec. 4, T. 23 N., R. 13 W.
Sec. 7, T. 23 N., R. 13 W.
Sec. 2, T. 23 N., R. 14 W.
Sec. 12, T. 24 N., R. 11 W.
Sec. 32, T. 24 N., R. 11 W.
Sec. 33, T. 24 N., R. 11 W.
Sec. 35, T. 24 N., R. 11 W.
Sec. 25, T. 24 N., R. 13 W.
Sec. 35, T. 24 N., R. 13 W.

PERRY COUNTY.

PRIMARY LIMONITE.

1. GERLER BANK.

Owned by Frederik Gerler, Altenburg, Mo.

N. W. ¼, S. W. ¼, Sec. 1, T. 33 N., R. 13 E.

This bank is located 2½ miles west of Gerler and half a mile north of Apple creek. It is situated about 20 feet below the crest of the southeast slope of a high hill which is thickly chert covered.

Developments, made during the early 70's, consist of two openings both of which are now partly filled. The larger opening consists of a long, shallow cut from the face of which a 20 foot drift was driven into the hill. The outer portion of this drift has recently caved exposing a face of 20 feet of soft, ocherous clay, intermixed with layers of hard and decomposed chert. The lower half of the face shows nodules and irregular masses of limonite. The upper half of the face shows very little or no ore.

The ore is a primary limonite of a dense, even texture and a uniform dark, seal brown color. It is hard and silicious, from the presence of minute, irregular grains of quartz, and often encloses an irregular core of unreplaced decomposed chert. In most cases the boulders have the same exterior outlines and structures of the original chert nodules. The evidence of chert replacement is very pronounced. No cellular or porous ore occurs here. A sample of the ore, taken to represent a crushed and washed product, when analyzed showed 48.90% iron, 21.62% silica, 0.183% Phos., 0.018% Sul., 9.49% combined water, and 0.68% moisture.

Eighty feet below the cut is an outcrop of shelly, fossiliferous limestone, of probable Trenton age. (C.—1910.)

REPORTED OCCURRENCES.

S. ½, Sec. 6, T. 33 N., R. 14 E.
Sec. 36, T. 34 N., R. 13 E.
Sec. 19, T. 34 N., R. 14 E.

PHELPS COUNTY.

Phelps county ranks fifth in the production of iron ore in this State, having an accredited output of 613,390 tons. With the exception of five secondary limonite banks, the deposits of this county consist of red and specular hematite occurring in filled sinks. The distribution and locations of the known deposits are shown on the accompanying county map.

Iron mining began in this county in 1826 when the Meramec bank, located five miles southeast of St. James, was opened. The Meramec furnace was completed in 1829 and was operated intermittently up to 1860. The Ozark furnace, near Newburg, was built in 1874, and at about this time a number of mines were opened. However, the De Camp mine is the only property in operation at the present time.

HEMATITES OF THE FILLED SINKS.

1. AFRICAN MINE.

Owned by Edw. Campbell.

S. E. 1/4, Sec. 22, T. 36 N., R. 6 W.

This mine, located one mile southwest of Winkler, is situated on the east bank of a small stream. The principal workings consist of a circular pit having a diameter of 60 feet and a depth of 25 feet. Ore was encountered throughout the entire depth and is reported to occur below the principal workings. Several shallow shafts were sunk in the residual clay and chert on the west side of the stream. No ore was encountered.

This deposit occurs in the Roubidoux formation, a sandstone member of which outcrops along the stream to the southwest and a dolomite member to the northeast. The nearest approach to a rim-rock occurs on the west bank of the stream, where several steeply dipping ledges of sandstone form prominent outcrops. There is little or no outcrop of ore and consequently the lateral extent of the deposit can be determined only by prospecting.

The ore body, composed of red and specular hematites, was found to dip 45° to the northwest. At the northwest corner of the pit the ore is overlain by nine feet of cherty clays and soil. The contact between the ore and overburden is sharp.

This mine was worked prior to 1888 by the Missouri Iron Company when, according to Nason, it produced 1,658 tons of ore. The property deserves systematic prospecting. (H.—1910.)

2. BEAVER CREEK MINE.

Owned by Samuel Massey and Thomas James.

S. 1/2, Sec. 33, T. 37 N., R. 8 W.

This mine, located six miles southwest of Rolla, is situated near the crest of a ridge about one mile southwest of Beaver creek. Developments consist of a pit 400 feet long, 250 feet wide, and 50 feet deep. The bank was probably discovered by an exposure of ore near the top of the hill, there being no structural indications of a deposit at this place. Sandstone of the Roubidoux formation outcrops along a ravine immediately west of the pit. The walls of the pit, which apparently consisted of interstratified clay and chert, are now badly caved.

The ore consisted of soft, red hematite with which occurred small quantities of specular ore and limonite. According to Nason, about 49,000 tons of ore were produced prior to 1892. (W. L.—1910.)

3. BRADY MINE.

Owned by P. G. Will, Winkler, Mo.

S. W. ¼, Sec. 27, T. 36 N., R. 6 W.

This mine, located one mile west of Clinton switch, is situated on the south face of a gentle slope. It occurs in the Roubidoux formation, a sandstone member of which outcrops 100 yards to the south. The principal workings consist of a pit 200 feet long, 150 feet wide, and 25 feet deep. The ore body was enclosed by stratified clay having a general dip towards the center of the pit. Several shafts sunk in close proximity to the pit penetrated only residual clay and chert.

This mine was operated prior to 1892, producing between two and three thousand tons of ore. The ore consisted of soft, red hematite, an average sample of which ran 62.66% iron and 0.026% Phos. The deposit has the appearance of being practically exhausted. (H.—1910.)

4. BUCKLAND MINE.

Owned by John M. Hodgen, Potosi, Mo.

N. E. ¼, S. W. ¼, Sec. 20, T. 37 N., R. 8 W.

This mine, located four miles southwest of Rolla, and about 1000 feet south of the St. Louis and San Francisco R'y., is situated in a ravine 120 feet below the crests of the adjoining hills. Developments consist of an elliptical pit 150 feet long, 70 feet wide, and 30 feet deep, from which apparently all of the available iron ore has been taken. The property is still of interest, however, because of the presence of a considerable deposit of iron sulphide, chiefly marcasite, which occupies the bottom of the old pit. Recent drilling, by the Commercial Acid Company of St. Louis, who have the property under lease, show as much as 32 feet of sulphide. The following are records of two holes drilled within the limits of the old pit: (These holes are 35 feet apart.)

HOLE NO. 1.

Feet.	*Inches.*	
9	0	Wash, consisting of clay and sand.
3	0	Hard, low-grade, red hematite.
2	0	Marcasite.
1	0	Low-grade, hard red hematite.
32	6	Marcasite.
2	6	Clay, gray to white, containing crystals of pyrite.

HOLE NO. 2.

Feet.	*Inches.*	
6	0	Wash, sandy clay.
22	0	Marcasite.

Bottomed on hard marcasite.

(C.—1910)

5. BURNS MINE.

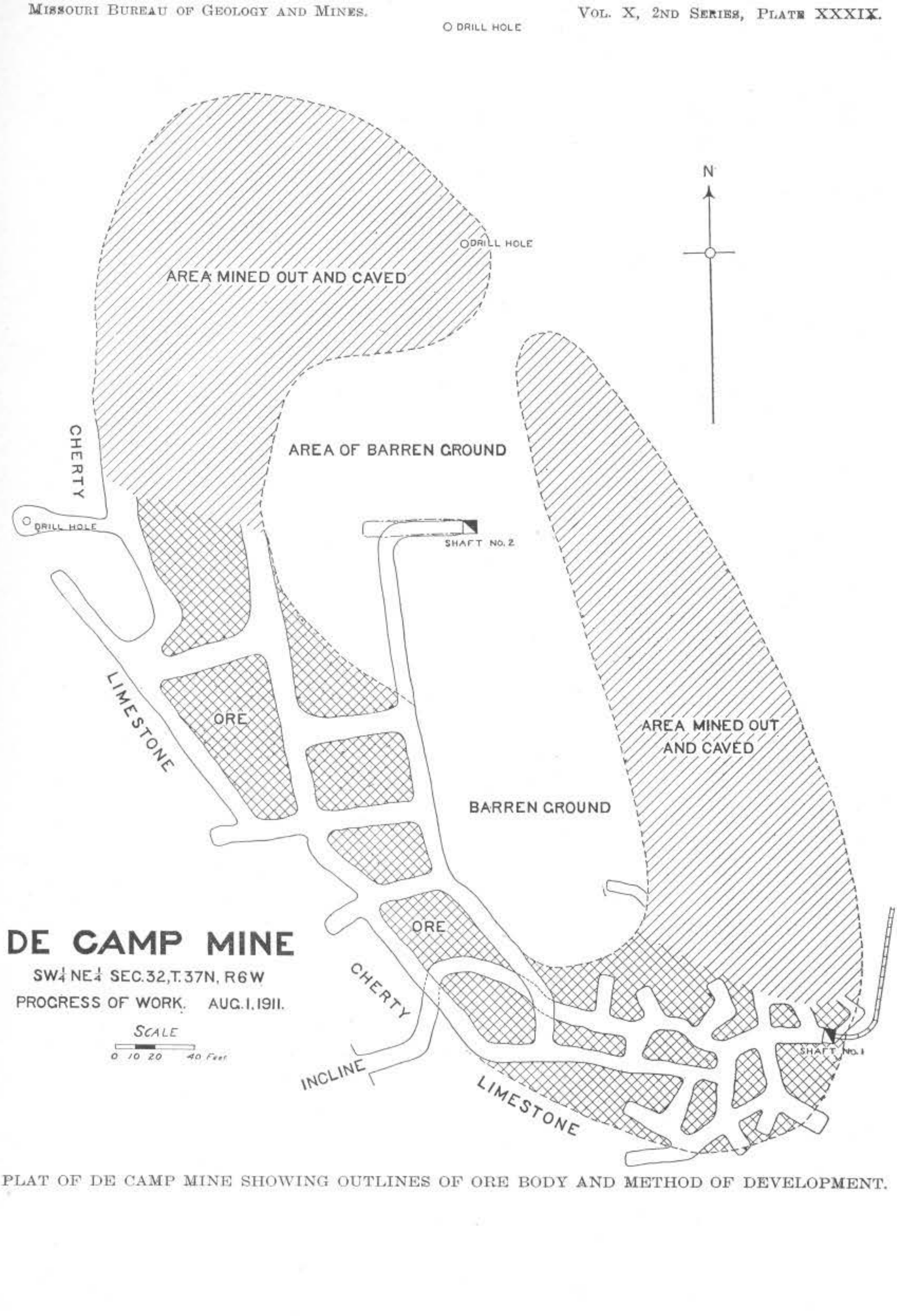
Sec. 34, T. 36 N., R. 6 W.

This mine, located 2½ miles southwest of Winkler, produced 300 tons of ore prior to 1892. The property was not visited and the present condition of the mine is not known.

6. CLARK MINE.

Sec. 23, T. 36 N., R. 6 W.

This mine is situated near the summit of a long range of hills on the western slope. Here there is one principal cut with shallow shafts and a small cut



PLAT OF DE CAMP MINE SHOWING OUTLINES OF ORE BODY AND METHOD OF DEVELOPMENT.

adjacent to it. The large cut was about thirty feet deep, sixty yards long and fifty yards wide. Some broken masses of hard blue specular ore are found lying on the surface and both blue and red ore were taken from the cut. The walls of the mine are washed and caved in but show a large amount of chert, in large and small pieces, white and red clay, blocks of sandstone and blue and red iron ore. Much yellow ocher with a small amount of limonite is also found in this mine. (L.—1892.)

7. CLINTON MINE.

Owned by D. H. Smith.

S. W. ¼, S. W. ¼, Sec. 26, T. 36 N., R. 6 W.

This mine, located a few yards west of the DeCamp Branch R'y, is situated on the crest of a divide. Developments consisted of a pit 200 feet long, 100 feet wide, and about 50 feet deep. The east and north walls consist of massive quartzitic sandstone, beneath which the ore extended for a short distance.

The ore consisted of soft red "paint ore" which, according to the report of the Tenth Census, showed an average analysis of 63.13% iron and 0.048% Phos. According to Nason this mine has yielded 22,000 tons of ore. It is apparently exhausted. (H.—1910.)

8. COOPER MINE.

Owned by Jerry Cooper, De Camp, Mo.

S. E. ¼, N. W. ¼, Sec. 17, T. 37 N., R. 6 W.

This mine, located three miles north of DeCamp, was not visited by a member of this Bureau but, according to reports submitted by the St. Louis Blast Furnace Company, it was operated in 1908, producing 78 tons of ore. The ore is red hematite, shipments of which showed an analysis of 54.84% iron, 8.05% silica, 0.101% Phos., and 11% moisture.

9. DeCAMP MINE.

Owned by Sligo Furnace Company, St. Louis, Mo.

S. W. ¼, N. E. ¼, Sec. 32, T. 37 N., R. 6 W.

This mine is located eight miles due south of St. James, and is connected by a spur with the Salem branch of the St. Louis and San Francisco R'y. It is situated near the crest of a ridge at an elevation of about 130 feet above the bed of Norman creek. The surrounding area is underlain by Roubidoux sandstone, which has, in this locality, a thickness of at least 150 feet.

Mining has been conducted entirely by the underground method in the progress of which three shafts and one incline have been sunk. The accompanying sketch, Plate XXXIX, shows the mine as completely developed and the progress of the work of drawing the pillars.

There are no surface indications of a sink at this place, a few boulders of brown ore having been found at the surface. The ore lies in a large circular body and has a thickness of from 2 to 18 feet. It is from 40 to 140 feet in width, and almost completely encloses a central, barren area. The longer diameter of the ore body is about 600 feet, its greatest width is 280 feet and its average thickness is about 10 feet. It lies at a depth of 80 to 95 feet below the surface and dips 5 to 10 degrees in a westerly direction. The eastern wall of the mine is not exposed but is reported to consist of a mixture of chert, sandstone, and clay, as does also the central barren area. The western wall consists of hard cherty limestone into which the ore occasionally extends a few feet before pinching out. Within the main ore body are several lenses of decomposed and hard chert. One of these was fully 100 feet long and from 2 to 3 feet thick. Filling joints and crevices in the ore, there is also considerable red clay which is very fine grained, free from grit, and shows well developed slickensides.

The overburden consists of a mixture of clay, chert, and sandstone similar to that in the east wall and in the enclosed barren area. It is usually iron stained and locally some of the decomposed cherts have been partly replaced by limonite. It has a roughly stratified structure and wherever exposed was observed to dip in the same direction as the ore.

Shaft No. 1 is 95 feet deep and is used for hoisting purposes. Shaft No. 2 was sunk as a prospect shaft to a depth of 150 feet. The first 135 feet shows residual materials, like those of the overburden. The lower 15 feet was sunk through a massive yellow to rusty brown sandstone. A 50-foot drift extending west from the bottom of the shaft encountered similar sandstone which was not ore bearing.

The ore consists largely of soft, red hematite with important quantities of hard blue specular hematite. Some soft black ore was noted at one point associated with seams of clay. It has resulted from the softening of the hard specular ore and is not hydrated. Locally, there are patches of soft yellow ocher which show direct alteration from the sulphide of iron. The hard blue ore is chiefly coarse grained and contains small cavities lined with specular hematite and crystalline quartz although some of it is exceedingly fine grained and dense, breaking with a conchoidal fracture. The coarser grained variety frequently exhibits many sulphide pseudomorphs. The ore occurring near the bottom and margins of the ore body often contains small quantities of carbonate of copper. Boulders of marcasite occur locally in the bottom of the mine. They generally have a coarse grained texture like that of the coarser grained, blue ores and contain small crystals of iron and copper sulphide lining cavities.

To January 1st, 1911, this mine has produced approximately 40,000 tons. The ore is a non-bessemer hematite which varies considerably in composition, due to rather wide fluctuations in the amount of silica and lime. The following are analyses of recent shipments. Nos. 1 to 7, inclusive, were made by the Sligo Furnace Company and Nos. 9 to 13, inclusive, were made by the St. Louis Blast Furnace Company. Analyses Nos. 8 and 14 are averages of Nos. 1 to 7, inclusive, and Nos. 8 to 13, inclusive, respectively:

Number.	Iron.	Silica.	Sulphur.	Phos.	Mn.	Alumina.	$CaCO_3$.	Moisture.
1	54.60	7.15	0.082			1.15	9.25	12.10
2	56.00	3.70	0.000			0.67	12.79	5.74
3	57.90	4.10	0.041			0.88	9.55	7.58
4	58.40	6.95	0.110			0.56	5.25	7.42
5	59.60	3.63	0.014			0.50	8.93	5.56
6	55.30	11.75	0.000			1.17	2.44	4.02
7	58.60	8.45	0.000			1.13	2.44	10.82
8	57.20	6.53	0.035			0.86	7.23	7.60
9	56.51	8.30		0.110				6.00
10	58.86	6.78		0.094				6.00
11	57.75	8.10		0.114	0.12			7.00
12	57.41	9.50		0.094	0.14			8.00
13	59.96	5.40		0.116				8.00
14	58.10	7.61		0.106	0.13			7.00

(C.—1910.)

10. HORSE HOLLOW BANK.

Owned by Chas. Hoffman.

N. W. ¼, Sec. 1, T. 35 N., R. 9 W.

This mine, located ten miles south of Newburg, is situated in a small ravine on the east side of Horse Hollow. It occurs at one end of a very small, elongated sink structure in the Roubidoux formation. The outcrop is small. Developments consist of a cut 30 feet long and 20 feet deep, and several shallow test pits.

The ore consists of red and specular hematites. An analysis of the former showed 55.73% iron and 0.032% Phos. No shipments have been made. (W. L.—1910.)

11. HUDGEONS MINE.

Owned by B. W. Hudgeons.

N. W. ¼, Sec. 31, T. 37 N., R. 8 W.

This mine, located 3½ miles southeast of Newburg, is situated on a point at the junction of Little Piney river and Treable creek. Developments consist of a cut 65 feet long, 20 feet wide and 12 feet deep from which a small amount of soft, red hematite and specular ore has been taken. The ore is slightly silicious. Apparently no shipments have been made. The property has not been thoroughly prospected. (W. L.—1910.)

12. HYER MINE.

Owned by John Hyer.

Sec. 26, T. 36 N., R. 7 W.

This mine, located six miles west of the Winkler switch, produced 1,200 tons of ore prior to 1892. It was not visited and its present condition is not known.

13. KELLY MINE NO. 1.

E. ½, Sec. 18, T. 36 N., R. 8 W.

This mine is situated near the summit of a hill. The bank resembles the Thornton bank, but seems to be more extensive and contains larger pieces of hard specular ore. There is next to the ore on each side, a thick layer of white clay mixed with broken chert, and outside of this a mass of yellow sand and red loam, irregularly mixed and free from chert. (S.—1872.)

According to Nason, this mine produced 3,000 tons of ore prior to 1892. No recent developments have been made.

14. KELLY MINE NO. 2.

N. E. ¼, Sec. 21, T. 37 N., R. 8 W.

Here two openings have been made, one on the summit and another on the eastern slope of a hill. The lower opening shows a double succession of layers of clay, of broken chert and of broken ferruginous sandstone dipping southeastward and below this an irregular mass of soft hematite, red and brown, containing thin veins and small pockets filled with crystalline carbonates of iron. These carbonates are also found as cement of broken chert. The large mass of loose gray rock on the north side of the cut contains single crystals of iron pyrites and also veins of carbonate of iron.

The upper opening shows a bed of boulders of limonite some six inches in diameter, imbedded in loam without any chert. (S.—1872.)

According to Nason, this mine produced 1,070 tons of ore prior to 1892.

No recent developments have been made.

15. KELLY MINE NO. 3.

S. W. ¼, Sec. 6, T. 36 N., R. 6 W.

This mine, located three miles southwest of DeCamp, is situated near the base of a ridge. The small amount of ore mined consisted of red hematite and a small amount of limonite. Thin seams of copper carbonate cut across the ore body and the mine was apparently opened with the expectation of developing a commercial body of copper ore.

16. LAMB MINE.

Owned by John Lamb.

N. W. ¼, Sec. 35, T. 36 N., R. 6 W.

This mine, located half a mile south of Clinton switch, is situated on the divide between Benton Creek and Norman Hollow. The main workings consisted of an irregular pit 140 feet long, 110 feet wide, and 40 feet deep, which was sunk on the main outcrop of ore. Several shallow shafts have been sunk in the area surrounding the pit but encountered no ore.

There is no rim-rock from which to determine the probable extent of the ore body. There is, however, an annular outcrop of ferruginous clay and chert breccia fragments surrounding the pit which may outline the extent of the sink structure at this place.

Except at the southwest corner, where massive chert is exposed, the walls of the pit are covered with detritus and no geologic relations can be observed. The south half of the east wall forms an alcove 50 feet long and 30 feet wide. The pit face here shows five feet of red and purple hematite overlain by seven feet of chert and soil. A tunnel has been driven eastward for a distance of 30 feet into this ore face.

The ore consists of red and specular hematites. An average sample of the latter showed an analysis of 63.38% iron and 0.022% Phos.

This mine has produced 4,580 tons of ore. The deposit is reported to have been but partly opened and that the main portion of the ore body still remains uncovered. (H.—1910.)

17. LENOX MINE.

Owned by St. Louis and San Francisco R'y.

Sec. 36, T. 37, R. 7 W.

This mine, located 2½ miles west of DeCamp, produced 720 tons of ore prior to 1892. The property was not visited and its present condition is not known.

18. MERAMEC MINE.

Owned by Thomas James, and Samuel Massey.

N. W. ¼, Sec. 1, T. 37 N., R. 6 W.

This mine is located near the Meramec Springs, seven miles southeast of St. James. The main workings consisted of a circular pit 225 feet in diameter and 80 feet deep, the top of which occurs near the contact of the Roubidoux and Gasconade formations. The enclosing sink structure is well outlined on the east, north, and west by steeply dipping ledges of sandstone and the ore body was enclosed by steeply dipping beds of the same material. According to the Tenth Census Report, a horse of clay occurred in the center of the deposit near the surface. Near the bottom of the pit this mound of clay was underlain by soft red hematite, which has been removed as far as safety would permit. It is reported that the bottom of the pit is still in ore at the 80 feet level, below which a shaft sunk an additional 40 feet, passed through the ore into clays and sand at a depth of about 20 feet.

The ore consisted of soft red and specular hematites, an average sample of which ran 68.06% iron, 2.06% silica, 0.040% Phos., and 0.00% Sul. Samples of the red ore alone showed 60.76% iron, 9.78% silica, 0.051% Phos., 0.126% Sul., and 0.00% Mn.

This mine was operated intermittently from 1826 to 1891, producing a total of about 375,000 tons of ore.

19. MOSELLE MINE NO. 1.

Owned by J. Williams.

S. E. 1/4, Sec. 26, T. 36 N., R. 8 W.

This mine, located 10 miles south of Rolla, is situated near the crest of a ridge. Developments consist of an open pit from which red and specular hematites have been mined. According to the Report of the Tenth Census, the red ore showed an average analysis of 55.21% iron and 0.074% Phos. The mine was worked in 1880, producing several hundred tons of ore.

20. MOSELLE AND JAMES MINE.

S. 1/2, S. E. 1/4, Sec. 29, T. 38 N., R. 6 W.

These two mines are situated close together, on a low ridge, on the plateau of St. James, between the Dry Fork and the Bourbeuse rivers.

This deposit is formed in connection with the Second sandstone and Third Magnesian limestone.

Both of these banks are nearly worked out; the best and richest ores are all taken out, and the walls and the bottoms of the deposits are laid bare. The ore formerly contained in these pockets was mostly soft, red, and in part greasy hematite, enclosing large boulders of specular ore. (S.—1872.)

21. MOSELLE MINE NO. 10.

Owned by the St. Louis and San Francisco R'y.

N. W. 1/4, N. E. 1/4, Sec. 20, T. 36 N., R. 8 W.

This mine, located ten miles southwest of Rolla, is situated in a ravine tributary to Gourd Creek. Developments consist of a pit 200 feet long, 90 feet wide, and 32 feet deep. The east wall is composed of vertical ledges of sandstone containing fragments of chert. The north, west and south walls are covered by detritus. The lateral extent of the sink structure is well outlined on the east, north, and west by numerous steeply dipping ledges of sandstone.

The ore consists of red and specular hematites with small amounts of ocher.

This mine was operated prior to 1892, producing 10,000 tons of ore. The bank was abandoned on account of the long haul by wagon and does not appear to have been exhausted. (W. L.—1910.)

22.

OZARK MINE.

Owned by Edw. Pooley.

N. W. ¼, Sec. 3, T. 35 N., R. 9 W.

This mine is located nine miles south of Newburg. Developments consist of a small open pit which shows both red and specular hematites. According to the Report of the Tenth Census, a sample of mixed ore occurring near the surface ran 45.76% iron and 0.042% Phos. The mine was opened in 1880 and subsequently produced a small amount of ore.

23.

REED MINE.

Owned by H. C. L. Scheer.

N. W. ¼, N. W. ¼, Sec. 31, T. 37 N., R. 6 W.

This mine, located two miles west of DeCamp, is situated on a high ridge capped with sandstone. Developments consist of a pit and two shafts. The former is 160 feet long, 90 feet wide, and about 30 feet deep. A portion of the walls shows interstratified chert, ore, and clay dipping towards the center of the pit. The remainder of the wall is covered with detritus.

One of the shafts, sunk in the southeast corner of the pit, penetrated cotton rock to a depth of 40 feet. Drifts extended to the north and east of this shaft penetrated a solid body of ore. The other shaft, sunk on the north rim of the pit, is reported to have penetrated ore to a depth of 40 or 50 feet.

The ore consists of red and specular hematites containing locally thin seams of copper carbonate.

24.

SANTEE AND CLARK MINE.

Owned by Samuel Massey and Thomas James.

S. W. ¼, Sec. 33, T. 38 N., R. 6 W.

This mine lies on a high bluff of Gasconade dolomite and Roubidoux sandstone, on the east side of Dry Fork river.

Red and brown ores were encountered in several openings. (S.—1872.)

25.

SEE BANK.

Owned by Michael Maxwell.

S. E. ¼, Sec. 36, T. 36 N., R. 8 W.

This bank, located 12 miles south of Rolla, is situated on the east side of a ravine tributary to Perry branch. Developments consist of a shallow pit 60 feet in diameter, situated on the south edge of a small sink in the Roubidoux formation.

The ore consists of red and specular hematites with a small amount of ocher.

A small amount of ore has been shipped. The deposit has not been exhausted but will probably prove to be comparatively small. (W. L.—1910.)

26.

SMITH MINE.

Owned by P. G. Will.

S. ½, S. W. ¼, Sec. 27, T. 36 N., R. 6 W.

This mine, located 1½ miles west of Clinton Switch, is situated on the south face of a hill, near the head of a ravine. The principal workings consist of two cuts, one driven to the northwest and the other to the west. The former is 200 feet long, 150 feet wide and 40 feet in maximum depth. The cut driven to the west is 200 feet long, 70 feet wide and 20 feet deep. A shallow cut, about 60 feet long, connects the two at their mouths. The walls of the cuts are covered with detritus or expose massive beds of chert. There is no rim-rock, although horizontal ledges of Roubidoux sandstone outcrop a few rods east of the mine.

The ore consisted of red and specular hematites, both of which showed stalactitic structures. A portion of the ore contained much secondary quartz and was left on the dumps.

This mine was abandoned in 1880, after producing about 6,000 tons. The deposit is thought to be exhausted. (H.—1910.)

27. SOUTH MOUNTAIN MINE.

Sec. 23, T. 38 N., R. 6 W.

This mine, located 3½ miles east of St. James, produced 800 tons of ore prior to 1892. This property was not visited and the present condition of the mine is not known.

28. STIMSON MINE.

Owned by R. S. Shoemate.

S. W. ¼, Sec. 10, T. 36 N., R. 6 W.

This mine, located two miles northwest of Winkler, is situated near the head of a ravine tributary to Norman Hollow. The main workings consist of a pit 250 feet long, 150 feet wide, and 20 feet deep, on the south and west sides of which three shafts have been sunk on the contact between the ore and the wall rock. Each shaft encountered ore on the pit side while the opposite walls consist of steeply dipping dolomite. The two southernmost shafts are connected at a depth of 50 feet by a drift which was driven the entire distance in ore. The third shaft, located near the northwest corner of the pit, is reported to have encountered ore throughout its entire depth of 93 feet.

One-hundred yards north of the main workings a small cut has been driven 40 feet into the hill. The face consists chiefly of chert cemented with specular ore and limonite.

The ore consists chiefly of soft red and specular hematites. It contains considerable copper carbonate which occurred in thin seams. An analysis of the soft red hematite ran 54.90% iron and 0.017% Phos.

The mine has not been operated since 1880 up to which time it produced 5,845 tons. From the reported occurrence of ore in the shafts and connecting drift, there is apparently a large proportion of the ore body that has not been mined. (H.—1910.)

29. STRAWHUN BANK.

Owned by J. Strawhun.

N. W. ¼, Sec. 2, T. 37 N., R. 9 W.

This bank, located four miles north of Newburg, is situated in a small ravine tributary to Tick creek. Developments consist of several small pits, having a maximum depth of six feet. They encountered red and specular hematites with a small amount of limonite.

This deposit is situated in the upper part of the Roubidoux formation. No sink structures are observable in the immediate vicinity and the extent of the deposit can be determined only by systematic prospecting. (W. L.—1910.)

30. TAYLOR'S ROLLA MINE.

S. W. ¼, Sec. 15, T. 37 N., R. 8 W.

This mine is situated a short distance from the Kelly bank No. 2. The bottom of the cut consists of a bed of finely broken chert. Above this is a layer, three feet thick, of soft red hematite, in part clayey, and full of seams, specks, and irregular masses of spathic iron ore, and enclosing boulders and pieces of specular ore and chert. Above this are five feet of alternate layers of red, somewhat ferruginous sandstone, and of red loam with broken chert. A cherty soil covers the slope. (S.—1872.)

This mine produced 5,000 tons of ore prior to 1892. Its present state of development is not known.

31. THORNTON-DOWLING MINE.

N. E. ¼, Sec. 33, T. 38 N., R. 6 W.

The ore here occurs with red and white clay and with white chert and yellow and red sandy clay. It is soft red, with small pieces of hard specular ore. No large boulders have as yet been found. (S.—1872.)

This mine produced 2,300 tons of ore prior to 1892. Its present state of development is not known.

32. WILLIFORD MINE.

Sec. 36, T. 37 N., R. 6 W.

This mine is on the point of a large hill with moderate slopes, covered principally by large chert fragments, but also by blocks of sandstone. The cut from which the ore was taken is sixty feet long, twenty feet wide and apparently rather shallow. No section is here obtainable. On the surface are bodies of good red ore with chert and hard sandstone and brecciated brown ore, which have been removed from the cut. A few shallow pits, dug near the cut, show hard sandstone and chert, but a very small amount of ore. It is reported that all of the ore taken from this mine still lies on the bank of the cut. The mine has long since been abandoned. (L.—1892.)

33. WINKLER MINE.

Owned by T. L. Winkler.

S. ½, Sec. 14, T. 36 N., R. 6 W.

This mine, located at Winkler P. O., is situated on the eastern edge of the plateau between West Benton creek and Norman Hollow. The main workings consist of a pit 165 feet long and 145 feet wide which is reported to have been worked to a depth of 60 feet. On the west side of the pit, the ore body was worked an additional ten feet in depth. This ore is reported to extend to the east and southeast but has not been mined.

A shaft, located 75 feet southeast of the pit, encountered ten feet of red and specular ore at a depth of 85 feet. This ore was worked northward to a point beneath the pit.

Four feet of brown and red ore, overlain by three feet of quartzite and clay, is exposed in a small drift 110 feet south of the pit. The ore dips sharply to the north of east.

For a distance of several hundred feet southeast of the main workings, shallow test pits show the presence of much limonite at, and near, the surface.

In this direction apparently lies the possibility of an extension of the ore body. There is no rim-rock to aid in determining the extent of the sink structure and the property deserves systematic prospecting. Two additional pits, situated 250 yards north of the principal workings, have produced several hundred tons of ore. The largest of these is 125 feet in diameter and both are filled with water. It is reported that the walls enclosing the ore body consist entirely of stratified clay. A shaft 70 feet deep, sunk 25 yards south of the larger excavation, penetrated only cherty dolomite.

This mine has been worked intermittently since the early 90's producing several thousand tons of ore. The ore consisted of red and specular hematites. Analysis of shipments ran 54.01% iron, 12.32% silica, 0.079% Phos., 0.12% Mn., and 5.00% moisture. (H.—1910)

SECONDARY LIMONITE.

34. ### AGRICULTURAL COLLEGE LAND.

N. E. ¼, N. E. ¼, Sec. 13, T. 37 N., R. 10 W.

This property, located one mile north of Arlington, is situated on the south side of a ravine tributary to the Gasconade river. No developments have been made.

The ore is secondary limonite and occurs in a fissure in the Gasconade dolomite. It contains much chert and will probably be found to be sulphurous with depth. (W. L.—1910)

35. ### LITTLE PINEY BANK NO. 1.

S. E. ¼, S. E. ¼, Sec. 2, T. 36 N., R. 9 W.

This bank, located 4½ miles southeast of Newburg, is situated in the south fork of a small ravine. No developments have been made. The outcrop covers an area several hundred feet in diameter and consists of boulders of limonite intermingled with residual clay and chert.

The ore is secondary limonite, chiefly of the stalactitic variety. It contains scattered fragments of chert. (W. L.—1910)

36. ### LITTLE PINEY BANK NO. 2.

N. E. ¼, N. E. ¼, Sec. 11, T. 36 N., R. 9 W.

This bank, located 4½ miles southeast of Newburg, is situated in a small ravine tributary to Little Piney river. No developments have been made.

The outcrop, which occurs at the base of the Roubidoux formation, covers an area about 400 feet in diameter, within which is exposed numerous boulders of ore and a ledge of limonite 8 feet long by three feet thick. The ore is of the secondary type and contains a relatively small amount of chert.

This bank is located in an area which has been subjected to minor faulting.
(W. L.—1910.)

37. ### OZARK BRANCH BANK.

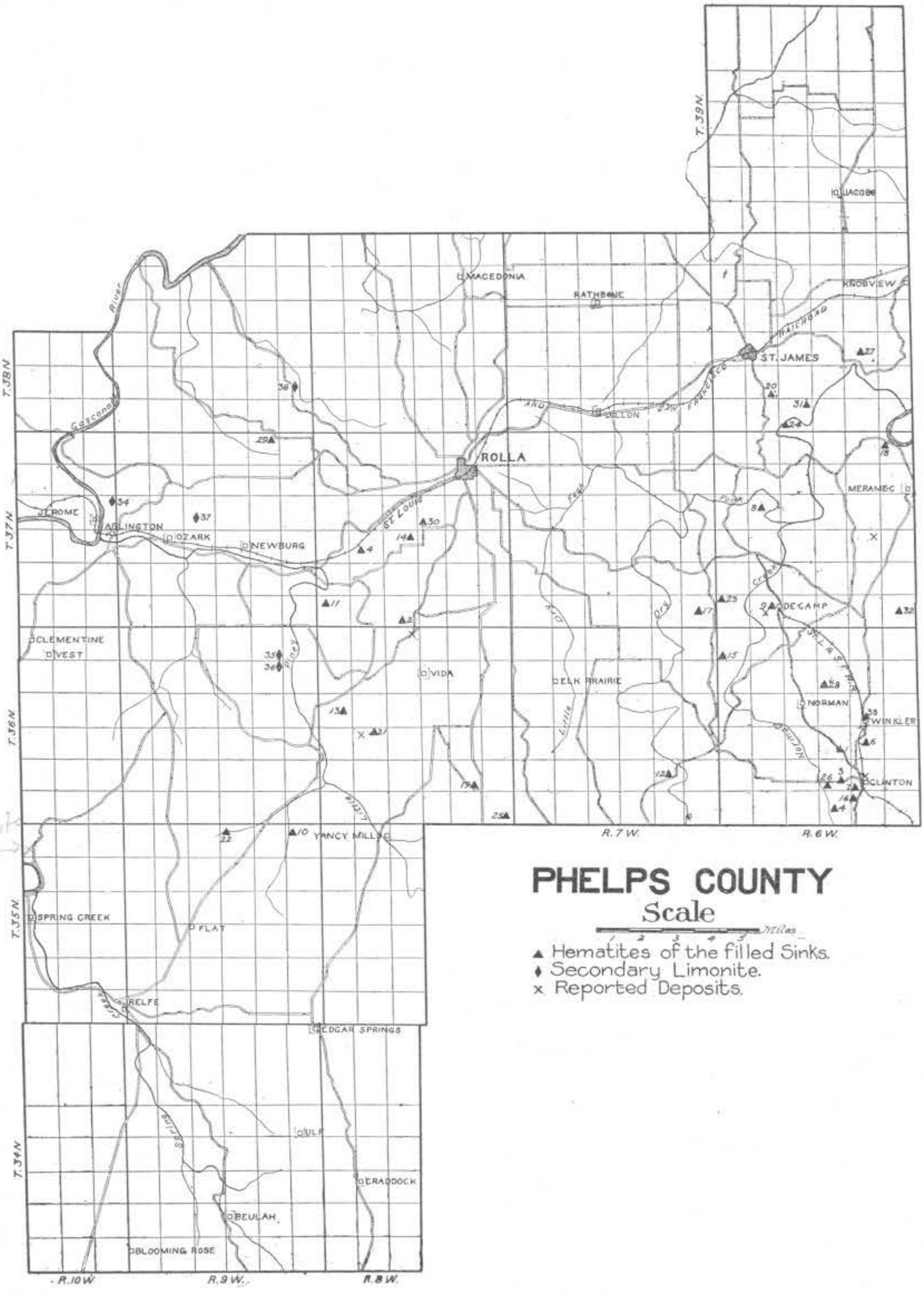
N. E. ¼, S. W. ¼, Sec. 16, T. 37 N., R. 9 W.

This bank, located two miles northwest of Newburg, is situated on the east bank of Ozark Branch. No developments have been made. Here, for some distance along the hillside, the surface is covered with small boulders and fragments of ore which is a secondary limonite, showing both stalactitic and crystalline structures after the sulphide. (W. L.—1910.)

38. STRAHAN LAND.

Center Sec. 25, T. 38 N., R. 9 W.

This bank, located eight miles northwest of Rolla, is situated on the crest of a narrow ridge. No developments have been made. The outcrop consists of boulders of secondary limonite scattered over an area of several acres. Numerous ledges of Jefferson City dolomite outcrop on the crest of this ridge indicating that the residuum at this place is very shallow. (H.—1910.)


PHELPS COUNTY
Scale
Miles
▲ Hematites of the filled Sinks.
♦ Secondary Limonite.
x Reported Deposits.
T. 39 N.
T. 38 N.
T. 37 N.
T. 36 N.
T. 35 N.
T. 34 N.
R. 10 W.
R. 9 W.
R. 8 W.
R. 7 W.
R. 6 W.
JACOBS
KNOBVIEW
MACEDONIA
RATHBONE
ST. JAMES
ROLLA
DILLON
MERAMEC
JEROME
ARLINGTON
OZARK
NEWBURG
CLEMENTINE
VEST
VIDA
ELK PRAIRIE
DECAMP
NORMAN
WINKLER
CLINTON
YANCY MILLS
SPRING CREEK
FLAT
RELFE
EDGAR SPRINGS
ULP
CRADDOCK
BEULAH
BLOOMING ROSE
Gasconade River
Little Piney
Dry Fork
Little Dry Fork
Bourbois
Railroad
St. Louis and San Francisco

PHELPS COUNTY.

HEMATITES OF THE FILLED SINKS.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	African Mine	36	6 W.	22	S. E. ¼.
2	Beaver Creek Mine	37	8 W.	33	S. ½.
3	Brady Mine	36	6 W.	27	S. E. ¼.
4	Buckland Mine	37	8 W.	20	N. E. ¼, S. W. ¼.
5	Burns Mine	36	6 W.	34	
6	Clark Mine	36	6 W.	23	
7	Clinton Mine	36	6 W.	26	S. W. ¼, S. W. ¼.
8	Cooper, Jerry, Mine	37	6 W.	17	S. E. ¼, N. W. ¼.
9	DeCamp Mine	37	6 W.	32	S. W. ¼, N. E. ¼.
10	Horse Hollow Bank	35	9 W.	1	N. W. ¼.
11	Hudgeons Mine	37	8 W.	31	N. W. ¼.
12	Hyer Mine	36	7 W.	26	
13	Kelly Mine No. 1	36	8 W.	18	E. ½.
14	Kelly Mine No. 2	37	8 W.	21	N. E. ¼.
15	Kelly Mine No. 3	36	6 W.	6	S. W. ¼.
16	Lamb, J., Bank	36	6 W.	35	N. W. ¼.
17	Lenox Mine	37	7 W.	36	
18	Meramec Mine	37	6 W.	1	N. W. ¼.
19	Moselle Mine No. 1	36	8 W.	26	S. E. ¼.
20	Moselle and James Mine	38	6 W.	29	S. ½, S. E. ¼.
21	Moselle Mine No. 10	36	8 W.	20	N. W. ¼, N. E. ¼.
22	Ozark Mine	35	9 W.	3	N. W. ¼.
23	Reed Mine	37	6 W.	31	N. W. ¼, N. W. ¼.
24	Santee & Clark Mine	38	6 W.	33	S. W. ¼.
25	See Mine	36	8 W.	36	S. E. ¼.
26	Smith Mine	36	6 W.	27	S. ½, S. W. ¼.
27	South Mountain Mine	38	6 W.	23	
28	Stimson Mine	36	6 W.	10	S. W. ¼.
29	Strawhan Bank	37	9 W.	2	N. W. ¼.
30	Taylor's Rolla Mine	37	8 W.	15	S. W. ¼.
31	Thornton-Dowling Mine	38	6 W.	33	N. E. ¼.
32	Williford Mine	37	6 W.	36	
33	Winkler Mine	36	6 W.	14	S. ½.

SECONDARY LIMONITE.

34	Agricultural College Land	37	10 W.	13	N. E. ¼, N. E. ¼.
35	Little Piney No. 1	36	9 W.	2	S. E. ¼, S. E. ¼.
36	Little Piney No. 2	36	9 W.	11	N. E. ¼, N. E. ¼.
37	Ozark Branch	37	9 W.	16	N. E. ¼, S. W. ¼.
38	Strahan Land	38	9 W.	25	Center.

REPORTED OCCURRENCES.

Chambers, J. A.	36	6 W.	26	N. E. ¼, S. W. ¼.
Grand Union Land	37	6 W.	31	
McDole Land	37	6 W.	23	N. W. ¼.
Railroad Land	36	8 W.	4	N. W. ¼.
Southgate Land	36	8 W.	20	N. W. ¼.

POLK COUNTY.

The iron deposits of this county consist exclusively of secondary limonite which occurs embedded in the residuum overlying the Burlington limestone. Only two deposits are known. One of these shipped some ore in 1910 while the other is undeveloped. In the western portion of the county are occasional outcrops of red, ferruginous sandstone which is frequently mistaken for ore but is uniformly too silicious to be utilized for blast furnace purposes.

SECONDARY LIMONITE.

1. AKARD LAND.

Owned by J. P. Akard, Fair Play, Mo.

S. W. 1/4, N. E. 1/4, Sec. 5, T. 33 N., R. 24 W.

This prospect, located about one mile southwest of Fair Play, consists of an outcrop of secondary limonite in the form of boulders and fragments thickly strewn over an area of half an acre. No developments have been made.

The ore is a compact, dark brown limonite, which contains no chert. It is, however, somewhat silicious due to the presence of sand. Immediately north and northwest of the ore outcrop occur two small exposures of Burlington limestone, indicating a thin blanket of residuum. (H.—1910.)

2. HENNEY MINE.

Owned by C. Henney, Eudora, Mo.

N. W. 1/4, N. W. 1/4, Sec. 35, T. 32 N., R. 24 W.

This mine, located two miles southwest of Eudora, consists of two shallow cuts situated on the west bank of a broad, shallow ravine. The larger opening, which is 20 feet long, 10 feet wide, and 5 feet deep, showed the following descending section:

1 foot of loam, containing fragments of ore and chert,
3 feet of good ore-bearing clay,
1 foot of decomposed chert.

The smaller pit, which is 12 feet long, 7 feet wide, and 5 feet deep, showed very much the same conditions.

The surface indications at this place consisted of several large, half buried boulders of ore on the site of the larger opening. Burlington limestone outcrops at one place near the crest of the hill and the surface is strewn with residual chert.

The ore is secondary limonite, occurring chiefly in the form of pipes, some of which still retain a core of unaltered sulphide. It is uniformly of good quality containing neither chert nor sand.

The above developments were made during 1910 at which time 99 tons of ore were mined and shipped. Analyses of the ore shipped show an average of 53.75% iron, 5.95 silica, 0.044% Phos., 0.11% Mn., and 3.00% moisture. (H.—1910.)

REPORTED OCCURRENCE.

S. E. ¼, Sec. 27, T. 32 N., R. 24 W.

PULASKI COUNTY.

HEMATITES OF THE FILLED SINKS.

1. SPECULAR BANK.

Sec. 31, T. 37 N., R. 12 W.

This bank, located about three miles southeast of Swedeborg, is situated in the breaks bordering the Gasconade river on the west. According to B. F. Shumard, who visited the property during the 60's, the outcrop covers several acres and consists of large and small boulders of specular ore. No developments have been made, although it would appear from Shumard's description, that the deposit is quite extensive.

REPORTED OCCURRENCE.

N. E. ¼, Sec. 30, T. 36 N., R. 11 W.

REYNOLDS COUNTY.

With the exception of one red hematite deposit near Bunker, the known iron deposits of this county are secondary limonite, the distribution and location of which are shown on the accompanying county map. The red hematite deposit is of the filled sink type. The limonite deposits, which consist chiefly of boulder ore with only minor quantities of pipe ore, occur in the residual, cherty clay overlying the Roubidoux and Gasconade formations. Except in the areas adjacent to the main streams and those underlain by the pre-Cambrian rocks the residuum is fairly thick, outcrops of the sedimentary rocks being few.

Up to January 1, 1911, no shipments have been made from this county and but little development work has been done.

HEMATITES OF THE FILLED SINKS.

1. RED ORE BANK.

N. E. ¼, Sec. 20, T. 32 N., R. 2 W.

This bank, located 1½ miles east of Bunker, is situated at the conjunction of two small streams. There is no surface exposure at this place and the discovery of iron ore was probably due to the presence of a very red clay which occurs over an area of about half an acre. Within this area five test pits have been sunk, four of which occur in a cluster while the fifth is located 100 feet to the south. The dumps of the first four pits, the deepest of which was about 15 feet, show the presence of greasy, red clay and a small amount of red hematite. The ore is of good quality and is secondary after marcasite. The fifth pit is shallow and encountered only fragmental chert and yellow clay. (B.—1910.)

SECONDARY LIMONITE.

2. BROOKS LAND.

Owned by W. M. Brooks, Centerville, Mo.

Lot 2, Sec. 6, T. 31 N., R. 1 E.

This prospect, located about five miles east of Reynolds, consists of two outcrops of brown ore, one of which is situated on the north point and the other along the western slope of a ridge. The former covers an area of about one acre, within which the surface is strewn with boulders of pipe ore. The latter covers an area 70 yards in diameter. A small test pit sunk on this outcrop shows massive boulders of limonite extending to a depth of three feet. Massive blocks of sandstone occur between the two outcrops. The ore at both places is a secondary limonite, free from chert and sand. (B.—1910.)

3. COLLINS LAND NO. 1.

Owned by E. Collins.

S. W. ¼, S. W. ¼, Sec. 4, T. 32 N., R. 2 E.

This prospect, located nine miles west of Sabula, consists of an outcrop of brown ore over an area 70 yards in diameter, situated on the east point of a ridge.

The ore is a secondary limonite, of which both the massive and pipe forms are represented. No chert or sand was observed associated with either form of the ore. (B.—1910.)

4. COLLINS LAND NO. 2.

Owned by E. Collins.

N. E. ¼, N. E. ¼, Sec. 8, T. 32 N., R. 2 E.

This prospect, located nine miles west of Sabula,—the nearest shipping point,—consists of an outcrop of brown ore, covering an area about 300 feet in diameter, on the crest and south slope of a ridge. Blocks of chert occur intermingled with the boulders of ore.

The ore is secondary limonite and is rather remarkable for the well preserved pseudomorphs after sulphides. That occurring lowest on the slope is more silicious than that on the ridge, and, with this exception, the ore is of excellent quality. (B.—1910.)

5. EVANS-JOHNSON LAND.

Owned by A. J. Evans and T. A. Johnson, Ellington, Mo.

N. W. ¼, S. E. ¼, Sec. 8, T. 29 N., R. 1 E.

This prospect, located 1½ miles north of Chitwood and 150 yards from the Missouri Southern R'y., consists of two outcrops of brown ore, situated 150 yards apart near the west base of a hill. The larger of these is 100 yards long and 60 yards wide, the smaller 70 yards long and 50 yards wide. No development work has been done on either outcrop.

The ore is secondary limonite and occurs as boulders and slabs, the latter showing sulphide pseudomorphs. The boulder ore often contains a central mass of ocherous limonite and occasionally fragments of chert. (B.—1910.)

6. EVANS LAND.

Owned by A. J. Evans, Ellington, Mo.

S. E. ¼, S. W. ¼, Sec. 8, T. 29 N., R. 1 E.

This prospect, located one mile north of Chitwood, and 400 yards west of the Missouri Southern R'y., consists of an outcrop of brown ore covering an area about 30 yards in diameter, near the top of a southern slope. Below the outcrop, the hillside is strewn with fragments of chert and sandstone.

The ore is secondary limonite and includes both the massive and pipe varieties. Much of it consists of brecciated chert cemented by limonite and is too silicious to be of commercial value. (B.—1910.)

7. KIPP LAND.

S. E. ¼, N. E. ¼, Sec. 5, T. 32 N., R. 2 E.

This prospect, located nine miles west of Sabula, consists of an outcrop of brown ore, covering an area 100 yards long by 50 yards wide on the south slope of a secondary ridge. Within the area of outcrop, the surface is thickly strewn with boulders of pipe ore, which also extend for a distance of 200 yards along the adjacent stream bed. No developments have been made. (B.—1910.)

8. LACLEDE LUMBER COMPANY LAND.

Owned by Laclede Lumber Co., Laclede, Mo.

Sec. 19, T. 30 N., R. 2 E.

This prospect, located six miles northeast of Ellington, consists of an outcrop of brown ore in the form of boulders scattered over an area 120 yards long and from 70 to 100 yards wide, on the crest of a ridge. Intermingled with the ore are scattered boulders of sandstone and chert.

The ore is secondary limonite and is slightly silicious, due to inclusions of thin seams and lenses of sand and occasionally fragments of partially decomposed chert. (B.—1910.)

9. MISSOURI LUMBER AND MINING COMPANY LAND NO. 1.

Owned by Missouri Lumber and Mining Co., Grandin, Mo.

S. ½, Sec. 12, T. 29 N., R. 1 E.

This property, located five miles southeast of Ellington, bears an outcrop of brown ore covering an area 40 yards wide and 50 yards long, on the crest of a ridge. The ore consists of pipe and boulder limonite, the latter containing occasional angular fragments of chert.

On the crest of a high east-west ridge, in the N. ½ of Sec. 12, is an outcrop of ore 20 yards wide and 40 yards long. The ore at this place is entirely of the pipe variety and contains no chert or sand. Small scattered outcrops of similar ore occur along this ridge for a distance of nearly half a mile. (B.—1910.)

10. MISSOURI LUMBER AND MINING COMPANY LAND NO. 2

Owned by Missouri Lumber and Mining Co., Grandin, Mo.

S. ½, Sec. 34, T. 30 N., R. 1 E.

This property, located two miles east of Ellington, is characterized by three outcrops of brown ore which are distributed for a quarter of a mile along a southeast trending ridge. Each outcrop is approximately 50 yards square but in none is the surface ore very abundant.

The ore is a secondary limonite, occurring in both boulder and tabular form and is practically free from sand and chert. (B.—1910.)

11. SUTTON LAND.

Owned by J. L. Sutton, Ellington, Mo.

S. W. ¼, Sec. 34, T. 30 N., R. 1 W.

This prospect, located two miles southwest of Bedwell, consists of an outcrop of brown ore in the form of boulders and fragments scattered over an area 50 yards long and 30 yards wide, on the southwest slope of a ridge.

The ore is a secondary limonite containing little or no chert or sand. It occurs embedded in residual clays overlying partly exposed beds of Gasconade dolomite. (B.—1910.)

REYNOLDS COUNTY.

HEMATITES OF THE FILLED SINKS.

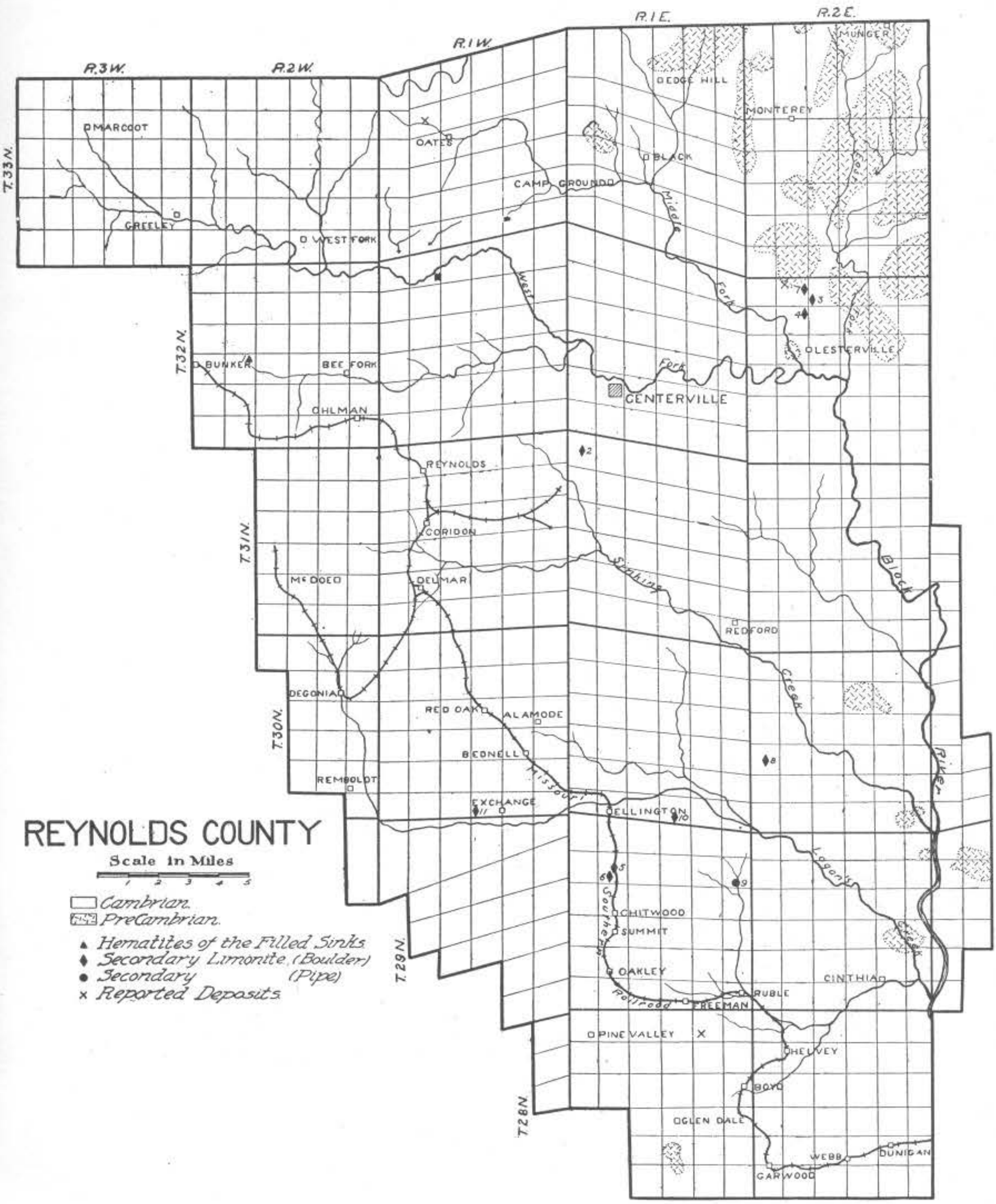
No.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
1	Red Ore Bank	32	2 W.	20	N. E. ¼.

SECONDARY LIMONITE.

2	Brooks, W. M., Land	31	1 E.	6	Lot 2.
3	Collins, E., Land No. 1	32	2 E.	4	S. W. ¼, S. W. ¼.
4	Collins, E., Land No. 2	32	2 E.	8	N. E. ¼, N. E. ¼.
5	Evans-Johnson Land	29	1 E.	8	N. W. ¼, S. E. ¼.
6	Evans, A. J., Land	29	1 E.	8	S. E. ¼, S. W. ¼.
7	Kipp Land	32	2 E.	5	S. E. ¼, N. E. ¼.
8	Laclede Lumber Co. Land	30	2 E.	19	
9	Mo. Lum. & Min. Co. Land No. 1	29	1 E.	12	S. ½.
10	Mo. Lum. & Min. Co. Land No. 2	30	1 E.	34	S. ½.
11	Sutton, J. L., Land	30	1 W.	34	S. W. ¼.

REPORTED OCCURRENCES.

	Lone Star	28	1 E.	2	S. W. ¼.
	Owner unknown	32	2 E.	5	N. W. ¼.
	" "	33	1 W.	8	


R.3W.
R.2W.
R.1W.
R.1E.
R.2E.
T.33N.
T.32N.
T.31N.
T.30N.
T.29N.
T.28N.
MARCOOT
GREELEY
WEST FORK
OATES
CAMP GROUND
BLACK
DEDGE HILL
MONTEREY
MUNGER
LESTERVILLE
BUNKER
BEE FORK
OHLMAN
CENTERVILLE
REYNOLDS
CORIDON
McDOED
DELMAR
REDFORD
DEGONIA
RED OAK
ALAMODE
BEDNELL
REMBOLDT
EXCHANGE
ELLINGTON
CHITWOOD
SUMMIT
OAKLEY
RUBLE
FREEMAN
CINTHIA
PINE VALLEY
HELVEY
BOYD
OGLEN DALE
WEBB
DUNIGAN
GARWOOD
West Fork
Middle Fork
Sinking Creek
Black River
Logan's Creek
Missouri
Southern Railroad
REYNOLDS COUNTY
Scale in Miles
Cambrian.
PreCambrian.
Hematites of the Filled Sinks.
Secondary Limonite (Boulder)
Secondary (Pipe)
Reported Deposits.

RIPLEY COUNTY.

Ripley county ranks seventeenth in the production of iron ore, having shipped a total of 2,769 tons. The iron deposits of the county consist of secondary and primary limonite, the relative abundance, distribution, and locations of which are shown on the accompanying county map.

Both types of deposit occur in the Cambrian residuum which apparently is very thick in this county, outcrops of the underlying Roubidoux and Gasconade formations being confined chiefly to the main stream courses.

The above shipments were made by the Missouri Lumber and Mining Company during the years 1903 to 1905 from mines in the northwestern portion of the county. Aside from these developments very little attention has been given to the iron deposits in this county, due chiefly to a lack of adequate transportation facilities.

SECONDARY LIMONITE.

1. DALTON (LEVI C.) LAND.

S. E. ¼, Sec. 9 T. 22 N., R. 1 E.

Iron ore occurs here near the foot of a hill of moderate slope. Only a few small pieces are to be seen on the surface, but recently Judge Dalton has sunk a shaft six feet deep and in so doing, has taken out many fragments of ore. This ore is in the form of masses an inch or so thick, somewhat botryoidal, and frequently several such masses are cemented together. It is non-siliceous, or nearly so, and occurs both as limonite and as dark red fibrous turgite. These masses are disseminated through reddish yellow clay. This locality is ten miles from the Doniphan Branch of the I. M. Ry. (L.—1892.)

2. GOVERNMENT LAND NO. 2.

Sec. 16, T. 22 N., R. 1 E.

Limonite is found in fragments on the flat extension of a high hill which occurs at this place. The ore exists as pipe, or stalactitic, massive and pseudomorphous after pyrites. Each variety is non-siliceous. Only scattered fragments of ore mingled with much chert are seen on the surface around the ore area, with limestone exposed a few feet lower on the hill. (L.—1892.)

3. GOVERNMENT LAND NO. 3.

W. ½, S. E. ¼, Sec. 7, T. 22 N., R. 2 E.

Limonite is found here covering an area about one hundred and ten yards long and from fifteen to forty yards wide. It occurs on a long, narrow, low spur. The lower half of this area is composed almost entirely of this ore, the upper half contains some fragments of chert. Higher on the hill chert and no ore is found. The ore occurs in the form of irregularly shaped masses and fragments of stalactitic and massive types. It is of a very good quality and only a few masses contain small fragments of chert. On another spur of this hill, and about one hundred and fifty yards northwest of the last deposit, there is an area fifteen yards square which is probably an extension of the last, as the ore is similar and occurs similarly. This deposit is on the land of Mr. Joseph Jaco. Again two hundred yards west, near the base of yet another spur from this same hill, also on Mr. Jaco's land, several large boulders and blocks of semi-massive and stalactitic limonite are found, covering perhaps twenty yards square. There is little doubt but that this last deposit belongs to or is connected with the two deposits just described. Across the branch from these, small fragments of good brown ore mixed with much chert are found. The slopes of the hill in each of these cases are very gradual. (L.—1892.)

4. GOVERNMENT LAND NO. 4.

Sec. 1, T. 23 N., R. 1 W.

Limonite occurs in the form of fragments scattered over several square yards near the summit of a hill. The surface fragments are mingled with chert. A shallow hole has been dug and many large and small pieces of ore, stalactitic in form, and of good quality were taken out. Limestone is exposed at a divide a short distance westward from the ore deposit. This locality is about eighteen miles from Doniphan. (L.—1892.)

5. MARTIN LAND NO. 2.

Owned by C. H. Martin, Doniphan, Mo.

S. ½, S. W. ¼, N. W. ¼, Sec. 12, T. 22 N., R. 2 E.

This deposit is located about five miles south of Doniphan and about one mile northeast of the Current river. It is situated upon the crest and the north slope of a high, chert covered ridge where brown ore outcrops over an area of about one acre. The ore is secondary limonite chiefly of the pipe variety. Some years ago a shaft 50 to 75 feet deep was sunk upon the outcrop as a prospect for lead and zinc. The shaft is timbered to within eight feet of the surface. The untimbered portion shows a red, cherty clay carrying considerable ore. The surface outcrop indicates considerable ore bearing dirt in the immediate vicinity of the shaft. The surrounding hills are thickly covered with residual chert.

(C.—1910.)

6. McGONIGAL LAND.

Owned by E. McGonigal.

S. E. ¼, Sec. 3, T. 23 N., R. 2 E.

This deposit is located four miles north of Doniphan. It is marked by a strong outcrop of brown ore embracing an area of about 50 by 200 feet, on a gentle northeast hillside. Above the outcrop is a cultivated field in which occasionally boulders of float ore have been turned up in plowing. Below the outcrop the surface of the hillside is thickly covered with residual chert. The ore is secondary limonite and is remarkably free from chert and sand. It occurs in large massive boulders with occasional stalactitic and botryoidal forms. No developments have been made. (C.—1910.)

7. MISSOURI LUMBER AND MINING COMPANY LAND NO. 1.

S. E. ¼, S. W. ¼, Sec. 1, T. 24 N., R. 1 E.

This mine is located nine miles southwest of Grandin, the nearest shipping point, and half a mile east of the Current river. It is situated near the base of the north slope of a very high, chert covered hill. Developments consist of a single cut about 100 feet long and 50 feet wide, from which about 700 tons of ore were shipped during 1903. The cut was originally about 25 feet deep but its sides are now badly caved and except in the first five to eight feet below the surface, very little ore can be seen in place. A shaft, now filled, sunk in the head of the cut is said to have shown ore to a depth of 40 feet from the surface, and a 30 foot heading extending into the hill developed considerable ore of a soft, ocherous variety.

The ore is a secondary limonite and is exceptionally free from chert and sand, but, being somewhat porous, is apt to contain considerable infiltered clay. An average sample of the boulder ore showed 49.58% iron, 9.20% silica, 0.163% Phos., 0.112% Sul., and 10.70% combined water. A sample of the ocherous ore from the heading showed 41.17% iron, 23.31% silica, 0.272% Phos., 0.177% Sul., and 9.55% combined water. Early shipments, which were made over a logging branch now removed, are reported to have averaged about 50% iron. (C.—1910)

8. PONDER LAND.

Owned by Asel Ponder, Doniphan, Mo.

S. E. ¼, S. W. ¼, Sec. 26, T. 23 N., R. 2 E.

Brown ore outcrops on this land on both sides of the county road about 200 yards south of the Doniphan depot. The exposure is restricted to a small area and no developments have been made. The ore consists of fragments of pipe limonite embedded in clay. (C.—1910)

9. PONDER (D. K.) LAND.

S. W. ¼, S. E. ¼, Sec. 26, T. 23 N., R. 2 E.

Limonite is found here covering an area of from twenty to thirty square yards. The ore is stalactitic in form, and the deposit forms a slight rise on the slope. The ore is non-siliceous and is in the form of large and small masses. This locality is only a few hundred yards from the Doniphan Branch Ry. (L.—1892.)

10. RANKIN (THOS. JR.) LAND.

S. ½, Sec. 35, T. 23 N., R. 1 W.

Here limonite occurs in the form of fragments and blocks over the surface of an area about forty yards long and twenty yards wide, on a rather steep slope. Within this area nothing but iron ore is found. It is a siliceous ore, silica occurring as grains of sand. Surrounding the ore area fragments of chert may be found, and in the ravine at the foot of the hill limestone is found in place. This deposit is about nineteen miles from Doniphan. (L.—1892.)

11. STOOPS (P.) LAND.

N. ½, N. W. ¼, Sec. 23, T. 22 N., R. 1 E.

Here scattered fragments of good massive limonite are found with much chert on a hill. At two or three places these fragments are quite numerous. (L.—1892.)

12. WILLLIAMS (J. T.) LAND.

S. ½, S. W. ¼, Sec. 10, T. 22 N., R. 1 E.

Limonite occurs here on a gradual slope in the form of boulders of massive and pipe-ore. A little digging has been done here exposing one boulder about three feet in diameter and a few small pieces. The pipe-ore is of a good quality, but the massive portion is slightly cherty. Only a few blocks and fragments of iron can be seen. These are mingled with much chert and small blocks of limestone. This locality is, perhaps, nine miles distant from Doniphan. (L.—1892.)

PRIMARY LIMONITE.

13. AGRICULTURAL COLLEGE LAND NO. 2.

N. ½, Sec. 19, T. 22 N., R. 3 E.

Limonite here covers a small area near the higher position of a flat-topped hill. It occurs in the form of fragments and also cementing small pieces of white chert; it contains fine grains of silica. This deposit is about six miles from Doniphan. (L.—1892.)

14. BOOKER (J. S.) LAND.

N. W. ¼, S. E. ¼, Sec. 12, T. 22 N., R. 2 E.

Massive siliceous limonite occurs here at the summit of the hill, over an area which is about forty yards long and thirty yards wide. This ore contains much silica in the form of grains of sand. No rock other than chert boulders and spalls are to be seen near the deposit. This property is about four miles from the Doniphan Branch Ry. Mr. Booker owns a similar deposit in the N. ½, S. W. ¼, Sec. 22, T. 12 N., R. 2 E., situated on an adjoining hill. (L.—1892.)

15. CURRENT RIVER LAND.

N. ½, N. W. ¼, Sec. 24, T. 22 N., R. 2 E.

Limonite covers here an area about sixty yards long and thirty yards wide. The ore is in the form of huge boulders and probably occurs in ledges. It is fair in quality. Some of the ore cements small chert chips. Small fragments of loose chert are found within the area and on adjacent portions of the hill, but no bedded rock. This deposit is about five miles from the Doniphan Branch Ry. (L.—1892.)

16. EATON (Z. A.) LAND.

Sec. 25, T. 23 N., R. 3 E.

Limonite occurs here in boulders scattered over an area about fifty yards square, on the top of a hill. These boulders are either somewhat spongy, or porous, or are hard and of a light brown color. Most of the boulders are but slightly silicious, others contain small fragments of chert. With the ore there is much soil and but little chert and no bedded rock. This deposit is only about one mile from the Doniphan Branch of the I. M. Ry. (L.—1892.)

17. GRAY (MRS. LYDIA) LAND.

Lot 2 S. W. ¼ & Lot 2 N. W. ¼, Sec. 31, T. 23 N., R. 3 E.

Limonite is found here over an area about twenty yards square. The ore is in rough masses and is found capping the spur of a hill. It is very siliceous, silica occurring as grains of sand. Chert chips and boulders are found on other portions of this hill. About one-third of a mile east of this deposit, on the property of Mr. H. R. Walland, is another deposit of similar ore. Scattered masses appear over about as large an area as the last. The associated rock and the mode of occurrence of the ore are also similar. (L.—1892.)

18. HERR (C. B.) LAND.

N. E. ¼, Sec. 24, T. 22 N., R. 2 E.

Limonite is found here in scattered boulders over a number of acres. A few boulders and small fragments of chert are found within this area but no bedded rock is exposed. This locality is five miles distant from the Doniphan Branch Ry. The summits of the hills in this neighborhood are broad and in many localities numerous pebbles are found mingled with large chert fragments. (L.—1892.)

19. HOLLAND TRACT.

N. ½, Sec. 19, T. 25 N., R. 3 E.

Limonite covers here the greater portion of four or five acres, besides occurring as isolated boulders on different portions of the hill. The ore is in the form of rough masses extending along a steep slope from the top of a hill to the waters of the North Fork of Little Black river. Portions of the surface ore are quite siliceous, containing grains of sand and particles of chert, besides being porous. Some chert masses lie on the surface adjacent to the ore deposit. This deposit is about four miles from Grandin, on the C. R. Ry. (L.—1892.)

20. KING (E. M.) LAND.

S. W. ¼, Sec. 24, T. 22 N., R. 2 E.

Limonite occurs in several localities covering small areas, on this hill. It is found in irregular masses and small fragments. It is somewhat siliceous, containing a low percentage of silica, both as grains of sand and as chert chips. Pebbles of sandstone and chert with some chert fragments are found on the hill. This locality is nearly six miles from the Doniphan Branch Ry. (L.—1892.)

21. MABREY (T. W.) LAND NO. 1.

W. ½, N. E. ¼, Sec. 23, T. 23 N., R. 3 E.

Limonite shows here on the surface over an area of about eighty yards long and ten yards wide. The ore occurs, in the form of a reef-like deposit, in three localities, on the lower portion of a gradual slope, and in the form of boulders and fragments scattered over the whole area. It is only slightly siliceous, containing scattered particles of chert and grains of sand. Pebbles of sandstone and chert, chips of chert and blocks of sandstone are found on the same slope but no bedded rock is to be seen. This locality is about two miles distant from the Doniphan Branch Ry. (L.—1892.)

22. MABREY (T. W.) LAND NO. 2.

S. ½, S. W. ¼, Sec. 13, T. 23 N., R. 2 E.

Limonite is here found covering portions of an area about thirty yards long and sixty yards wide. The ore occurs in the form of small boulders and fragments on the slope of a hill, and is associated with loose angular chert and large and small pebbles and small boulders of sandstone and chert. This locality is about one mile from the Doniphan Branch Ry. (L.—1892.)

23. MARTIN LAND NO. 1.

Owned by C. H. Martin, Doniphan, Mo.

S. E. ¼, Sec. 33, T. 24 N., R. 2 E.

This deposit, located about five miles north of Doniphan, is situated upon the crest of a high, chert covered hill. It is marked by an almost continuous exposure of primary limonite over an area of 2,000 square yards. The outcrop consists of large boulders of porous, cherty limonite embedded in clay which contains smaller fragments of ore and chert. The ore is quite silicious, due to the presence of both chert and sand. The neighboring hills are thickly covered with residual chert. (C.—1910.)

24. MARTIN LAND NO. 3.

Owned by C. H. Martin, Doniphan, Mo.

S. E. ¼, S. E. ¼, Sec. 13, T. 22 N., R. 2 E.

This deposit is located about four miles south of Doniphan, the nearest shipping point on the Doniphan division of the St. Louis, Iron Mountain and Southern R'y. It is situated upon the crest of a ridge where large boulders and small fragments of limonite outcrop over an area of about one acre. A shaft 50 to 75 feet deep which was sunk as a prospect for lead and zinc developed a few feet of limonite near the surface. The ore is of the primary type and has an open, porous texture. It is embedded in cherty clay and is quite silicious, due to the presence of both sand and partly replaced chert. (C.—1910.)

25. MISSOURI LUMBER AND MINING COMPANY MINE NO. 2.

S. E. ¼, S. W. ¼, Sec. 32, T. 25 N., R. 2 E.

This mine is located five miles southwest of Grandin and is situated near the head of a small ravine which drains westward into Colvin creek. The outcrop is composed of large and small boulders of cherty brown ore covering several acres. Developments consist of an open cut and a number of pits, the distribution of which is shown on the accompanying topographic sketch, (Fig. 25.) The cut, which is nearly circular in outline, is 150 feet long, 100 feet wide, and 25 feet deep. A large part of the face shows ore; at one place about 20 feet of nearly solid limonite being exposed.

The ore is a primary limonite of which there are three distinct types exposed. Underneath an overburden of from two to four feet of residual cherty clay there occurs a hard, dense, silicious ore in uneven undulating seams or layers enclosing nodules and boulders of chert and seams of clay. In color this ore is a light chestnut brown to a deep chocolate, but it is also characterized by a distinctly laminated structure with cross joints coated with lustrous blue and black goethite.

Directly beneath the bed of hard, silicious ore is a layer of clay and sand about one foot thick. Beneath the clay and sand there is a three foot ledge of very porous, cellular ore which grades downward and in some places laterally into a dark, ashy gray to soft, bluish, clayey ore. In some parts of the mine the soft ore occurs directly beneath the hard, silicious ore. The soft ore is best developed near the south end of the cut where it is exposed in the bottom and forms a large part of the face.

At the north end of the cut is a 10 foot pit which is reported to show the soft ore throughout its depth. A 50 foot pit, sunk on the bank above the south end of the cut, is reported to have shown 40 feet of soft ore underlain by yellow ocher.

Representative samples of the various types of the ore in this mine, when analyzed, ran as follows:

	Iron.	Silica.	Phos.	Sulphur.	Combined water.
(1) Hard, dense, laminated ore.......	44.26%	20.65%	0.038%	0.107%	9.70%
(2) Hard, porpus, cellular ore........	45.44	21.46	0.038	0.145	10.06
(3) Soft, brown and blue earthy ore..	52.86	9.88	trace	0.048	8.21

(3) also gave 2.68% Manganese.

Filling the ravine below the mine is a large pile of waste dirt consisting of small fragments of soft ore mixed with soft, ocherous materials and clay, but containing very little chert. This dirt is reported to wash 80% ore.

The several pits on the hillsides to the north of the main cut all developed ore of the hard silicious and porous, cellular varieties. The depth of the ore is not shown.

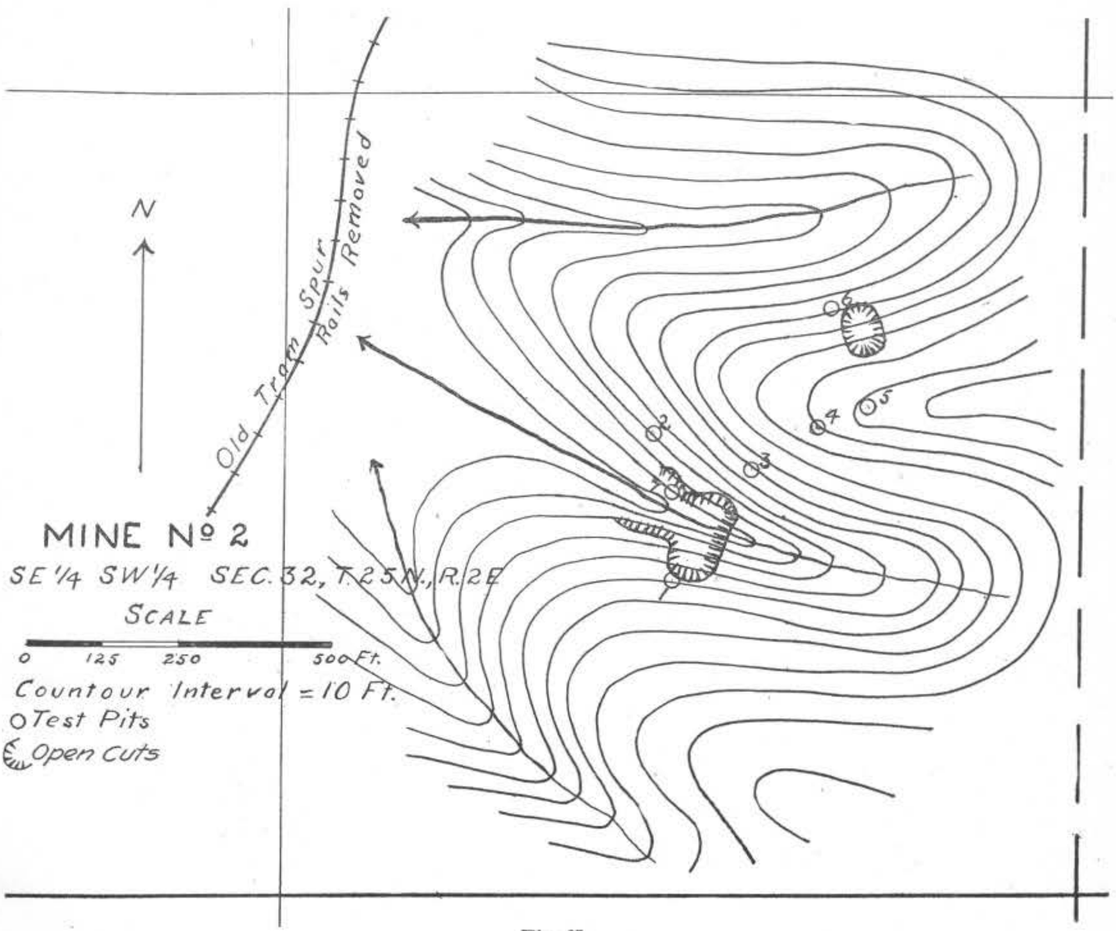


Fig. 25.

The mine was opened in 1903 and was worked during 1904 and 1905. It has produced about 2,000 tons of ore averaging 48% iron. A logging road crossing the property made it possible to load the ore directly into cars at the mine. This road has since been removed and Grandin is now the nearest shipping point.

(C.—1910.)

26. MISSOURI LUMBER AND MINING COMPANY MINE NO. 3.

S. E. ¼, N. E. ¼, Sec. 31, T. 25 N., R. 2 E.

This mine, located half a mile northwest of Mine No. 2, is situated near the head of a small ravine. Developments consist of a single cut about 40 feet long by 20 feet wide from which about 30 tons of ore have been taken. The ore is cherty, primary limonite, very largely of the porous, cellular type. An average sample taken from the ore in stock, showed 46.40% iron, 14.90% silica, 0.087% Phos. and 10.41% Sul. No shipments have been made. (C.—1910.)

27. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 4.

S. W. ¼, N. E. ¼, Sec. 31, T. 25 N., R. 2 E.

This deposit is located about one mile northwest of Mine No. 2, and, as shown by the accompanying topographic sketch, (Fig. 26,) is situated upon the crest of a high hill. The outcrop consists of boulders and fragments of cherty, brown ore covering two circular areas of about an acre each. Pits 1 to 4, 9, and 12 to 15 inclusive, which are outside or upon the edge of the outcrop and range from 6 to 30 feet in depth, show very little or no ore of value. Pits Nos. 5 to 8 inclusive on the southern outcrop, and Nos. 10 and 11 on the northern outcrop, each produced some ore of merchantable grade in the first 5 to 8 feet below the surface. The best showing is that of pit No. 8. This is a shallow opening about 12 feet in diameter from which a half dozen or more large boulders of ore have been blown by shooting. The depth of the ore at this point is not known.

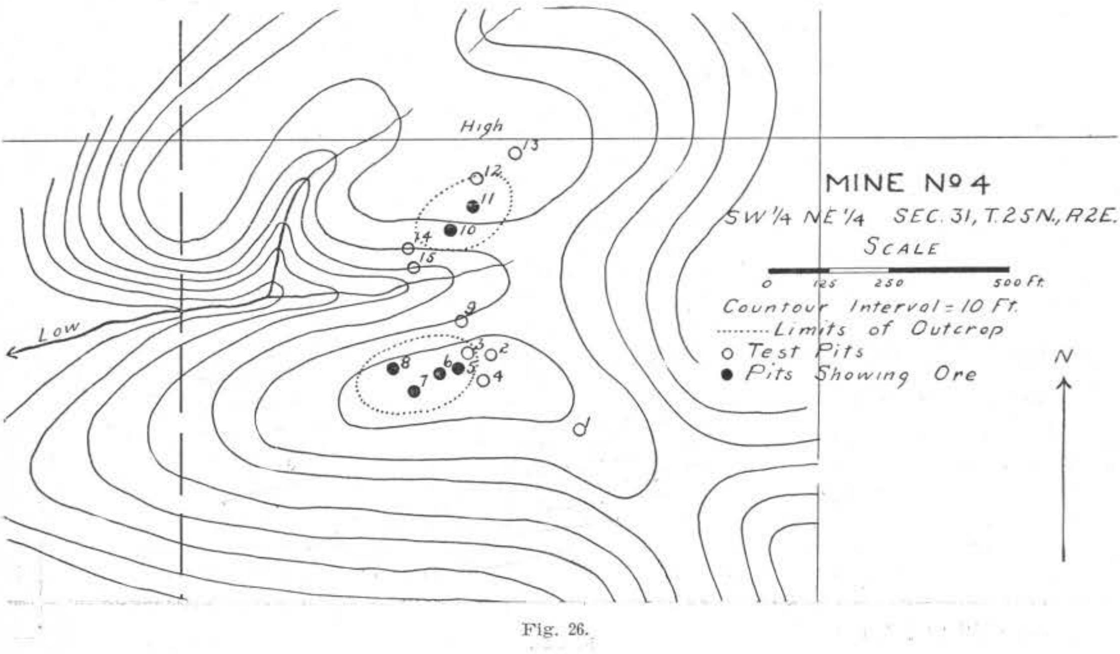


Fig. 26.

The ore is a porous, primary limonite and is, for the most part, highly silicious due to the presence of included fragments of chert and grains of sand. A mine sample showed 43.49% iron, 26.24% silica, 0.041% Phos., and 0.041% Sul.

(C.—1910.)

28. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 9.

N. E. ¼, S. W. ¼, Sec. 21, T. 25 N., R. 4 E.

The deposit lies 12 miles southeast of Grandin and is situated upon a gentle north slope on the west bank of Hurricane creek. The outcrop consists of occasional boulders of silicious, primary limonite over an area of about two acres. It has been prospected by nine test pits with results as follows: Pits Nos. 3, 4, 7, 8, and 9 which are upon the edge of the area of outcrop, range from 5 to 15 feet in depth and show no ore. Pits Nos. 5 and 6, 23 and 25 feet deep respectively, also near the edge of the area of outcrop, show a little silicious ore near the surface, but none of merchantable grade. Pits Nos. 1 and 2, 27 and 30 feet deep, are both within the area of outcrop and each shows a low grade ore to a depth of about 16 feet. The ore is very silicious, due to the presence of sand and fragments of chert. An average sample of the ore from pits Nos. 1 and 2, when analyzed, showed 36.16% iron, 33.58% silica, 0.04% Phos., 0.054% Sul., and 8.78% combined water. (C.—1910)

29. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 13.

S. W. ¼, S. E. ¼ and S. E. ¼, S. W. ¼ } Sec. 28, T. 25 N., R. 4 E.

This prospect is located 14 miles southeast of Grandin. It is marked by an occasional surface boulder of cherty, brown ore scattered over a slight rise in the crest of a high, dividing ridge. Developments consist of five pits.

Pit No. 1, 30 feet deep, shows porous boulder ore to a depth of 20 feet. The lower 10 feet is in sandy clay and chert, some of which is ferruginous. Pit No. 2, 20 feet deep, shows six feet of very cherty ore, none of which is merchantable. The lower 14 feet is in red, sandy clay and chert. A very large boulder of cherty ore outcrops near this pit. Pit No. 3, 36 feet deep, is reported to show boulder ore to 33 feet with three feet of sandy clay and ferruginous chert in the bottom. The ore is very similar to that at pit No. 1. Pit No. 4, 28 feet deep, is in all respects like pits Nos. 1 and 3. Pit No. 5, 45 feet deep, is reported to show boulder ore to a depth of 43 feet with sandy clay and flint in the bottom. Below 15 feet the ore became soft and contained some manganese. A large boulder of fair ore outcrops beside this pit.

The ore is a porous, cherty limonite of the primary type. A mine sample obtained from pits Nos. 1, 3, and 4 analyzed 41.17% iron, 25.00% silica, 0.014% Phos., and 0.399% Sul. A sample of the ore from pit No. 5 analyzed 38.42% iron, 22.10% silica, 0.070% Phos., and 0.213% Sul. (C.—1910.)

30. MISSOURI LUMBER AND MINING COMPANY TRACT NO. 14.

S. ½, N. E. ¼, Sec. 30, T. 25 N., R. 4 E.

This prospect lies 10 miles southeast of Grandin, and covers an area of about 10 acres on the north slope of a hill near Beaver Dam creek. Developments consist of 11 test pits, the distribution of which is shown on the accompanying topographic sketch. Pits Nos. 4, 7, 8, 9, and 10, ranging from 8 to 23 feet in depth, show no ore. Pits Nos. 2, 5, and 6, which range from 15 to 22 feet in depth show 10 to 16 feet of very silicious ore mixed with a large quantity of cherty clay. Pit No. 1, 22 feet deep, shows 15 feet of good boulder ore underlain by a sandy, cherty clay. Pit No. 11, 26 feet deep, shows large boulders of very porous and highly silicious ore to the bottom, mixed with very little dirt.

The ore is a primary limonite of the porous, cherty type. A mine sample taken from pit No. 1 showed 50.86% iron, 11.96% silica, 0.071% Phos., and 0.151% Sul. A similar sample taken from pit No. 11 showed 37.98% iron, 25.10% silica, 0.045% Phos., and 0.076% Sul. (C.—1910.)

31. RIPLEY COUNTY LAND.

Sec. 16, T. 22 N., R. 1 E.

Limonite is found here covering an area about thirty yards long and ten yards wide. The ore is in the form of rough boulders which make up the surface of the southern portion of the top of the high hill. It is quite siliceous, silica occurring principally in the form of grains of sand. Years ago digging was done within this area but none of the ore was ever utilized. Some chert fragments are found over the entire hill and pebbles are seen on the northern slope and bedded limestone is exposed near the base of the hill. This deposit is about ten and one-half miles from Doniphan (L.—1892.)

32. STEPHENS (W. W.) LAND.

W. ½, Sec. 19, T. 22 N., R. 1 E.

Limonite is found here covering an area about twenty yards long and forty yards wide and making up the point of a spur of a chert hill. It is not a heavy ore and is somewhat siliceous, silica occurring as grains of sand. Chert fragments are found on the hill adjoining the deposit of ore. This locality is about fourteen miles from the Doniphan Branch Ry. (L.—1892.)

33. TOWELL (I. M.) LAND.

E. ½, S. E. ¼, Sec. 19, T. 22 N., R. 1 E.

Limonite is found here covering an area about thirty yards long and ten yards wide. It occurs as numerous rough masses on the steep slope at the foot of a high hill. The ore is quite siliceous, silica occurring both as fine grains of sand and small fragments of white chert. Other loose masses of similar ore are found about one hundred yards northeast and across the creek from this deposit. This area is only about fifteen yards square. Much surface chert gravel is assosiated with these deposits but no bedded rock is observed. This locality is about thirteen miles from Doniphan. (L.—1892.)

34. WILSON (ROBERT) LAND.

S. E. ¼, Sec. 32, T. 22 N., R. 3 E.

Limonite is found here covering three localities. The most southern area is about forty yards long and sixty yards wide. The other two deposits occupy about one-third of an acre and are from one hundred and fifty to three hundred yards apart. The boulders are slightly porous but the per cent. of insoluble material runs rather high, silica occurring in the form of grains of sand. Pebbles of chert and sandstone and angular chert fragments are found over the entire area occupied by the three deposits. These localities are about six miles distant from the Doniphan Branch Ry. (L.—1892.)

35. YOUNG BANK.

Owned by D. B. Young, Doniphan, Mo.

S. E. ¼, S. W. ¼, Sec. 23, T. 23 N., R. 2 E.

This property, located just north of the city limits of Doniphan, has been partially developed by three shallow cuts and one 10 foot pit. These openings indicate a shallow deposit of primary limonite embedded in cherty clay. The ore has an open texture and carries both sand and chert. No shipments have been made. (C.—1910.)

RIPLEY COUNTY.

SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Dalton, Levi C., Land	22	1 E.	9	S. E. $\frac{1}{4}$.
2	Government Land No. 2	22	1 E.	16	
3	Government Land No. 3	22	2 E.	7	W. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
4	Government Land No. 4	23	1 W.	1	
5	Martin, C. H., Land No. 2	22	2 E.	12	S. $\frac{1}{2}$, S. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
6	McGonigal, E., Land	23	2 E.	3	S. E. $\frac{1}{4}$.
7	Mo. Lum. & Min. Co. Mine No. 1.	24	1 E.	1	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
8	Ponder, Asel, Land	23	2 E.	26	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
9	Ponder, D. K., Land	23	2 E.	26	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
10	Ranken, Thos., Land	23	1 W.	35	S. $\frac{1}{2}$.
11	Stoops, P., Land	22	1 E.	23	N. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
12	Williams, J. T., Land	22	1 E.	10	S. $\frac{1}{2}$, S. W. $\frac{1}{4}$.

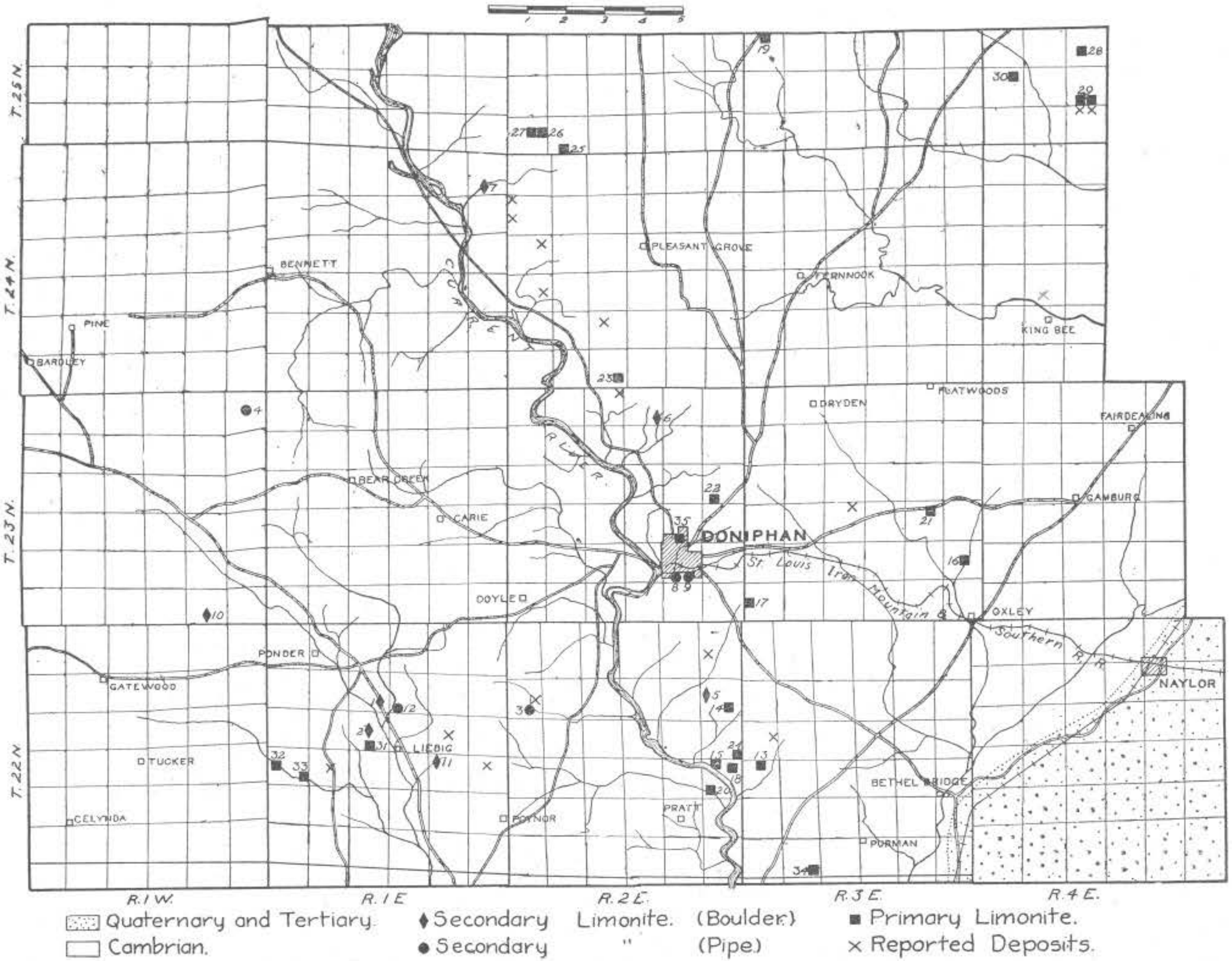
PRIMARY LIMONITE.

13	Agricultural Col. Land No. 2	22	3 E.	19	N. $\frac{1}{2}$.
14	Booker, G. S., Land	22	2 E.	12	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
15	Current River Land	22	2 E.	24	N. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
16	Eaton, Z. A., Land	23	3 E.	25	
17	Gray, Lydia, Land	23	3 E.	31	Lot 2, S. W. $\frac{1}{4}$. Lot 2, N. W. $\frac{1}{4}$.
18	Herr, C. B., Land	22	2 E.	24	N. E. $\frac{1}{4}$.
19	Holland Tract	25	3 E.	19	N. $\frac{1}{2}$.
20	King, E. M., Land	22	2 E.	24	S. W. $\frac{1}{4}$.
21	Mabrey, T. W., Land No. 1	23	3 E.	23	W. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
22	Mabrey, T. W., Land No. 2	23	2 E.	13	S. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
23	Martin, C. H., Land No. 1	24	2 E.	33	S. E. $\frac{1}{4}$.
24	Martin, C. H., Land No. 3	22	2 E.	13	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
25	Mo. Lum. & Min. Co. Mine No. 2.	25	2 E.	32	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
26	Mo. Lum. & Min. Co. Mine No. 3.	25	2 E.	31	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
27	Mo. Lum. & Min. Co. Mine No. 4.	25	2 E.	31	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
28	Mo. Lum. & Min. Co. Mine No. 9.	25	4 E.	21	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
29	Mo. Lum. & Min. Co. Mine No. 13	25	4 E.	28	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$. S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
30	Mo. Lum. & Min. Co. Mine No. 14	25	4 E.	30	S. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
31	Ripley County Land	22	1 E.	16	
32	Stephens, W. W., Land	22	1 E.	19	W. $\frac{1}{2}$.
33	Towell, I. M., Land	22	1 E.	19	E. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
34	Wilson, Robert, Land	22	3 E.	32	S. E. $\frac{1}{4}$.
35	Young, D. B., Bank	23	2 E.	23	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.

REPORTED OCCURRENCES.

	Herr, C. B	22	1 E.	24	N. $\frac{1}{2}$.
	Owner unknown	22	1 E.	14	
	" "	22	1 E.	20	
	" "	22	2 E.	1	Lot 1, N. W. $\frac{1}{4}$.
	" "	22	2 E.	7	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	22	3 E.	18	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.

RIPLEY COUNTY



REPORTED OCCURRENCES—Continued.

Name of Mine or Owner.	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
Owner Unknown.............	23	2 E.	4	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
" "	23	3 E.	21	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
" "	24	2 E.	7	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
" "	24	2 E.	7	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
" "	24	2 E.	18	N. E. $\frac{1}{4}$.
" "	24	2 E.	19	E. $\frac{1}{2}$.
" "	24	2 E.	28	N. W. $\frac{1}{4}$.
" "	25	4 E.	33	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
" "	25	4 E.	33	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.

ST. CLAIR COUNTY.

The iron ore deposits of this county consist of red hematite occuring in the Carboniferous and secondary limonite occurring in the residuum overlying the Burlington limestone.

The hematite deposits are small and are frequently sandy, grading into ferruginous sandstone. No ore has been shipped from this county. Aside from the Green bank the known secondary limonite deposits are probably too small to warrant attention at this time. The Green bank, while promising, is 12 miles from Osceola, the nearest shipping point.

HEMATITES OF THE CARBONIFEROUS.

1. COLLINS BANK.

Sec. 23, T. 39 N., R. 25 W.

An outcrop of red, earthy hematite, portions of which are somewhat argillaceous, extends over a distance of two hundred feet, along the ravine at the foot of a steep slope, on which no rocks are perceptible, except broken chert above the soil. (S.—1872.)

2. GROVER BANK.

Sec. 16, T. 39 N., R. 24 W.

Large and small fragments of ferruginous sandstone, frequently very rich in iron, together with some brown and red hematite, are spread over a zone several hundred feet wide, and about one-fourth of a mile long across a limestone ridge. (S.—1872.)

3. MARMADUKE BANK.

Sec. 23, T. 39 N., R. 25 W.

Fragments of earthy, red hematite partly altered into yellowish brown, porous limonite, are found on the surface on the summit of the ridge, over an area measuring six hundred feet across, and four hundred feet along the ridge. Some of the ore is sandy and passes into a regular ferruginous sandstone in places. Most of the ore is good and the fragments large and sharp-edged. (S.—1872.)

SECONDARY LIMONITE.

4. GREEN BANK.

Owned by T. F. Green, Iconium, Mo.

S. W. ¼, Sec. 27, T. 39 N., R. 24 W.

On this property, located half a mile west of Iconium, boulders of brown ore outcrop for a distance of 150 to 200 feet in a general northeast-southwest direction along the top of a 25 foot bluff of Burlington limestone. Developments consist of a 72 foot shaft which was sunk upon the outcrop about 40 years ago, disclosing a fissure in the limestone filled with limonite. The shaft has since caved and filled to within 12 feet of the surface, but still shows the fissure to be 12 feet in width at the surface and to gradually narrow with depth.

The ore, filling the fissure, is a porous, cindery, secondary limonite which, in places, is very fossiliferous, showing many crinoid casts. An analysis of the ore showed 53.31% iron, 6.26% silica, 0.075% Phos., 0.044% Sul., 0.675% Mn., and 10.98% combined water.

Dr. A. Schmidt, who visited the property in 1872, reports the ore to extend to the bottom of the shaft, the width of the vein decreasing, however, with depth. On the basis of this report, there is a good quantity of ore awaiting development at this place.

Osceola, 12 miles to the southwest, is the nearest shipping point.

(H.—1910.)

5. GREENWELL BANK.

Sec. 15, T. 39 N., R. 25 W.

The ore occurs scattered over an area 70 feet long and 40 feet wide on the slope of a low, flat hill. This hill is covered with chert and large boulders of crystalline, gray limestone; part of the ore is hard and solid and part is argillaceous. (S.—1872.)

6. SHELDON LAND.

N. E. ¼, Sec. 8, T. 38 N., R. 24 W.

This prospect, located seven miles northeast of Osceola, consists of an outcrop of secondary limonite in the form of boulders and fragments strewn over an area 60 feet square, situated near the crest of a hill.

The ore occurs intermingled with chert and partly embedded in red clay. It is dark brown in color and varies in texture from compact to cellular. Some of the ore is inclined to stalactitic structures and all of it is free from silicious materials. Burlington limestone outcrops in a number of places on the adjoining hill slopes and probably nowhere in the area is the residuum more than three or four feet thick. Owing to this fact, the deposit will probably prove to be small. (H.—1910.)

ST. FRANCOIS COUNTY.

St. Francois county ranks first in the production of iron ore, having an accredited output of 3,939,799 tons. With the exception of about 500 tons of secondary limonite mined during the early 70's, all of this ore was blue specular hematite obtained from Iron Mountain. Mining operations began at Iron Mountain in 1844. In August 1846 the first Iron Mountain furnace was put in blast to be followed by a second in 1848. In 1851 Valley Forge was built 2½ miles east of Farmington, and continued in operation until 1866 making iron blooms from Iron Mountain ore, the blooms being hauled to the Mississippi river at Ste. Genevieve. In January, 1855, a third furnace was put in blast. In 1858 the St. Louis, Iron Mountain, and Southern R'y was built as far as Pilot Knob, giving Iron Mountain ore an outlet to other furnaces.

With the exception of 1907, Iron Mountain has been operated more or less continuously since the date of its opening.

SPECULAR ORES IN PORPHYRY.

1. ### IRON MOUNTAIN.

Owned by W. H. Smollinger, Iron Mountain, Mo.

Sec. 31, T. 35 N., R. 4 E.

Mining operations at Iron Mountain are described in full on page 108.

SECONDARY LIMONITES.

2. ### MAR'S HILL BANK.

Owned by W. T. Franklin, Valles Mines, Mo.

S. W. ¼, N. E. ¼, Sec. 23, T. 38 N., R. 5 E.

This deposit is located four miles southeast of Valles Mines. It is situated on the eastern slope of a secondary ridge which is capped by residual materials of the Potosi formation. The outcrop is composed of boulders of limonite scattered over an area of about ten acres. Developments consist of a 24 foot pit and two shallow cuts located 20 feet below the crest of the ridge. The cuts, each 20 feet long and 5 feet wide, expose boulders of compact, silicious ore embedded in red, cherty clay derived from the decomposition of the Potosi formation. The 24 foot pit, which is located 200 feet north of the two cuts, is reported to show boulders of limonite embedded in a similar clay throughout its depth. The ore at the bottom of the pit contained much unaltered marcasite.

The ore is a secondary limonite, much of which is silicious due to the included fragments of chert and small druses of quartz. Two mine samples, taken from the ore on the dump, show the following analyses:

Number.	Iron.	Silica.	Phos.	Mn.	Alumina.
1..................................	56.79	4.80	0.052	0.10	....
2..................................	54.45	8.30	....	0.40	1.20

(B.—1910.)

3. ### MINE LAMOTTE BANK NO. 1.

Owned by Mine Lamotte Lead Co., Fredericktown, Mo.

Sec. 17, T. 34 N., R. 7 E., Mine Lamotte Spanish Grant.

This bank, located one mile north of Mine Lamotte, is situated in an open field on the crest of a low hill. Developments consist of a number of irregular pits scattered over an area of several acres. This work was done by the Mine Lamotte Company during the early 70's, at which time about 500 tons of ore were produced and utilized for fluxing purposes.

The ore is a secondary limonite and occurred as boulders embedded in a red clay, which contains chert and drusy quartz of the Potosi formation. The deposit is located near, if not on, a fault line which brings the Lamotte sandstone to the surface on the south. Similar geologic conditions extend along the fault to the northwest for a quarter of a mile or more and an outcrop of ore in the road on the west indicates that workable ore may be found in that direction. (C.—1910.)

STE. GENEVIEVE COUNTY.

SECONDARY LIMONITE.

1. NAEGER BANK.

Owned by Peter Naeger, Ste. Genevieve, Mo.

S. E. ¼, Sec. 11, T. 37 N., R. 8 E.

This bank is located three miles southeast of Zell, the nearest shipping point on the Illinois Southern R'y. The outcrop consists of boulders of secondary limonite exposed along the county road for a distance of 60 yards. Mr. Naeger, the owner, reports that some ore was mined from several small pits located in the field immediately east of the outcrop. The ore occurred as boulders embedded in clay. It was somewhat silicious due to the presence of a amount of sand occurring in small lenses or seams.

The ore mined is reported to have been used as a flux at the Cornwall Copper Works two miles southeast of this place (B.—1910.)

REPORTED OCCURRENCES.

Sec. 7, T. 35 N., R. 8 E.

Sec. 12, T. 37 N., R. 7 E.

SHANNON COUNTY.

Shannon county ranks ninth in the production of iron ore, having shipped a total of 40,363 tons. With the exception of one deposit of primary limonite, near Birchtree, the known deposits of the county are secondary limonite, the distribution and locations of which are shown on the accompanying county map. The secondary deposits consist chiefly of boulder ore which occurs embedded in the residual, cherty clay overlying the Roubidoux and Gasconade formations. Except along the courses of the main streams the residuum is uniformly thick, outcrops of the underlying formations being few.

Mining operations began in this county in 1902 since which time eight mines have been opened and shipments have been made each year.

SECONDARY LIMONITE.

1. CARR LAND.

Owned by David Carr, Timber, Mo.

E. ½, N. E. ¼, Sec. 31, T. 31 N., R. 4 W.

The outcrop of limonite at this place occurs near the base of a ridge 100 yards west of Sinkin creek. The outcrop, consisting of boulders and fragments of ore, is 35 feet in width and extends up the slope for a distance of 175 feet. No attempt has been made to determine the depth of the ore body.

The ore is secondary after marcasite and is very free from silica and other impurities.

The surface surrounding the outcrop is covered with fragments of chert and sandstone. Dolomite of the Gasconade formation forms a low bluff a few yards south of the outcrop. (H.—1910.)

2. CHRISCO LAND.

Owned by Daniel Chrisco, Timber, Mo.

S. W. ¼, Sec. 17, T. 31 N., R. 4 W.

This bank, located three miles north of Timber, is situated on the west point of a hill. No developments have been made. The outcrop covers an area 200 feet by 150 feet, within which occur scattered boulders of ore. The ore is secondary limonite and is often very cherty. The outcrop is not a promising one. (H.—1910.)

3. CHILTON BANK.

Owned by J. H. Darr, Eminence, Mo.

N. E. ¼, N. W. ¼, Sec. 27, T. 29 N., R. 4 W.

This bank is located one mile northwest of Eminence, and is situated upon a low point of Gasconade limestone not over 40 feet above the level of Jacks-Fork. The ore lies in a depression in the dolomite and outcrops over an area of about 300 square yards. A few dolomite fragments were observed scattered among the outcropping ore but none of the former appeared to be in place. A number of shallow pits show the ore to be not over three to four feet thick. In one four foot pit, near the west side of the deposit, the ore is exposed in a solid ledge underlain by bedded dolomite and overlain by clay containing fragments of dolomite and ore. Another pit, near the middle of the ore body, shows four feet of ore in dense, massive blocks.

The ore is secondary limonite and is entirely free from sand and chert. An average sample taken from the outcrop ran 59.47% iron, 3.14% silica, 0.161% Phos., 0.076% Sul., 8.45% combined water, and 1.07% moisture.

(C.—1910.)

4. CORDZ-FISCHER MINE.

Owned by Shannon County Mining and Development Company, Winona, Mo.

S. W. ¼, Sec. 14, T. 26 N., R. 5 W.

This mine is located five miles south of Birchtree. It consists of three relatively large pits distributed over a tract of 80 acres. The opening farthest to the southeast, known as No. 1, consists of a roughly circular pit about 300 feet in diameter and 40 feet deep with a large cone shaped area of barren ground near its center. There is only an occasional showing of wash dirt in the upper portion of the face, the best ore being exposed at the lowest levels of the pit where there is apparently considerable ore. Two shafts, sunk on the site of the pit during the early exploration of the property, are reported to have developed ore to a depth of 70 feet.

The next largest opening, known as No. 3, is located on the west end of the property. It consists of an irregular pit about 300 feet long, 60 feet wide, and 25 feet deep. Because of the caved condition of the face, ore can be observed in place at a few points only. Beneath about five feet of surface clay and chert, at the north end of the pit, there is exposed a six-foot ledge of rather dense, dark brown and red ore which no doubt is, in part, hematite.

Pit No. 2, located between No. 1 and No. 3, is about 100 feet in diameter and nearly circular in outline. That portion of the face not covered by detritus, shows no ore and the pit is reported to be worked out.

The dump at No. 1 is about 800 feet long, 75 to 100 feet wide, and from 10 to 30 feet deep. This dirt will apparently wash about 50% ore.

The ore is a secondary limonite. In both No. 1 and No. 3, boulders of ore were found to contain but slightly altered marcasite encased in a shell of limonite. This material was found upon the dump and its original position in the mine was not determined. Much of the ore appears to have occurred in the form of boulders containing seams and cavities filled with yellow ocher. It grades on the one hand to soft ocher and fine fragments of ore, and on the other hand to a rather hard blue and red ore resembling hematite.

The property was opened by the Shannon County Mining and Development Company during 1901 and was worked intermittently by that and the Frisco Ore Mining Company up to 1908, producing 14,730 tons of ore. The average analysis of eleven shipments ran 49.95% iron, 14.13% silica, 0.094% Phos., 0.145% Mn., and 4.95% moisture. A logging road, crossing the property, made it possible to load ore directly into cars at the mine. This road has since been removed and the nearest shipping point is Birchtree on the St. Louis and San Francisco R'y., five miles to the north. (C.—1910.)

5. CUTLER LAND.

Owned by T. J. Humphrey, Birchtree, Mo.

N. ½, N. E. ¼, S. W. ¼, Sec. 33, T. 27 N., R. 5 W.

This deposit is located 1¾ miles southwest of Birchtree. It is situated upon the crest and east face of a ridge. Secondary limonite outcrops over an area 100 yards long by 50 yards wide. No developments have been made. The outcrop consists chiefly of small boulders of dense to porous, brown ore, free from silicious impurities. The surface of the surrounding tract is covered by a mantle of small chert and quartzite boulders, the depth of which was not ascertained. (C.—1910.)

6. DEAN (J. H.) LAND.

S. ½, Lot 2, N. W. ¼, Sec. 30, T. 28 N., R. 3 W.

Here, near the highest part of a mountain, there is but a small surface showing of ore; but a shallow pit has been dug and pieces of good limonite taken out. Mr. Vanausdall says solid ore was struck at the bottom of the hole. The ore is of good quality. It occurs in light yellowish-gray, sandy clay. The associated rock is chert. (L.—1892.)

7. EMBREE LAND.

N. W. ¼, N. W. ¼, Sec. 12, T. 28 N., R. 4 W.

Limonite is found here covering only a small area, at the lower extremity of a long flat point. It is a good ore and occurs massive and pseudomorphous. (L.—1892.)

8. GOVERNMENT LAND NO. 5.

S. E. ¼, N. E. ¼, Sec. 25, and S. E. ¼, N. E. ¼, Sec. 24, T. 28 N., R. 4 W.

Stalactitic limonite is found in these localities on and near the summits of hills which are thickly covered with fragments of chert. But little ore is on the surface, yet, at each locality, a little digging has been done and small and large masses of pipe ore have been exposed. It is a good ore, some parts of it are pseudomorph after pyrite. (L.—1892.)

9. GRANDIN BANK.

S. W. ¼, Sec. 19, T. 31 N., R. 4 W.

This bank, located about three miles northwest of Timber, is situated in a small gully which pitches precipitously down a steep ridge on the south side of Barren Fork. No developments have been made. The outcrop occurs in a belt 40 to 75 feet wide, extending from the base to the crest of the ridge, a vertical distance of 90 feet. The ore occurs intermingled with fragments of porous chert and consists of secondary limonite. The residuum at this place is probably very thin, as several outcrops of Gasconade dolomite occur along the sides of the small ravine in which the ore is exposed. (H.—1910.)

10. HEARST MINE.

Owned by James Hearst, Winona, Mo.

N. E. ¼, S. W. ¼, Sec. 16, T. 27 N., R. 3 W.

This mine is located 2½ miles east of Winona. It consists mainly of an open cut 150 feet long and 50 to 60 feet wide, which was made upon a small outcrop of brown ore located upon the southeast slope of a prominent hill. The west face of this pit consists almost entirely of barren, residual clay, and flint, with a broken bed of quartzose sandstone 12 to 18 inches thick lying in an uneven but well defined line slightly above the middle of the face, but dropping abruptly to near its base at the north end. The east face shows some brown ore in clay but no sandstone. Forty to 50 feet of the north face shows considerable hard brown and soft red ore occurring in veins and seams pitching rather uniformly about 35° west of north.

The red ore is soft and greasy and is associated with a fine, ocherous clay which in places is replaced laterally by a seam of soft yellow sand. At the base of the north face, the ore lies both above and below a 12 inch layer of quartzose sand and chert breccia which resembles the sandstone ledge in the west face described above.

In the extreme northeast corner of the cut a small heading encountered streaks of soft red ore varying from 12 to 20 inches in thickness mixed with seams of clay, all of which pitch to the northwest.

A 40 foot shaft near the north end of the cut is reported to be in ore mixed with some sand throughout its entire depth. From the foot of this shaft a drift has been driven 15 feet to the north. The west face of this drift carries very little ore, while the east face shows seams of soft red and hard brown ore which dip to the northwest.

A 15 foot shaft, located on the east bank of the cut, encountered, throughout the lower 12 feet, pitching seams of red ore mixed with seams of white, yellow, and red clay and soft white sand. A 30 foot drift, extending south 35° west from the bottom of this shaft, shows pitching seams of similar material throughout its length. A 15 foot drift, extending north 55° west from the same point, encountered red ore in the back and developed an 18 inch seam of ore at the foot of the shaft pitching in the direction of the drift. Another shaft, about 30 feet south of the last, is reported to have encountered similar material, having the same general northwest dip.

From the foregoing, it would appear that this deposit of red and brown hematite occurs along a zone of brecciation or faulting, or some sort of sink structure, the degree or exact nature of which has not been determined. Since the hills in this vicinity are everywhere thickly covered with a mantle of residuum, mining developments alone will disclose the factors controlling the extent of the ore body. The facts so far developed suggest that a northeast-southwest zone of brecciation cuts the large pit near the point where the 40 foot shaft is now sunk, and that the red ore will be confined to a belt on the east and conform closely to such a line.

The ore is secondary after iron sulphites, and shows sulphide pseudomorphs. It is partly red and partly brown, but in the absence of more definite knowledge regarding the accompanying structures, it is classed as a secondary limonite deposit.

This property was opened during 1902 and 1903, after which operations ceased until the fall of 1909. An early shipment ran 53.15% iron, 11.93% silica, 0.103% Phos., 0.06% Mn., and 7.30% moisture.

The ore was hauled three miles by wagon and placed on board cars at Low Wossie for 75 cts. per ton. Three hundred and fifty tons were produced. (C.—1910.)

11. HURT BANK.

Owned by Samuel Hurt, Timber, Mo.

N. ½, N. W. ¼, Sec. 17, T. 31 N., R. 4 W.

This bank, located three miles north of Timber, is situated near the base of a ridge on the north side of Barren Fork. Here, over an area of about half an acre, the surface is thickly covered with fragments of ore. The ore is secondary limonite of good grade, containing very little chert and apparently no sulphur. The only developments consist of one shaft 20 feet deep. Mr. Hurt states that boulders of ore embedded in brown clay were encountered in this shaft. (H.—1910.)

12. IRON HILL MINE.

Owned by J. W. Woods, Birchtree, Mo.

N. E. ¼, S. W. ¼, Sec. 14, T. 27 N., R. 5 W.

This mine is located about 1½ miles northeast of Birchtree. It is situated on the crest of a high, chert covered hill, where limonite, in large and small boulders, outcrops over an area 100 yards in diameter. Two circular pits about 30 feet wide and 6 feet deep have been made within this area. The faces of each show large boulders of ore embedded in cherty clay. The ore is a porous, secondary limonite the cavities of which contain considerable clay and some drusy quartz. About one car load of ore has been mined and shipped. (C.—1910.)

13. MELTON MINE.

Owned by The Shannon County Mining and Development Company, Winona, Mo.
N. E. ¼, N. E. ¼, Sec. 9, T. 26 N., R. 6 W.

This mine, located three miles south of Montier, consists of two large and three small cuts which have been made upon an outcrop of brown ore situated along the crest and gentle slopes of a small knoll.

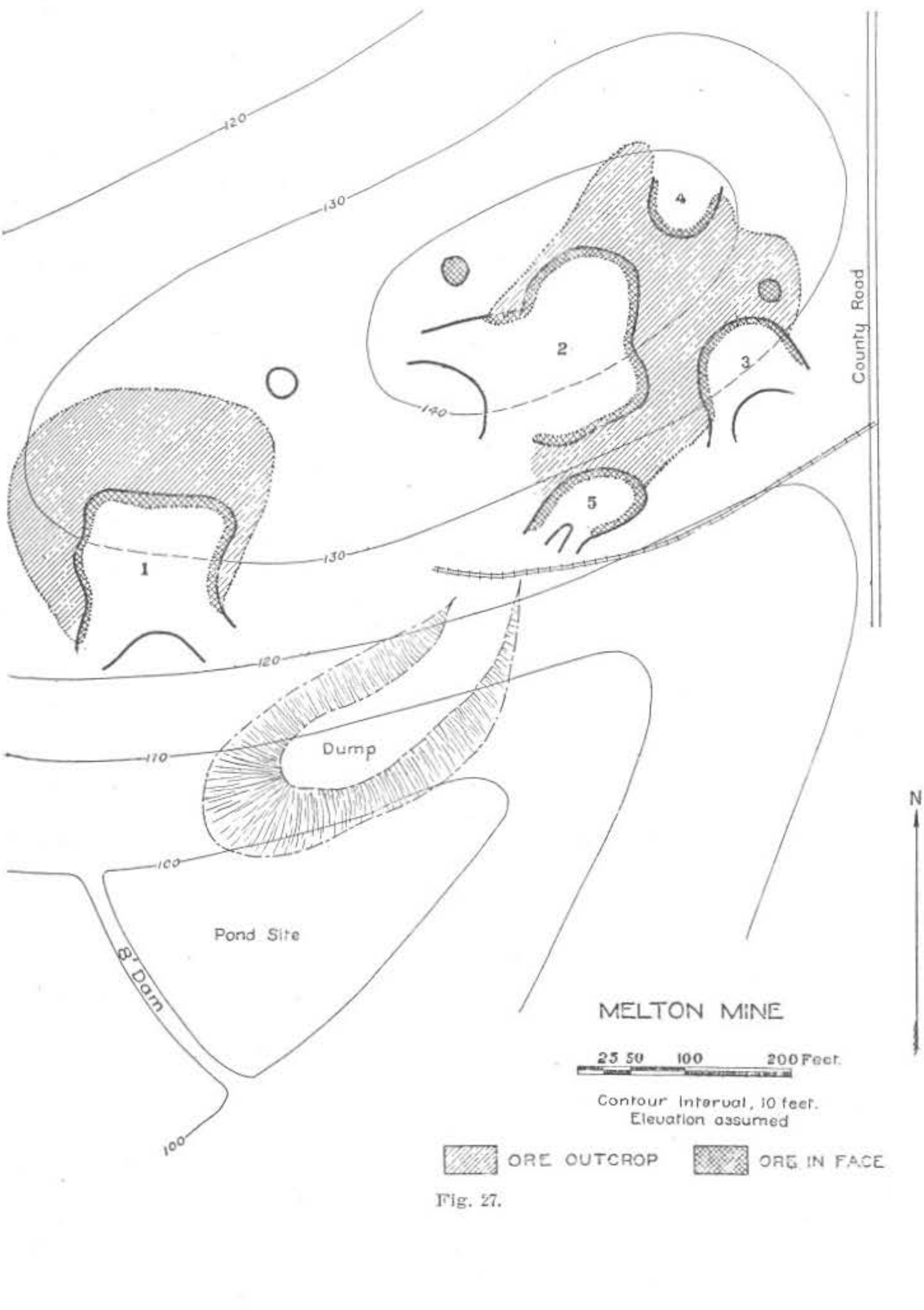


Fig. 27.

Cut No. 1 (see accompanying sketch, Fig. 27) located near the west end of the knoll, is approximately 150 feet square and from 10 to 15 feet deep. The cut is badly caved but where the face is exposed it shows ore embedded in clay.

Cut No. 2, more irregular in outline, has been made upon a splendid outcrop near the crest of the knoll. All the exposed faces in this cut show ore. At one point there is about 10 feet of nearly solid ore and ocher. Directly above the face the outcrop is strong and encloses the pit on three sides by a crescent shaped area 50 feet or more wide. Within this outcrop three smaller cuts have been made, all of which have developed good faces of ore, and a test pit near the east margin of the outcrop is reported to show ore to a depth of 15 feet.

The ore consists of large and small masses of porous, arborescent, secondary limonite with some denser varieties. It is mixed with much red clay and soft yellow ocher, the latter grading in places to a harder lump ore. Some of the denser ore is silicious and grades into a ferruginous chert and into a yellow clayey ocher.

A sample of all the material in the 10 foot face of solid ore, described above, ran 42.28% iron, 26.16% silica, 0.028% Phos., 0.134% Sul., 8.04% combined water, and 1.08% moisture, while a sample of boulder ore alone ran 53.93% iron, 9.68% silica, 0.005% Phos., 0.063% Sul., 12.47% combined water, and 0.78% moisture.

On the south side of the knoll and partly filling a small ravine, is a large dump of mine dirt consisting of red, cherty clay carrying small fragments of hard and soft ore and ocher. This material would wash and jig to advantage. In fact, a large part of the ore can be saved by no other means.

This property had just been well opened and equipped when mining operations were brought to a close by the depression of 1907. Altogether about 5,000 tons were mined and shipped to the St. Louis Blast Furnace Company. An average of six analyses representing as many car loads, ran as follows: 48.00% iron, 16.7% silica, 0.063% Phos., 0.11% Mn., and 5.0% water. The ore was mined by hand and trammed three miles in narrow gauge cars to Montier, the nearest shipping point on the St. Louis and San Francisco R'y. (C.—1910.)

14. MISSOURI LUMBER AND MINING COMPANY, MINE NO. 15.

S. E. ¼, N. W. ¼, Sec. 9, T. 29 N., R. 5 W.

This mine is situated on the west side of the crown of a hill, five miles northwest of Angeline. The outcrop is strong and covers an area nearly 100 yards in diameter. The developments consist of one open cut and five test pits. From the cut, which is 50 feet long, 40 feet wide, and 8 feet deep, about 174 tons of ore have been mined and shipped. The test pits were sunk to depths varying from 6 to 27 feet, and show ore to depths ranging from 4 to 20 feet.

The ore is a hard, dense, secondary limonite of an unusually silicious variety, silica occurring in the form of chert and sand. The ore occurs in fragments and boulders embedded in residual clay and in large solid masses, with which very little clay is associated.

The 174 tons shipped showed an average analysis of 47.59% iron, 16.20% silica, 0.116% Phos., 0.15% Mn., and 4.0% moisture. (C.—1910.)

15. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 32.

N. E. ¼, S. W. ¼, Sec. 24, T. 30 N., R. 6 W.

This deposit, located four miles northwest of Ink P. O., is surrounded by a rough country and is several miles from the nearest logging road of the Missouri Lumber and Mining Company. It is marked by a very prominent mound-like outcrop of brown ore which occurs in a ravine at the foot of a gentle hill. The ore forms a nearly solid mass over an area about 30 feet in diameter with an abundance of float ore scattered over a somewhat larger area. The ore is a rather soft, even textured, finely porous, non-silicious, secondary limonite. A sample taken from a dozen or more of the surface boulders showed 58.67% iron, 3.92% silica, 0.083% Sul., 0.142% Phos., 10.725% combined water, and 0.455% moisture.

Float ore can be traced fully 100 yards down the ravine to the northwest, to where a ledge of limestone outcrops at an elevation but slightly below the ore deposit. This, and the low position of the outcrop, would indicate that the residuum at this place is thin and that the ore body is correspondingly shallow. (C.—1910.)

16. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 33.

S. W. ¼, S. W. ¼, Sec. 32, T. 30 N., R. 5 W.

This tract is located two miles southwest of Ink P. O. and is situated on the north slope of a high hill. Developments consist of three test pits all of which show secondary limonite embedded in clay to depths varying from 4 to 14 feet below the surface. The records of the pits are as follows:

Pit.	Depth.	Ore-bearing clay.	Barren clay.	Pit bottomed in
1	14 feet	14 feet		Ore-bearing clay.
2	10 "	4 "	6 feet	Not indicated.
3	8 "	3 "	5 "	Ore-bearing clay.

A sample of the ore taken from pits Nos. 1, 2, and 3, when analyzed, showed 59.01% iron, 2.7% silica, 0.08% Phos., and 0.10% Mn. (Sampled by the Missouri Lumber and Mining Company and analyzed by the St. Louis Blast Furnace Company.) (C.—1910.)

17. MISSOURI LUMBER AND MINING COMPANY, TRACT NO. 34.

S. W. ¼, N. E. ¼, Sec. 5, T. 30 N., R. 5 W.

This tract is located five miles northwest of Ink P. O. and is situated in a ravine, near the head of Patten's Hollow. It has been developed by four test pits, all of which show boulders of secondary limonite embedded in clay, to depths varying from 4 to 35 feet. The records of the pits are as follows:

Pit.	Depth.	Ore-bearing clay.	Barren clay.	Pit bottomed in
1	35 feet	35 feet		Barren clay.
2	22 "	10 "	12 feet	" "
3	20 "	10 "	10 "	" "
4	15 "	4 "	11 "	" "

A sample of the ore from pits Nos. 1, 2, and 3, when analyzed, showed 58.10% iron, 3.98% silica, 0.15% Phos., and 0.11% Mn. (Sampled by the Missouri Lumber and Mining Company and analyzed by the St. Louis Blast Furnace Company.)

(C.—1910.)

18. OZARK LAND AND LUMBER COMPANY, TRACT NO. 1.

W. ½, Sec. 13, T. 26 N., R. 4 W.

This property is located 6 miles south of Winona and 2½ miles southwest of the nearest point on the company's logging road. The outcrop consists of large and small boulders of brown ore scattered over an area 100 yards long by 50 yards wide. Within this area nine pits from 3 to 4 feet deep have been sunk. Seven of these show about one part ore to three parts clay, while the remaining two encountered only chert and clay. The ore, which is embedded in a residual, cherty clay, occurs in lumps ranging from a few inches to one foot in diameter. It is a high grade, light brown, secondary limonite free from chert and sand. Individual boulders are even textured throughout, while others have dense shell-like exteriors with soft, ocherous interiors, showing the alteration of marcasite to limonite. A mine sample of the ore taken from the pits, when analyzed, showed 51.41% iron, 12.47% silica, 0.078% Phos., 0.430% Sul., 6.87% combined water, and 0.02% moisture.

The residuum at this point appears to be thick, but a five-foot ledge of nearly horizontal sandstone 25 to 30 feet long, lying near the east edge of the outcrop, may mark the lower limit of the deposit. (C.—1910.)

19. PIATT LAND.

Owned by Samuel Piatt, Timber, Mo.

N. W. ¼, Sec. 5, T. 30 N., R. 4 W.

On this land, located one mile west of Timber, P. O., brown ore outcrops over small areas on both the east and west slopes of a high ridge.

The ore is a compact, secondary limonite which is highly pseudomorphous after marcasite and quite free from chert. It occurs in the form of boulders and fragments embedded in cherty clay. Gasconade dolomite outcrops at frequent intervals from the base to the crest of the ridge.

In the N. E. ¼ of this section, the surface of an area of about one acre is very profusely covered by fragments of secondary limonite. The ore is very cherty and, unless a better quality should be encountered below the surface, the deposit would not prove commercial. (H.—1910.)

20. TALKINGTON BANK.

Owned by T. A. Talkington.

S. E. ¼, S. E. ¼, Sec. 4, T. 26 N., R. 6 W.

This bank is located 2½ miles south of Montier and lies just north of the Melton mine. It is marked by a very prominent outcrop of silicious, brown ore, upon which a number of shallow pits have been sunk. Two of the pits, which show some ore embedded in red clay, bottomed in barren, cherty clay. Some distance below the outcrop a cut 50 feet long and 15 to 25 feet wide is reported to have produced some ore, although when visited but little ore was to be seen in the face. The ore is secondary after the sulphide and is somewhat cherty, especially at the outcrop. (C.—1910)

21. TRIPP (G. W.) LAND.

N. E. ¼, S. E. ¼, Sec. 31, T. 29 N., R. 3 W.

Limonite is found here along the steep southern slope of a limestone hill, with much exposed limestone appearing in places, about fifty feet lower than the summit.

The ore occurs in pieces weighing from a few ounces to fifty pounds as pseudomorphs and also as stalactitic and massive ore. It is of a good quality and bears no visible impurities. (L.—1892.)

22. WEST EMINENCE BANK.

Owned by the Missouri Lumber and Mining Company, Grandin, Mo.

N. W. 1/4, Sec. 34, T. 29 N., R. 4 W.

This bank is located on the point of a limestone hill about 100 yards east of the West Eminence Hotel. Developments consist of a 12 foot pit from which a ton or more of very pure, secondary limonite has been taken. The walls of the pit showed no ore and it is probable that the ore removed represents the entire deposit. (C.—1910.)

23. WILLIS MINE.

Owned by J. R. Willis, Winona, Mo.

N. E. 1/4, S. E. 1/4, Sec. 9, T. 27 N., R. 3 W.

This mine is located three miles northeast of Winona and is situated on the south point of a steep hill rising 180 feet above the valley. Developments consist of one large cut, entering the crest of the hill from the west, and several small pits. The outcrop covers a considerable area and the developments all show ore.

The large cut is about 120 feet long, 60 feet wide and has a maximum depth of 10 feet. Nearly the entire face shows a porous, brown ore of good quality mixed with ocher and a very little clay. The ore is a secondary limonite of the boulder and ocherous varieties. A sample of the face gave returns of 43.33% iron, 25.24% silica, 0.35% Sul., 0.03% Phos., 8.76% combined water, and 0.65% moisture.

The above developments were made since 1902 and several car loads of ore have been shipped. These are reported to have given returns of 46 to 52% iron. The ore was hauled 2½ miles to Low Wossie, the nearest shipping point on the St. Louis and San Francisco R'y. (C.—1910.)

24. WOODS MINE.

Owned by W. W. Woods, Montier, Mo.

N. E. 1/4, S. E. 1/4, Sec. 12, T. 26 N., R. 6 W.

This mine is located three miles southeast of Montier and is situated at the base of the northeast slope of a high hill. Developments consist of two circular pits, each about 30 feet in diameter, from which two car loads of ore have been mined and shipped. At present, one pit shows only a little cherty ore, while the other is in nearly solid ore of good grade.

The ore is a secondary limonite and contains a few angular fragments of chert but is practically free from sand. Much of the dirt on the dumps is a good wash product.

The outcrop consists of occasional boulders of brown ore scattered along the base of the hill for a distance of 150 yards. (C.—1910.)

25. WOODSIDE-CHRISCO BANK.

Owned by Judge L. B. Woodside, Salem, and Daniel Chrisco, Timber, Mo.

N. W. 1/4, Sec. 21, T. 31 N., R. 4 W.

This bank, located 2½ miles north of Timber is situated on the crest of a hill overlooking the valley of Barren Fork. No developments have been made.

The outcrop, which covers an area of about half an acre, consists of large and small boulders of ore thickly strewn over the surface. The ore is secondary limonite, containing scattered fragments of chert. The residuum at this place is probably comparatively shallow. (H.—1910.)

PRIMARY LIMONITE.

26. BRYSON BANK.

Owned by A. L. Bryson, Birchtree, Mo.

N. E. ¼, N. E. ¼, Sec. 22, T. 27 N., R. 5 W.

This bank is located about one mile northeast of Birchtree and is situated on the northwest face of a gentle hillside. Developments consist of an open cut 150 feet long and 35 feet wide exposing a face of 8 to 10 feet of almost solid ore. The ore lies beneath 2 to 4 feet of surface materials consisting of yellow, residual clay and white, cherty fire clay. It consists chiefly of a dense, light colored, highly silicious, primary limonite apparently replacing a cherty, sandy clay. No pits have been sunk to test the depth of the ore and its lateral extent is not shown.

On the east edge of the forty, is a cut 30 feet long and 15 feet wide from which several car loads of silicious ore of the same character have been mined. A number of small pits have been sunk between the larger cuts. Only two of these encountered ore. (C.—1910.)

SHANNON COUNTY.

SECONDARY LIMONITE.

No.	*Name of Mine or Owner.*	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
1	Carr Land......................	31	4 W.	31	E. $\frac{1}{2}$, N. E $\frac{1}{4}$.
2	Chrisco, Daniel, Bank...........	31	4 W.	17	S. W. $\frac{1}{4}$.
3	Chilton Bank....................	29	4 W.	27	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
4	Cordz-Fisher Mine...............	26	5 W.	14	S. W. $\frac{1}{4}$.
5	Cutler Land.....................	27	5 W.	33	N. $\frac{1}{2}$, N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
6	Dean, J. H., Land...............	28	3 W.	30	S. $\frac{1}{2}$ Lot 2, N. W. $\frac{1}{4}$.
7	Embree Land.....................	28	4 W.	12	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
8	Government Land No. 5..........	28	4 W.	24	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
				25	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
9	Grandin Bank....................	31	4 W.	19	S. W. $\frac{1}{4}$.
10	Hearst, James, Mine.............	27	3 W.	16	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
11	Hurt, Samuel, Bank..............	31	4 W.	17	N. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
12	Iron Hill Mine..................	27	5 W.	14	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
13	Melton Mine.....................	26	6 W.	9	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
14	Mo. Lum. & Min. Co. No. 15	29	5 W.	9	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
15	Mo. Lum. & Min. Co. No. 32	30	6 W.	24	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
16	Mo. Lum. & Min. Co. No. 33	30	5 W.	32	S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
17	Mo. Lum. & Min. Co. No. 34	30	5 W.	5	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
18	Ozark Land & Lum.Co. Tract No.1	26	4 W.	13	W. $\frac{1}{2}$.
19	Piatt, Samuel, Land.............	30	4 W.	5	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
20	Talkington, T. A., Bank.........	26	6 W.	4	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
21	Tripp, G. W., Land..............	29	3 W.	31	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
22	West Eminence Bank..............	29	4 W.	34	N. W. $\frac{1}{4}$.
23	Willis, J. R., Mine.............	27	3 W.	9	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
24	Woods, W. W., Mine..............	26	6 W.	12	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
25	Woodside-Chrisco Bank..........	31	4 W.	21	N. W. $\frac{1}{4}$.

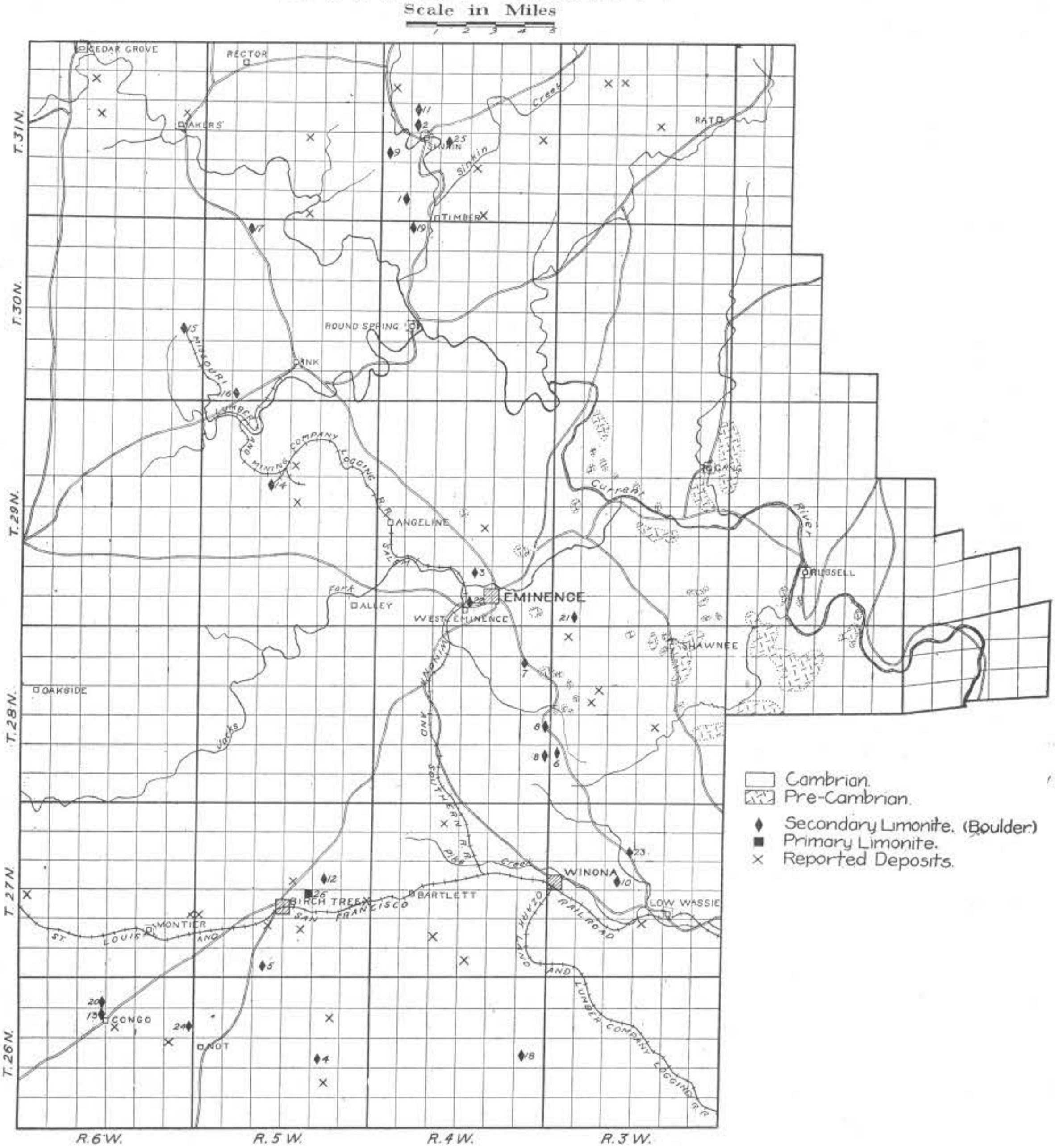
PRIMARY LIMONITE.

26	Bryson, A. L., Bank.............	27	5 W.	22	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.

REPORTED OCCURRENCES.

Biser, C. T......................	26	6 W.	10	S. W. $\frac{1}{4}$.
Biser, C. T......................	31	3 W.	8	N. E. $\frac{1}{4}$.
Butler, D........................	27	5 W.	28	N. $\frac{1}{2}$.
Carson and James................	29	4 W.	15	S. E. $\frac{1}{4}$.
Carson and James................	31	3 W.	9	N. W. $\frac{1}{4}$.
Collins, G. W....................	27	3 W.	27	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
Deweese, J. N....................	28	3 W.	6	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Government Land..................	27	5 W.	19	S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
Government Land..................	27	6 W.	24	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
Knight, S. H.....................	27	5 W.	27	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Livesay Land.....................	27	4 W.	28	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
Mo. Furnace Co...................	31	6 W.	13	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
Mo. Lum. & Min. Co...............	29	5 W.	3	W. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
Munsell, L. L....................	28	3 W.	17	N. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
Munsell, L. L....................	28	3 W.	22	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Organ and Swinney...............	31	5 W.	22	N. $\frac{1}{2}$.

SHANNON COUNTY



REPORTED OCCURRENCES—Continued.

Name of Mine or Owner.	*Twp. N.*	*R.*	*Sec.*	*Fractional.*
Organ and Swinney	31	5 W.	34	S. ½.
Ozark Land & Lum. Co	27	4 W.	34	W. ½.
Phennighausen	26	5 W.	11	N. E. ¼.
Seay, A. J	31	6 W.	16	
South Mo. Land Co	27	4 W.	4	S. ½.
Thomas, Wm	27	5 W.	15	S. W. ¼.
Woodside, L. B	31	3 W.	15	S. ½.
Owner unknown	26	5 W.	23	
" "	26	6 W.	13	N. W. ¼, N. W. ¼.
" "	27	5 W.	24	S. E. ¼, N. E. ¼.
" "	27	6 W.	19	S. ½ Lot 2, N. W ¼.
" "	28	3 W.	17	N. E. ¼, S. W. ¼.
" "	29	5 W.	10	S. ½, S. W. ¼.
" "	31	4 W.	7	
" "	31	4 W.	24	N. ½.
" "	31	4 W.	27	N. W. ¼.
" "	31	4 W.	34	S. ½.
" "	31	6 W.	9	N. W. ¼.

STODDARD COUNTY.

Stoddard county ranks twelfth in the production of iron ore, having an accredited output of 15,993 tons. The iron deposits of this county consist exclusively of primary limonite of the porous, sandy, and cherty type. With the exception of one or two deposits occurring in the Tertiary, they are confined to a line of low Cambrian hills which extend across the extreme northwestern portion of the county. Where associated with the Cambrian, the ore occurs embedded in the cherty residual clay which completely covers the underlying formations. Where associated with the Tertiary, it occurs cementing the gravel.

Iron ore was first mined in this county in 1901 and since 1905 shipments have been made each year. Although five mines have made shipments, all but a small part of the total production was derived from the Pico mine at Puxico.

PRIMARY LIMONITE.

1. BURGE (WILLIAM) LAND.

Sec. 17, T. 27 N., R. 9 E.

Here, on a gradually sloping crest of a long hill spur, sandy massive limonite is found. There are two small deposits a few hundred feet apart. The ore is in the form of loose, rough masses and of larger masses partially imbedded in the soil. Higher up the spur and on the point of the hill fragments and blocks of much more siliceous ore are found. This ore, belonging to Mr. Burge, is about one mile distant from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

2. GOFORTH (MRS. R. A.) LAND.

N. W. ¼, Sec. 2, T. 26 N., R. 8 E.

Massive limonite in the form of boulders is found here on a gradual slope of a low hill, covering an area about twenty yards square. There is no associated rock. The soil is quite dark. The ore is but slightly siliceous, this small amount of silica occurring in the form of grains of sand. This deposit is about one mile from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

3. HALL (H. E.) LAND.

W. ½, Sec. 3, T. 26 N., R. 8 E.

Here on the property of H. E. Hall, W. I. Smith and John King, massive limonite is found covering a strip of country about seven hundred yards long north and south, and from forty to eighty yards wide, on the gradual eastern slope of a hill and on a small spur branching therefrom, to the east. Within this area are many boulders and fragments of ore mingled with fragments of white chert. Some of these boulders are six feet in diameter. The ore is siliceous, silica occurring principally as chert fragments; but the percentage of siliceous material varies largely, portions of the ore being almost free from any silica, while the amount in other portions runs very high. The northern end of the deposit seems to bear the more siliceous ore. This locality is about one mile south of the St. L., C. G. & Ft. S. Ry. (L.—1892.)

4. HARTY LAND.

Owned by J. H. Harty.

N. E. ¼, Sec. 4, T. 26 N., R. 8 E.

Primary limonite outcrops at a number of points in this quarter section. The ore is very cellular, and is silicious due to the presence of fragmental chert and sand. No developments have been made. Mingo, half a mile to the northwest, is the nearest shipping point. (B.—1910.)

5. HAWKS (F. T.) AND HOUCK (L.) LAND.

Sec. 25, T. 27 N., R. 8 E.

Limonite occurs here in the form of rough masses and in an exposed ledge, lying within an area forty yards long and thirty yards wide. These loose boulders and fragments contain cavities, and in these cavities are found argillaceous material and coating of göthite scales. These boulders are in a cultivated field on the cap and western slope of a low knoll, with but little chert and no bedded rock near by. On the western margin of the area, within Sec. 35, a ledge of more massive ore is visible for a distance of nearly twenty-five feet, with the thickness not shown. This ledge is exposed, but a few feet above the small branch. The ore of this deposit is more or less siliceous, containing fine grains of sand. The locality is less than two miles from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

6. LEORA LAND.

Owned by E. A. P. Briney, Bloomfield, Mo.

Secs. 1 & 2, T. 27 N., R. 9 E.

Brown ore outcrops along the crests and upper slopes of two low hills situated on either side of the county road running north from Leora.

The outcrops are particularly prominent on the Lovesy and Kimmel properties. The ore consists of cellular, primary limonite, containing sand and chert. The cavities are often lined with goethite. The hills are capped with Tertiary gravels.

Similar ore outcrops along the ridge northwest of the Kimmel property. It is underlain at this point with cotton rock.

Givens, 1½ miles to the northwest, is the nearest shipping point. (B.—1910.)

7. M'GOWN (JOSEPH) LAND.

On line between Secs. 10 and 11, T. 26 N., R. 8 E.

Scattered boulders of limonite are found here on the northern slope of a hill, covering an area about twenty yards square. The ore is siliceous, silica occurring as small fragments of chert and fine grains of sand. A few blocks and fragments of chert are mingled with the ore boulders. This locality is about two miles distant from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

8. MURPHY (L. T.) MINE NO. 1.

N. W. 1/4, Sec. 34, T. 27 N., R. 8 E.

This mine, located 1½ miles west of Puxico, consists of two open cuts 50 yards apart on the crest of a ridge. The larger of these is 50 feet long, 30 feet wide, and 8 feet deep and exposes brown ore embedded in cherty residual clay. The smaller cut is 15 feet long, 12 feet wide, and exposes similar ore.

The ore is a cellular, primary limonite, the cavities of which are partly filled with decomposed chert.

The outcrop, which consists of similar ore, covers an area of five acres.

The above developments were made during 1908 at which time two car loads of ore are reported to have been shipped. (B.—1910)

9. MURPHY MINE, NO. 2.

Owned by L. T. Murphy, Puxico, Mo.

N. E. 1/4, Sec. 34, T. 27 N., R. 8 E.

This mine, located one mile west of Puxico, consists of an open cut 75 feet long, 15 feet wide, and 6 feet deep, in which is exposed an irregular ledge of brown ore.

The ore is a cellular, primary limonite containing hard and decomposed chert, and occasionally some sand. The same type of ore outcrops at various places over an area of 15 acres in the vicinity of the cut.

The mine was opened in 1908 at which time one car of ore was shipped. (B.—1910.)

10. MURPHY MINE, NO. 3.

Owned by W. J. Murphy, Ridgeway, Ill.

E. 1/2, Sec. 8, T. 27 N., R. 9 E.

This mine is located half a mile east of Idlewild, and adjacent to the St. Louis and San Francisco R'y. Developments consist of two open cuts, one of which is situated near the crest of a hill and the other at its foot 300 yards north of the first. The upper cut, which is 30 feet long, 15 feet wide, and 6 feet deep, discloses cellular, primary limonite containing some goethite and considerable decomposed chert. The lower cut, which is 25 feet wide and 40 feet long, encountered similar ore. These developments were made during 1908 at which time four cars of ore are reported to have been shipped.

The surface indications of ore at this place consist of a few scattered boulders of limonite. (B.—1910.)

11. PICO MINE.

Owned by the Puxico Iron Company, Puxico, Mo.

N. E. 1/4, Sec. 26, T. 27 N., R. 8 E.

This mine, located about one mile north of Puxico, is situated on the southeast slope of an outlying Cambrian foot-hill, which is surrounded by the southeast low-lands. The crest and upper slopes of the hill bear a strong outcrop of cherty brown ore which covers an area of several acres.

The mine consists of a series of openings extending for a distance of 300 yards along the line of the outcrop. The largest opening is about 200 feet long by 100 feet wide, and has been sunk in ore to a depth of 50 feet.

Fig. 1. PIT NO. 1, HOOPER MINE, BUTLER COUNTY, PRIMARY LIMONITE.

Fig. 2. PICO MINE, STODDARD COUNTY, PRIMARY LIMONITE.

Developments show that the hill consists of roughly stratified, cherty, residual clay overlying a core of cherty dolomite of Upper Cambrian age (probably Jefferson City). The stratification of the residuum is shown by more or less continuous layers of unaltered and partly decomposed chert embedded in it at certain horizons.

The ore occurs in irregular pockets in the residual materials and at one point, as shown by present developments, extends to the limestone underneath. It consists of dense to porous primary limonite, many of the cavities containing clay and sand. Unreplaced chert occurs throughout the deposit, especially in the larger boulders or masses. Some of the ore has a mottled appearance due to enclosed fragments of chert and is known locally as "peanut candy" ore. Many of the boulders have a concretionary structure and, when broken open, are found to contain a light colored silicious clay. In some instances they are filled with water and are lined with goethite.

This property is connected with the St. Louis and San Francisco R'y. It was opened and operated by Mr. T. J. St. Louis in 1908 and 1909, during which time about 2,100 tons of ore were mined. The present operators took possession Dec. 7th, 1909, and, during 1910, mined and shipped 10,011 tons of ore.

Only one side of the hill, showing the outcrop, has been developed and the property is no doubt capable of producing a large tonnage in the future.

The following analyses are of shipments made to the St. Louis Blast Furnace Company during 1909 and 1910: (No. 7 is an average of 10 shipments.)

Number.	Iron.	Silica.	Phos.	Mn.	Moisture.
1	44.87	19.50	0.038	0.60	2.00
2	46.76	18.84	0.031	0.74	3.80
3	48.28	16.00	0.038	0.63	4.00
4	49.10	15.25	0.044	0.95	3.00
5	50.85	12.70	0.063	0.68	2.00
6	52.33	12.80	0.040	0.78	2.00
7	48.00	16.59	0.041	0.77	3.38

(C.—1910)

12. PURCELL (H. B.) LAND.

Sec. 36, T. 27 N., R. 8 E.

Limonite is found here, on the property of Mr. H. B. Purcell, as partially-exposed boulders on a rather steep hill slope. But a few of these boulders in the soil are exposed. The ore is siliceous, silica occurring as grains of sand.

(L.—1892.)

13. SMITH MINE.

Owned by J. A. Hickman, Puxico, Mo.

N. W. ¼, Sec. 33, T. 27 N., R. 8 E.

This mine, located half a mile northeast of Mingo, is situated on the south face of a hill along the side of which primary limonite outcrops over an area of about seven acres. The mine consists of an open cut 50 feet in diameter exposing a good deposit of ore of which 103 tons were mined and shipped during 1909.

The ore is both massive and cellular and is highly silicious, due to the presence of sand and fragments of chert. That shipped gave returns of 42.91% iron, 19.73% silica, 0.217% Phos., 1.44% Mn. and 3.0% moisture. (B.—1910.)

14\. TERTIARY LAND.

Owned by Mrs. N. R. Scism, Bloomfield, Mo.

W. ½, Lot 1, N. W. ¼, Sec. 2, T. 26 N., R. 10 E.

This prospect, located three miles north of Bloomfield, consists of an outcrop of Tertiary gravel which has been cemented and partly replaced by limonite, the more decomposed chert being affected the most. No developments have been made and the ore exposed in the outcrop is too silicious to be of value.

The hills in this vicinity are thickly covered with Tertiary gravels and clays. (B.—1910.)

15\. WILHELM LAND.

Owned by John Wilhelm, Puxico, Mo.

N. W. ¼, Sec. 36, T. 27 N., R. 8 E.

This prospect, located half a mile southeast of Puxico, and an equal distance from the St. Louis and San Francisco R'y., consists of an outcrop of brown ore in the form of an occasional boulder of cellular, primary limonite of the usual type. The ore is highly silicious due to the inclusion of fragments of chert and sand. No development work has been done. (B.—1910.)

REPORTED OCCURRENCES.

S. E. ¼, Sec. 3, T. 26 N., R. 8 E.
N. W. ¼, Sec. 5, T. 27 N., R. 10 E.

TANEY COUNTY.

SECONDARY LIMONITE.

1\. SYLER LAND.

S. E. ¼, N. E. ¼, and N. E. ¼, S. E. ¼, Sec. 18, T. 23 N., R. 20 W.

This property is located three-quarters of a mile south of White river and six miles east of Branson, the nearest shipping point on the White River Division of the Missouri Pacific R'y.

The outcrop consists of boulders and fragments of secondary limonite scattered over an area of about two acres. The ore, which shows both the botryoidal and dendritic structures of marcasite, is compact, dark brown, secondary limonite containing no sand and only a few fragments of chert. Dolomite, of the Jefferson City formation, outcrops at many places in the stream bed and along the sides of the ridge, indicating that the residuum at this place is thin. The crest of the ridge is thickly strewn with boulders of porous, brick-red, ferruginous chert, which has, by some, been mistaken for iron ore.

It is reported that at one time three barges of surface ore from this place were floated down the White river. The barges, however, sank before market was reached. (H.—1910.)

REPORTED OCCURRENCE.

N. W. ¼, Sec. 6, T. 22 N., R. 21 W.

TEXAS COUNTY.

Aside from one of the filled sink type, the known iron ore deposits of this county are secondary limonite. The ore occurs embedded in the residual clays overlying the Roubidoux formation which outcrops frequently. With the exception of two shallow pits on the Sutton land, no prospecting has been done and no shipments have been made. The undeveloped state of the deposits is probably due in part to inadequate transportation facilities.

HEMATITES OF THE FILLED SINKS.

1. ROGER'S MILL LAND.

N. W. ¼, N. E. ¼, Sec. 23, T. 31 N., R. 9 W.

On the property of the Missouri Iron Company.

Specular iron ore occurs here near the top of a high spur next to Arthur's creek. The ore is in pieces, mostly small, though a *few* are as much as six inches across. It is somewhat siliceous, bearing silica in the form of drusy quartz or grains of sand. Next to the creek this spur is very steep, and sandstone, in horizontal ledges, is shown. Scattered fragments of the ore are to be found with this sandstone but it is said that these fragments were carried by rolling logs, from the deposit on the top of the hill. The main exposure of the area covers perhaps twenty square yards. Within this area a shallow pit was dug and from this pit fragments of specular ore and red, sandy clay were taken out in which were found scales of specular ore and a little red hematite. Chert fragments, large and small, are found in the surface of the hill around the ore area. Some of these are coated with limonite ore. Bedded sandstone is seen still higher up the hill, a short distance away. (L.—1892.)

SECONDARY LIMONITE.

2. DUKE (M. E.) LAND.

Sec. 1, T. 30 N., R. 10 W.

Limonite is found here on a slope of a nearly flat-topped hill, scattered over several square yards, in the form of rough masses. It occurs with a few boulders and fragments of chert. It is a fair quality of iron ore. This locality is twenty miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

3. FIELD BANK.

Sec. 11, T. 30 N., R. 9 W.

Limonite occurs here over perhaps sixty square yards, on the western slope of a hill, the top of which is in cultivation and shows quite a large number of boulders of ore and no rock. The ore on the slope lies in two ravines about one hundred yards from the cultivated summit. There seems to be no ledge of ore.

Just below, on the hill, bedded limestone is exposed; surrounding the ore are fragments of chert and a few limestone blocks. This deposit is perhaps twenty miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

4. GOVERNMENT LAND NO. 6.

E. ½, Lot 3, N. W. ¼, Sec. 6, T. 29 N., R. 9 W.

On the side of a hill limonite is found covering half of an acre and within this area little but ore is seen. It is somewhat siliceous, bearing silica as fine grains of sand. In addition to being siliceous it is not compact and hard but contains soft ocherous material. Sandstone in blocks is the principal rock associated with the ore, but no ledge is uncovered. This locality is about twelve miles from the K. C., Ft .S. & M. Ry. (L.—1892)

5. SMALLEY (H. H.) LAND.

Sec. 36, T. 28 N., R. 11 W.

Limonite occurs here near the foot of a rather steep slope, as scattered boulders, over about half an acre. It is a siliceous ore containing both chert and grains of sand. Much chert is found in the form of large fragments and sharp gravel on the slope adjacent to the area showing ore. (L.—1892.)

6. SMITH (N. W.) LAND.

S. E. ¼, S. W. ¼, Sec. 4, T. 30 N., R. 9 W.

A small amount of limonite is found on the surface at this locality and several shallow pits have been dug here on a very gradual hill slope. These pits are from five to twelve feet deep and, from one or two of these several large boulders of a fair quality of limonite were removed. Some fragments of good ore occur about three hundred yards south, on the slope, associated with limestone. The deposit is situated about twenty-three miles from the K. C., Ft. S. & M. Ry. (L.—1892.)

7. SUTTON (T. J.) LAND.

S. ½, N. E. ¼, Sec. 14, T. 30 N., R. 9 W.

Limonite occurs here in scattered masses on a gradual slope. Two shallow holes have been dug; in one several pieces of iron were found and in the other limestone was reached. This ore is semi-stalactitic in form and of good quality. (L.—1892)

REPORTED OCCURRENCES.

B. Ziegler—N. E. ¼, N. W. ¼, Sec. 14, T. 31 N., R. 9 W.
Sec. 36, T. 28 N., R. 7 W.
N. E. ¼, & S. E. ¼, Sec. 18, T. 28 N., R. 11 W.

WARREN COUNTY.

HEMATITES OF THE CARBONIFEROUS.

I. SANDMEYER LAND.

Owned by E. Sandmeyer, Warrenton, Mo.

W. ½, Sec. 21, T. 46 N., R. 2 W.

This prospect, located about four miles south of Warrenton, consists of scattered boulders of residual red and blue hematite situated on the north bank of a ravine. No developments have been made. Residual chert fragments occur intermingled with the ore.

Limestone, probably of Trenton age, outcrops at intervals along the bed of the ravine, below the ore outcrop, while west and southwest of the exposure of iron, fire clay outcrops at several places. (H.—1910.)

WASHINGTON COUNTY.

With the exception of a few filled sink deposits of red and specular hematite in the extreme northwestern corner of this county, the known deposits of iron ore consists of secondary limonite which occurs embedded in the residual clay overlying the Potosi and Bonneterre formations. According to Dr. Litton*, some ore was mined in this county as early as 1823 or '24 when the Eversol, Perry and Ruggles furnace was erected between Potosi and Caledonia. Here brown ore, obtained from Clear Creek and Absalom Eaton's place, was smelted and made into bar iron. The first blooms were made in 1832. Because of the great expense of transporting the furnace products this enterprise was soon abandoned. The next attempt to utilize the iron ore of this county was in 1859 when the Irondale furnace was built and secondary limonite obtained from the hills about two miles to the west, mixed with more or less Iron Mountain ore, was smelted. In 1873 the Hamilton Iron Works were built in the northwestern corner of the county and considerable red and specular hematite from deposits in that vicinity must have been mined to supply these works. Since the abandonment of this enterprise in 1876, no iron ore has been mined in this county. No records of productions have been obtained, but it is evident that during the life of its three furnaces, the county must have produced no inconsiderable quantity of iron ore.

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*Litton, A., Preliminary report on some of the principal mines in Franklin, Jefferson, Washington, St. Francois, and Madison counties, Missouri: Missouri Geol. Survey Rept., 1855, Part II, p. 73.

HEMATITES OF THE FILLED SINKS.

1. BLANTON SPECULAR MINE.

N. ½, S. E. ¼, Sec. 29, T. 40 N., R. 1 W.

Some rounded surface ore, mostly small, is found here, on three spurs of a low ridge. The spurs point about north and strata of solid sandstone crop out at the foot of each. A hole, dug fifteen feet deep on the top of the most eastern spur, passed through drifted, sandy detritus, with little ore, then struck a layer of chert. This bank is on a hill thickly covered with detritus, through which single pieces of specular ore are unequally distributed. The ore itself is of good quality. (S.—1872.)

2. PRIMROSE HILL MINE.

S. W. ¼, N. W. ¼, Sec. 32, T. 40 N., R. 1 W.

This mine is of similar character to the Blanton bank. The surface ore, mostly small and rounded, occurs on the inner side of a high horse-shoe shaped ridge, enclosing a deep ravine. Pieces of hard sandstone, with quartz cement, and of ordinary soft sandstone, are also found on the surface. The ridge was investigated by three shafts, one on the northern slope of the western spur, the others on the inner slope of the central and highest portion of the horse-shoe. Neither of these shafts reached solid rock. The two upper shafts are forty feet deep, in fine, sandy detritus, mixed with streaks and irregular masses of soft, red hematite and of broken stalactites or half decomposed specular ore, sometimes cemented by soft sandstone. (S.—1872.)

SECONDARY LIMONITE.

3. ADAMS PROPERTY.

Owned by Dan Adams and Walton Bros., Belgrade, Mo.

N. E. ¼, Sec. 4, T. 35 N., R. 2 E.

This property is located 16 miles southwest of Irondale, the nearest shipping point on the St. Louis, Iron Mountain and Southern R'y. The outcrop is situated on the north slope of a hill and consists of boulders of limonite scattered over an area of about 10 acres. The Belgrade-Caledonia road traverses the area and in the ditches on either side is exposed a large amount of ore embedded in red clay. Outcrops of Bonneterre dolomite occur near the base of the hill and in places are partly covered by residual ore.

The ore is dense, secondary limonite, many of the large boulders containing a core of unaltered marcasite. No chert or sand was observed associated with the ore. (B.—1910.)

4. BLANTON LIMONITE BANK.

S. ½, S. W. ¼, Sec. 29, T. 40 N., R. 1 W.

The limonite bank here is on the southern slope of the Blanton hills. The surface ore occurs in pieces and large boulders and can be traced about one hundred and fifty feet down the slope and sixty feet along the slope. On the hill above the ore sandstone and chert in blocks and fragments occur; in the ravine or branch at the foot of the hill bedded limestone is found exposed.

(S.—1872.)

5. DESLOGE LAND.

Owned by H. Desloge, Desloge, Mo.

N. E. 1/4, Sec. 30, T. 36 N., R. 2 E.

This property is located 11 miles southwest of Irondale, the nearest shipping point on the St. Louis, Iron Mountain and Southern R'y. The outcrop consists of boulders of secondary limonite, which are scattered for a distance of a quarter of a mile along the crest of a northeast trending ridge. The ore varies in texture from dense to slightly cellular, the small cavities of the latter being usually filled with red clay. Thin seams of ochre impart a mottled appearance to some of the ore boulders. No chert or sand was observed associated with the ore. (B.—1910.)

6. NICHOLSON BANK.

Owned by W. E. Nicholson, Belgrade, Mo.

N. E. 1/4, Sec. 33, T. 36 N., R. 2 E.

This bank is located eight miles southwest of Irondale, the nearest shipping point on the St. Louis, Iron Mountain and Southern R'y. The outcrop consists of boulders of limonite exposed immediately below the crest and on both sides of a southeast trending ridge. At one time several test pits were sunk on the outcrop, but these have since been filled by caving.

The ore is secondary limonite containing no chert, but a small amount of sand. Many of the boulders contain small lenses of ochre.

Mr. Nicholson reports that a small amount of the ore was hauled to Bonneterre, where it was used as a flux in lead smelting. (B.—1910.)

7. PREWITT MOUNTAIN.

Owned by O. W. Ramsey, Bismarck, and S. C. Crommer, Belgrade, Mo.

Sec. 16, T. 35 N., R. 2 E.

This property is located 16 miles southwest of Irondale. The outcrop consists of boulders of secondary limonite scattered about the base of a small spur between Prewitt and Tullock mountains. A test pit 12 feet in depth on the top of the spur encountered decomposed chert and drusy quartz fragments, but no ore.

The ore in the outcrop is quite porous and the cavities contained silicious, ocherous material. (B.—1910.)

REPORTED OCCURRENCES.

N. W. ¼,	N. E. ¼,	Sec. 7,	T. 35 N.,	R. 1 E.
S. W. ¼,	N. W. ¼,	Sec. 7,	T. 35 N.,	R. 1 E.
	S. W. ¼,	Sec. 7,	T. 35 N.,	R. 1 E.
N. W. ¼,	N. W. ¼,	Sec. 17,	T. 35 N.,	R. 1 E.
N. W. ¼,	N. E. ¼,	Sec. 18,	T. 35 N.,	R. 1 E.
		Sec. 13,	T. 35 N.,	R. 2 E.
N. E. ¼,	N. E. ¼,	Sec. 14,	T. 35 N.,	R. 2 E.
S. W. ¼,	N. W. ¼,	Sec. 13,	T. 35 N.,	R. 3 E.
S. W. ¼, N. E. ¼, and N. W. ¼, S. E. ¼,		Sec. 16,	T. 35 N.,	R. 1 W.
N. E. ¼,	N. E. ¼,	Sec. 24,	T. 36 N.,	R. 1 E.
	N. E. ¼,	Sec. 27,	T. 36 N.,	R. 2 E.

S. W. ¼,	S. E. ¼,	Sec. 16,	T. 36 N.,	R. 3 E.
Lot 1,	N. E. ¼,	Sec. 3,	T. 38 N.,	R. 1 W.
Lot 2,	N. E. ¼,	Sec. 3,	T. 38 N.,	R. 1 W.
Lot 1,	N. E. ¼,	Sec. 4,	T. 39 N.,	R. 1 E.
S. E. ¼,	N. W. ¼,	Sec. 33,	T. 39 N.,	R. 1 E.
S. W. ¼,	N. W. ¼,	Sec. 31,	T. 40 N.,	R. 1 W.
S. W. ¼,	S. E. ¼,	Sec. 33,	T. 40 N.,	R. 1 W.

WAYNE COUNTY.

Wayne county ranks eighth in the production of iron ore, having an accredited output of 52,342 tons. With the exception of two undeveloped deposits of specular ore in porphyry, the iron deposits of this county consist of secondary and primary limonite, the relative abundance, distribution, and locations of which are shown on the accompanying county map. The secondary deposits are of both the boulder and pipe varieties which are indicated on the map by separate symbols. The primary deposits are typical of those of Southeast Missouri. Both types of limonite occur embedded in cherty Cambrian residuum which is very thick, frequently exceeding 150 feet. Aside from the area occupied by the pre-Cambrian hills in the northern portion of the county, outcrops of the underlying formations, consisting chiefly of Roubidoux sandstone with some Gasconade limestone, occur only at intervals along the larger streams.

Iron ore was first mined in this county in 1883 when several mines in the vicinity of Leeper were opened and operated intermittently until 1888 producing in all about 3000 tons of secondary limonite. During the years 1889-1905 very little work was done but since 1905 shipments have been made each year. Thirty-seven secondary and sixteen primary limonite mines have been opened and four log washers, two at Greenville, one at Williamsville, and one at Taskee have been built. Of the total production, 44,864 tons were secondary, and 7,478 tons primary limonite.

SPECULAR ORE IN PORPHYRY.

I. CHEENEY BANK.

N. E. ¼, S. E. ¼, Sec. 21, T. 29 N., R. 4 E.

Specular ore of very fine quality was here found scattered over a large surface down the south slope of a high ridge, between and in two ravines, and a considerable distance down the main ravine formed by the union of these two. A number of cuts and test pits had been dug between the ravines in search of specular ore, but no large mass of it had been found. At the time of examination, one shaft had reached a depth of 30 feet, but no specular ore was found after passing the first four or five feet below the surface. The same thing was noticed in the cuts below this shaft. The specular ore occurred in clay quite near the surface. The shaft was sunk in a red clay with much broken, ferruginous chert intermixed. In the cut and shaft at top of the hill, considerable limonite was found in scattering pieces. No rock was seen in position anywhere near this bank. The top of the hill was covered with chert and sandy limestone, and much ferruginous chert was found in the cuts.

It is reported on reliable authority that afterwards another shaft was sunk about half way between the 30 foot shaft last described and the top of the hill. A large boulder of ore was found here near the surface, and ore in larger and smaller pieces in the clay and chert all the way down, to a depth of 70 feet, where the shaft stopped without reaching solid rock. (M.—1873.)

2. CLARK'S MOUNTAIN.

W. ½, S. E. ¼, Sec. 5, T. 29 N., R. 4 E.

On Clark's Mountain, in Wayne county, large boulders of specular ore have been found. An attempt to locate the vein from which these boulders were derived met with no success. Shafts were sunk in the clay in which the boulders were embedded, but they are reported not to have reached the porphyry. There is no certainty that this locality has been thoroughly explored. It was not visited, as no work had been done for several years and whatever holes had been dug had long since fallen in. (N.—1892.)

SECONDARY LIMONITE.

3. ALLEY MINE.

Owned by P. B. Alley, Greenville, Mo.

E. ½, S. E. ¼, Sec. 23, T. 28 N., R. 5 E.

This mine is located 1½ miles southwest of Greenville, and about half a mile south of the Williamsville, Greenville and St. Louis R'y. It is situated near the crest of the west slope of a hill which rises fully 150 feet above the valley. Developments consist of two cuts 30 to 40 feet in diameter and 15 feet deep from which 184 tons of ore were mined and shipped in 1907. Some ore is exposed in the bottom of the cuts, but there is very little shown in the faces.

The ore consists of typical secondary pipe and boulder limonite, a considerable proportion of which is small and can be recovered only by washing. Analysis of one shipment showed 55.40% iron, 6.90% silica, 0.070% Phos., 0.11% Mn., and 5.00% moisture. (C.—1910.)

4. ANDERSON BANK.

Owned by N. M. Anderson, Gads Hill, Mo.

S. W. ¼, Sec. 3, T. 29 N., R. 3 E.

This bank, located two miles southwest of Gads Hill and 300 yards west of the St. Louis, Iron Mountain and Southern R'y., is situated on the crest of a low ridge. There is practically no outcrop, but two test pits, each three feet in depth, show boulders of ore embedded in clay.

The ore is a secondary limonite, chiefly of the pipe variety. No shipments have been made. (B.—1910.)

5. ## ANDERSON MINE.

Owned by N. M. Anderson.

Sec. 2, T. 29 N., R. 3 E.

This mine, located 1½ miles south of Gads Hill, is situated on the south slope of a steep hillside upon which there are numerous boulders of porphyry, but practically no ore outcrop. Developments consist of an open cut 70 feet long and 15 feet wide, the walls of which show boulders and fragments of brown ore embedded in a cherty clay.

The ore is a secondary limonite, chiefly of the pipe variety and contains no chert or sand. The small fragments, which constitute a large part of the deposit, can be recovered only by washing. Three cars of boulder ore are reported to have been mined and shipped during 1908. (B.—1910.)

6. ## BAILEY MINE.

Owned by Henry Bailey, Taskee, Mo.

N. E. ¼, N. W. ¼, Sec. 29, T. 27 N., R. 6 E.

This mine, located two miles southeast of Taskee, is situated near the base of the east slope of a high hill. It consists of several small cuts from which about a car load of brown ore has been mined and shipped.

The ore is a secondary limonite, chiefly of the pipe variety. The outcrop extends over an area of approximately half an acre in the immediate vicinity of the pits. (C.—1910)

7. ## BEAR MOUNTAIN BANK.

N. W. ¼, Sec. 2, T. 29 N., R. 3 E.

On the base of Bear Mountain, an oblong porphyry hill, limonite is found covering several localities. Detritus of sandy limestone, chert, clay and broken porphyry cover the base of this hill for about one hundred and twenty-five feet up, and it is in this that the ore is found. These ore localities cover areas from eighty to two hundred and fifty feet long and from twenty to fifty feet wide. Several shafts and cuts have been dug in search of a solid body of ore. The lower cut was run altogether in a light colored clay. The upper one revealed, at the end, a considerable mass of broken limonite lying in cherty clay and a disturbed, decomposed sandy limestone. The shaft above the cut was sunk thirty feet, in light colored clay or decomposed chert passing through a few thin seams of ore, and ending in the clay without reaching any solid body of ore. The upper shaft was only a few feet deep, all in the same clay. The ore in the upper cut is much broken and shattered, and has considerable chert mixed with it. Upon the surface much ore is of stalactitic structure, and quite pure. (M.—1873.)

8. ## BINGHAM MINE.

Owned by The Wayne Iron and Lumber Company, Greenville, Mo.

S. ½, S. W. ¼, Sec. 27, T. 28 N., R. 5 E.

This mine, located upon the north slope of a hill immediately north of the Sawyer mine, consists of two open cuts from which several car loads of brown ore were shipped during 1909. Each cut is 50 feet long by 30 feet wide and has a maximum depth of 20 feet. There is considerable ore exposed in the faces and bottoms of these cuts and a strong outcrop covers an area of about two acres immediately adjacent to them. The ore is a secondary limonite very largely of the pipe variety. There is, however, some boulder ore enclosing fragments of chert. A mine sample taken and analyzed by the Wayne Iron Company, showed 59.74% iron, 1.45% silica, 0.04% Phos., and 3.50% moisture. Much of the ore is small and can be recovered only by washing. The mine is connected by means of a spur to the main line of the Williamsville, Greenville and St. Louis R'y. (C.—1910.)

9. BOWMAN BANK.

Owned by Bowman-Fayne and Company.

N. W. ¼, N. E. ¼, Sec. 15, T. 27 N., R. 5 E.

This bank, located three miles northeast of Williamsville and about a quarter of a mile north of the St. Louis and San Francisco R'y., is situated on the north slope of a high hill where brown ore outcrops over an area of approximately three acres. Developments consists of one cut extending 30 feet into the hill, four test pits from five to seven feet deep, and a 24 foot shaft sunk near the face of the cut.

From each of these openings secondary limonite,—chiefly of the pipe variety,—has been mined. The deposit is reported to have produced about one-third ore by hand picking, while the dump shows a good wash dirt remaining. With the exception of one pit, the ore occurred at the surface and is reported to have extended to the bottom of the 24 foot shaft. This bank was opened in 1909, at which time approximately 50 tons of ore were mined. No shipments have been made.

Situated near the top of the main ridge and about 200 yards east of the above bank, are five pits ranging from 4 to 14 feet in depth. With the exception of one shallow pit, these openings encountered good pipe and boulder ore in a cherty clay. The proportion of ore to dirt is somewhat lower than in those pits already described. (C.—1910.)

10. BUFFINGTON MINE.

Owned by A. Long, Greenville, Mo.

N. W. ¼, S. E. ¼, Sec. 13, T. 27 N., R. 4 E.

This mine, located two miles northwest of Williamsville, is situated in a small ravine surrounded by high, chert covered hills. The outcrop consisted of occasional boulders of pipe ore near the base of a hill. It has been opened by a single cut 40 feet wide and 12 feet deep from which 230 tons of ore were mined and shipped during 1910.

The ore is a secondary limonite, very largely of the pipe variety and occurs embedded in cherty, red clay. Massive boulders, when broken, show stalactitic structure in cross section. Only the coarser ore was loaded and much small wash ore was thrown upon the dump. Very little chert is enclosed by the ore, and it is very uniform in grade.. An average analysis of the seven car loads shipped showed iron 53.46%, silica 9.45%, Phos. 0.097%, Mn. 0.10%, and moisture 3.26%.

The ore was hauled two miles by wagon to Williamsville. (C.—1910.)

11. BURKETT MINE NO. 1.

Owned by J. M. Burkett, Williamsville, Mo.

N. E. ¼, S. W. ¼, Sec. 32, T. 27 N., R. 5 E.

This mine, located two miles south of Williamsville, and half a mile south of the Black river, is situated near the base of the west slope of a high, chert covered hill. The outcrop is composed of fragments and boulders of secondary limonite scattered over an area of about one acre. Developments consist of several shallow cuts, one of which extends 30 feet into the hill showing a face of eight feet. Two others, each 12 feet square, show faces of about four feet. These openings bottomed on sandstone, which outcrops near by in a ledge four to five feet thick.

The ore occurs in a thin bed just above the sandstone and as loose fragments in the overlying cherty, residual clay. A four-foot pit sunk in the sandstone in the bottom of the larger cut is reported to have shown a little ore beneath the first layer of sandstone, and to have bottomed in sandstone. The ore is a rather dense, light brown limonite, very free from chert and sand. It lies directly upon and conforms by sharp contact to the irregularities in the surface of the sandstone which is but slightly stained with iron even at the contact with the ore. A fresh fracture in the ore exhibits dendritic forms and structures common to marcasite of which it is an alteration product.

This mine was opened during 1909 when one car load of ore, giving returns of 56.11% iron, 6.60% silica, 0.070% Phos., 0.18% Mn., and 2.00% moisture was mined and shipped. Work was suspended because of the shallow nature of the ore body. (C.—1910.)

12. BURKETT MINE NO. 2.

S. W. ¼, S. W. ¼, Sec. 32, T. 27 N., R. 5 E.

This mine, located about 2½ miles south of Williamsville, is situated near the crest of the west face of a high hill where cherty brown ore outcrops over an area 100 feet in diameter. A small cut shows at the surface about three feet of ore mixed with clay beneath which is a red clay containing only a few boulders of ore. The ore is a secondary limonite but is rather silicious, due to enclosed chert. One car load, which was mined and shipped during 1909, gave returns of 50.95% iron, 11.94% silica, 0.070% Phos., 0.18% Mn., and 4.00% moisture.

(C.—1910.)

13. CADY MINE.

Owned by The Wayne Iron and Lumber Company, Greenville, Mo.

S. ½, S. E. ¼, Sec. 22, T. 27 N., R. 5 E.

This mine, located 2½ miles east of Williamsville, is situated at the foot of the south slope of a high, chert covered hill.

Developments consist of a series of irregular pits, ranging from 20 to 50 feet in diameter and from 8 to 24 feet in depth, a number of which have been connected, forming a very irregular opening, extending laterally fully 400 feet along the base of the hill. From these openings 3,659 tons of boulder ore were mined and shipped during 1908, '09, and '10.

The ore consists chiefly of pipe limonite and occurs embedded in a red and yellow clay, containing very little chert. The ore fragments vary greatly in size, ranging from those two feet or more in diameter to those too small to be handled with a loading fork. The fine ore is quite abundant and can only be saved by washing. Eleven shipments showed an average analysis of 55.51% iron, 7.55% silica, 0.078% Phos., and 3.3% moisture.

This property is leased by the St. Louis Blast Furnace Co. at a royalty of twenty cents per ton. The mine is worked on what might be designated as the Contract System, as each miner is given charge of his own heading, and is paid one dollar per ton for the ore produced. The ore is hauled by wagon 1¼ miles to the St. Louis, Iron Mountain and Southern R'y. at Blum. (C.—1910.)

14. CEDAR BAY MINE.

Owned by J. L. Clarkson, Sr., and heirs of J. G. Clarkson.

Secs. 14 and 23, T. 28 N., R. 3 E.

This bank, located two miles north of Leeper, is situated at the head of a ravine in an area of thick residuum. According to Nason, the bank was opened in 1882 and was worked intermittently until 1888, during which time several thousand tons of ore were mined and shipped. Developments consisted of a large cut 40 feet deep and numerous small pits. The face of the cut showed large masses of an iron-chert breccia in which the iron comprised the greater portion of the mass and formed a workable ore. Overlying the ore is 20 feet of barren clay and broken chert in alternate layers. The ore consists chiefly of the pipe variety with some shelly limonite which contains a small amount of sand. No rock outcrops occur in the immediate vicinity of the bank.

15. CHILDRESS MINE.

Owned by Bowman, Fayne and Company.

N. E. ¼, N. E. ¼, Sec. 11, T. 27 N., R. 5 E.

This mine, located two miles northwest of Taskee, is situated on the south slope of a high, chert covered hill, half a mile north of Otter creek. Developments consist of an open cut 45 feet long, 25 feet wide, and 12 feet deep, the entire face of which shows a 50 to 70% ore bearing dirt. The ore is almost entirely of the pipe variety, most of which is in small fragments.

A 12 foot pit, 300 yards to the north of the cut, and one shallow pit 100 yards to the southeast of it, show an abundance of pipe limonite embedded in clay.

The above developments were made in 1908, and about ten car loads of 54% ore are reported to have been mined and shipped. (C.—1910.)

16. CLUBB MINE.

Owned by Wayne Iron and Lumber Company, Greenville, Mo.

N. W. ¼, N. W. ¼, Sec. 23, T. 28 N., R. 5 E.

This mine, located 1½ miles southwest of Greenville, lies about half way up the west slope of a high, chert covered hill. Very little ore was observed to outcrop in the vicinity. Developments consist of a small open cut and two shallow pits from which a car load of ore is reported to have been shipped in 1909.

The ore is a secondary limonite, occurring chiefly in tabular form, mixed with a good deal of clay. A large proportion of that showing in the face of the cut occurs as small fragments. (C.—1910.)

17. CULLNAN BANK.

Owned by Pat Cullnan, Keener, Mo.

N. W. ¼, S. E. ¼, Sec. 6, T. 26 N., R. 6 E.

This bank, located 3½ miles east of Keener, is situated on the west slope of a hill where secondary limonite outcrops over an area of several acres. A shallow 50 foot trench, dug near the upper portion of the deposit, produced several tons of ore. The ore exhibits the usual forms of secondary limonite and is comparatively free from silicious material. The depth of the ore is not known. No shipments have been made. (C.—1910.)

18. DALTON (MRS. N. T.) LAND.

Sec. 11, T. 28 N., R. 5 E.

Massive limonite occurs here, covering an area about thirty yards square on a gentle slope. The ore is in the form of large fragments. It is silicious, silica occurring as small angular chert pieces.

This deposit is a little more than one mile from Greenville, which is at the terminus of the W., G. & N. Ry. Several small patches of ore, similar to the one just described, are found on this range of hills. (L.—1892.)

19. DANIEL MINE.

Owned by Miss Daniel, Piedmont, Mo.

S. E. ¼, Sec. 25, T. 29 N., R. 3 E.

This mine, located half a mile east of Piedmont, is situated on the south slope of a steep hill. It consists of an open cut 100 feet long, having a maximum depth of 20 feet. Dolomite outcrops on either side of the cut at the same elevation as the ore body.

The ore is secondary limonite, chiefly of the pipe variety and occurs embedded in a slightly cherty, red clay. This mine was opened about fifty years ago but no recent work has been done. (B.—1910.)

20. DICKSON MINE.

Owned by The Wayne Iron and Lumber Company, Greenville, Mo.

Lot 7, N. W. ¼, Sec. 6, T. 27 N., R. 6 E.

This mine, located three miles south of Greenville, was not visited by a member of this department, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened in 1910, when 66 tons of ore were mined and shipped. The ore ran 52.21% iron, 11.00% silica, 0.117% Phos., 0.10% Mn., and 3.00% moisture, indicating that it is a somewhat silicious limonite of the secondary type. (C.—1910.)

21. DURROW LAND.

Owned by John Durrow, Taskee, Mo.

N. E. ¼, S. E. ¼, Sec. 26, T. 27 N., R. 5 E.

This prospect, located 4½ miles east of Williamsville, and two miles southwest of Taskee, is situated on the north slope of a gentle hill where large and small fragments of brown ore occur scattered over an area of about half an acre. The ore is a rather dense, even textured, secondary limonite which is entirely free from sand and contains very little enclosed chert. No development work has been done. (C.—1910.)

22. EARLY BANK.

Owned by James Early.

S. E. ¼, Sec. 6, T. 28 N., R. 4 E.

This deposit, located 3½ miles southeast of Piedmont, is situated upon the middle slope of a steep, chert covered hill. Developments consist of three shallow pits, the walls of which show boulders of brown ore embedded in cherty clay.

The ore is a secondary limonite, chiefly of the pipe variety, and contains no chert or sand. The extent of the deposit has not been determined. (B.—1910.)

23. EASTMAN MINE.

Owned by F. W. Eastman, Keener, Mo.

S. E. 1/4, S. W. 1/4, Sec. 2, T. 26 N., R. 5 E.

This mine, located one mile east of Keener, is situated on the east face of a chert covered ridge. It consists of a single cut, 50 feet long, 30 feet wide and 10 feet deep from which about 120 tons of ore have been mined.

The ore, which is a secondary limonite of the pipe and boulder type, is mixed with cherty clay and lies in a pitching sheet or blanket, conforming closely to the slope of the hill. The cut passed through it, exposing clay and flint underneath. The dump shows a considerable quantity of small ore, which could be recovered by washing.

The above developments were made during 1905. Sixty tons of ore shipped during 1909, gave returns of 53.48% iron, 11.00% silica, 0.104% Phos., 0.10% Mn., and 3.00% moisture. (C.—1910.)

24. ESTES MINE.

S. 1/2, Lot 1, N. W. 1/4, Sec. 19, T. 27 N., R. 6 E.

This mine, located one mile south of Taskee, and half a mile south of Otter creek, consists of an almost continuous succession of shallow cuts extending for a distance of 300 yards along the crest of a narrow, southwest ridge. The pits farthest to the northeast are irregular in shape and shallow. They are in a worked out condition, the faces showing practically nothing but clay and chert. The waste dirt from these pits contains too little ore to wash profitably.

Several of the cuts near the southwest end of the ridge were originally 10 to 12 feet deep but they are now so badly caved that but little of the working face can be seen. The waste dirt from these pits, however, contain from 40 to 50% of wash ore. A 20 foot pit, sunk at this point, is said to have encountered ore to a depth of 15 feet. This would indicate that ore may be found in the bottom of the old openings.

The ore is secondary limonite, chiefly of the pipe variety, of which about 1,000 tons have been mined and shipped. An average analysis of six shipments showed 55.13% iron, 0.087% Phos., 8.31% silica, 0.10% Mn., and 4.1% moisture.

(C.—1910.)

25. ETHRIDGE MINE.

Owned by Mathew Ethridge, Keener, Mo.

S. W. 1/4, S. W. 1/4, Sec. 1, T. 26 N., R. 5 E.

This mine, located two miles east of Keener, is situated upon the southeast point of a secondary ridge. It consists of two open cuts which extend 20 and 40 feet into the hillside, showing faces approximately 10 feet in height. The ore is a secondary limonite occurring in the form of pipes and boulders embedded in a cherty clay. Some of the chert adheres to the ore but does not appear to be generally included. This mine was opened during 1908 and is reported to have produced 140 tons of ore which ran from 52 to 55% iron. One shipment of 24 tons, made during 1909, showed 51.63% iron, 13.16% silica, 0.060% Phos., and 3.00% moisture. (C.—1910)

26. FORBES MINE.

S. E. ¼, N. W. ¼, Sec. 12, T. 27 N., R. 5 E.

This mine, located 1¾ miles north of Taskee and half a mile north of Otter creek, is situated near the base of the north slope of a high, chert covered hill. Developments consist of an open cut, 30 feet long, 4 to 8 feet wide, and from 5 to 20 feet deep, from which 60 tons of ore were mined and shipped during the summer of 1909. The mine is now virtually in a worked out condition.

The ore is secondary limonite, chiefly of the pipe variety. A few small pits above the main cut show a little ore. The outcrop consisted of a few boulders of pipe ore on the present site of the pit. (C.—1910.)

27. FOSTER MINE.

Owned by Mrs. Foster, St. Louis, Mo.

N. E. ¼, S. E. ¼, Sec. 31, T. 27 N., R. 6 E.

This mine, located three miles south of Taskee, is situated near the base of a hill where secondary limonite outcrops over an area of 1½ acres. Developments consist of a single cut 100 feet long, 40 feet wide, and about 12 feet deep from which eight cars of ore are reported to have been shipped. In the upper three or four feet of the face, large and small boulders of limonite occur embedded in a matrix of chert and clay. Below this, the ore occurs embedded in soft ocher and comprises 70 to 80% of the face. This is especially true of the south end of the cut where this type of ore extends to the grass roots. Most of the ore bearing material is almost free from chert and would either screen or wash to advantage. An eleven foot pit in the bottom of the cut is reported to be entirely in ore, indicating a total thickness of at least 20 feet.

Mining operations were carried on during 1906 and the ore was hauled three miles over a ridge road to Keener. (C.—1910.)

28. FREDRICK MINE.

Owned by James Fredrick, Taskee, Mo.

S. ½, Lot 2, S. W. ¼, Sec. 18, T. 27 N., R. 6 E.

This mine, located about half a mile south of Taskee, is situated on the west bank of a ravine 50 feet west of the county road. It consists of three small pits, the largest of which is about 12 feet in diameter and 8 feet deep. From these pits about a car load of secondary pipe and boulder ore was shipped during 1908. The present face of the largest pit shows considerable ore mixed with clay and chert.

Two hundred yards to the south are two small pits, from which the same type of ore has been mined. The outcrops are restricted, in each case, to the immediate vicinity of the development work. (C.—1910.)

29. GUEST BANK.

Owned by W. S. Guest, Piedmont, Mo.

N. E. ¼, Sec. 35, T. 29 N., R. 3 E.

This bank, located half a mile southeast of Piedmont, is marked by an outcrop of secondary limonite in the form of boulders and pipes, covering an area of approximately one acre on the west slope of a high hill. Several shallow pits within the outcrop show the ore to carry a small amount of chert. No shipments have been made. (B.—1910.)

30. GUEST LAND.

Owned by W. S. Guest, Piedmont, Mo.

N. E. ¼, Sec. 36, T. 29 N., R. 3 E.

This deposit, located one mile southeast of Piedmont, consists of an outcrop of brown ore, 60 yards square, occurring at the north base of a hill.

The ore is secondary limonite, of which both the pipe and boulder forms are represented in the outcrop. The pipes are quite small and usually occur in clusters. The boulder ore is compact and does not show the pipe structure. No developments have been made. (B.—1910.)

31. HARNESS AND LUNDY MINE.

N. E. ¼, N. W. ¼, Sec. 34, T. 28 N., R. 5 E.

This mine, located 3½ miles southwest of Greenville, is situated on the south slope of the hill directly north of the Sawyer mine. It consists of a large, shallow cut, covering an area of about an acre, over which pipe ore outcropped in abundance. The ore is a secondary limonite, very largely of the pipe variety, and occurs as large and small fragments embedded in cherty clay. It was most abundant in the first few feet of surface dirt, but has been mined to a depth of 15 feet, below which ore occurs but no work has been done.

This mine was opened in 1908, and, during that and the following year, produced approximately 8,000 tons of ore which averaged 54.61% iron, 8.76% silica, 0.088% Phos., 0.215% Mn., and 3.50% moisture. (C.—1910.)

32. HAYNIE HOLLOW BANK.

Sec. 5, T. 27 N., R. 5 E.

Massive limonite occurs here about half way up the slope of a moderately steep hill. It is found as boulders, and, in one locality, as what appears to be a ledge. Portions of the ore are botryoidal. Some of the boulders are porous with ocherous particles and others contain many fragments of chert. The ore covers an area twenty or thirty square yards in extent. It occurs, not with bedded rock, but with chert in the form of loose fragments and boulders. This deposit lies about one mile from the W., G. & N. Ry., about the same distance from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

33. HAYNIE (S. C.) LAND.

S. W. ¼, Sec. 17, T. 27 N., R. 5 E.

Here several large boulders of limonite are strewn promiscuously over the face of a rather steep hill, on the surface of which are also found scattered boulders and pieces of chert. No bedded rock is exposed. The ore is quite compact, and, but for the small angular fragments of white chert which are cemented by the ore, contains but a small percentage of silica. This small deposit is located but a short distance from the W., G. & N. Ry. (L.—1892.)

34. HICKS MINE.

Owned by Andrew Hicks, Chaonia, Mo.

Lot 2, N. W. ¼, Sec. 23, T. 27 N., R. 6 E.

This mine, located about two miles northwest of Chaonia, adjoins the right of way of the St. Louis and San Francisco R'y. Brown ore outcropped on the west bank of the St. Francois river, about seven feet above low water mark. Mining operations have followed the ore into the bank 20 to 30 feet and have extended along the bank for a distance of 100 feet. The ore, embedded in red clay, forms a layer about five feet thick. It is overlain by 10 to 20 feet of barren river silt and appears to overlie a heavy, red clay containing no ore. A pit at the south end of the cut shows six feet of ore bearing clay at that point.

The ore is a secondary limonite of which about 100 tons were mined in 1909. That near the surface was mostly pipe, occurring in large clustered masses a few of which can still be seen outcropping at the water's edge. With depth, it grades into a dense, dark brown limonite, enclosing a few chert fragments but quite free from sand and of excellent grade. (C.—1910.)

35. HIGGINS MINE.

Owned by The Wayne Iron and Lumber Company, Greenville, Mo.

S. W. ¼, S. E. ¼, Sec. 5, T. 29 N., R. 7 E.

This mine, located two miles north of Hiram, is situated at the base of the west slope of a chert covered hill. It was opened in 1905 and was worked at intervals during 1906 and 1907, producing a total of about 50 car loads of ore. Developments consist of an irregular open cut 100 feet long, 80 feet wide, and 12 to 15 feet deep, the greater part of the face of which shows large and small boulders of limonite embedded in clay. A 10 foot pit, sunk in the bottom of the cut, showed ten feet of ore bearing dirt of the same character. The ore is a somewhat cherty, secondary limonite, one car load of which gave returns of 51.29% iron, 13.05% silica, 0.063% Phos., 0.10% Mn., and 4.00% water. Much of the fine ore was screened and all that would not pass a one inch mesh was loaded. A good outcrop of cherty ore surrounds the cut and reappears at intervals for a distance of 100 yards to the east.

By means of a short spur connected with the Williamsville, Greenville, and St. Louis R'y., the ore was loaded directly on board cars at the mine. (C.—1910.)

36. HOLLADAY (H. N.) AND HAYNIE (S. C.) LAND.

Sec. 20, T. 27 N., R. 5 E.

Limonite boulders, usually about one foot in diameter, and a few larger fragments of ore are exposed here over a small area, on a rather steep slope covered with fragments and boulders of white chert. The ore is somewhat siliceous, silica being contained in the ore masses in the form of scattered grains of sand. This deposit is but a short distance from the St. L., I. M. & S. Ry. and the St. L., C. G. & Ft. S. Ry. (L.—1892.)

37. HOLLIDAY-KLOTZ MINE.

Owned by the Mississippi Valley Iron and Furnace Company, Popular Bluff, Mo.

E. ½, S. E. ¼, Sec. 34, T. 27 N., R. 5 E.

This mine, located 1½ miles north of Keener and half a mile east of the Black river, consists of three or more open cuts entering the west flank of a short north and south ridge upon the crest and ends of which brown ore outcrops almost continuously over an area of approximately ten acres.

The area of outcrop has been tested by a series of 30 or more pits, ranging from 5 to 35 feet in depth. A row of 12 pits, strung along the crest of the hill, shows the ore to be pockety and to range up to 15 feet in thickness. In some places the ore disappears altogether, and it is not unusual for a blank pit to lie within 20 or 30 feet of one showing 15 feet of good ore bearing dirt. The pits showing the deepest ore are those lowest on the flanks of the outcrop. The faces of each of the cuts show a large proportion of ore bearing clay interspaced by occasional horses of barren clay. The deepest face of ore shown was about 18 feet with more ore in the bottom of the cut. In some places two to four feet of barren clay overlies the ore bearing dirt. The ore is a secondary limonite, consisting almost entirely of the boulder variety, with rare, if any, occurrence of pipes. It frequently exhibits pseudomorphs after marcasite and locally unaltered marcasite occurs incased in a hard shell of limonite. Some of it is silicious, due to the presence of enclosed fragments of chert.

This property was first opened in 1908 and during that and the following year 945 tons were mined and shipped. Shipment analyses showed the ore to average 52.08% iron, 11.79% silica, 0.083% Phos., 0.17% Mn., and 3.70% moisture.

(C.—1910.)

38. HUGHES MINE NO. 1.

Owned by W. H. Hughes, Taskee, Mo.

N. ½, Lot 1, N. W. ¼, Sec. 19, T. 27 N., R. 6 E.

This mine, located half a mile south of Taskee, is situated on the north slope of a high hill overlooking Otter creek. It consists of one cut about 50 feet in diameter and 6 to 10 feet deep, from which several car loads of ore have been mined and shipped. The ore is a secondary limonite, chiefly of the pipe variety, and occurs embedded in a cherty, residual clay. The face of the pit, where not covered by caving, shows a little ore. Two small pits on the hillside above the main opening, however, disclose good ore bearing dirt and it is probable that there is still a considerable quantity of ore to be had from this property. (C.—1910.)

39. HUGHES MINE NO. 2.

Owned by W. H. Hughes, Taskee, Mo.

N. E. ¼, N. E. ¼, Sec. 19, T. 27 N., R. 6 E.

This deposit, located half a mile southwest of Taskee, is situated on the north face, and 50 feet below the crest, of a high, chert covered hill adjoining Otter creek. There is practically no outcrop, most of the ore being exposed by a shallow cut 20 feet square and two small test pits. These openings show boulders and fragments of limonite embedded in red clay. Several cars of ore are reported to have been shipped and there is at present a small stock pile at the mine.

The ore is secondary limonite, the greater part of which occurs in pipe form. There is much fragmentary ore in the clay which could be recovered by washing.

(B.—1910.)

40. JANIS MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

Lot 5, N. W. ¼, Sec. 1, T. 27 N., R. 5 E.

This mine, located 1½ miles southeast of the Sawyer switch, is situated upon the crest of a high, chert covered ridge where brown ore outcropped over an area of about two acres. The mine consists of two open cuts, one entering the hill from the north and the other from the south, (Fig. 28). The northern cut is about 100 feet in diameter and 16 feet deep. The upper half of the face of this cut shows small and large boulders of ore embedded in red clay containing very little chert. The lower half of the face shows similar ore embedded in a soft, nearly pure, light brown ocher. The southern cut is about 100 feet long, 40 feet wide, and 8 feet deep. The face of this cut shows boulder ore in clay and is in all respects like the upper portion of the face of the northern cut.

The ore, which is a secondary limonite, contains no sand and is relatively free from chert.

Analyses of three shipments of the boulder ore, mined during 1909, showed an average of 54.11% iron, 8.74% silica, 0.092% Phos., 0.12% Mn., and 3.70% moisture. A sample of the boulder ore and ocher, in the lower 7 feet of the face of the larger cut, showed 52.16% iron, 11.58% silica, 0.013% Phos., 0.025 Sul., 1.502% Alumina, 10.74% combined water, and 0.647% moisture.

At the time the property was visited only the boulder ore was being saved while the dirt on the dump contained considerable small ore which could be recovered by washing. Up to Jan. 1st, 1911, about 1,500 tons of ore had been mined and shipped. (C.—1910.)

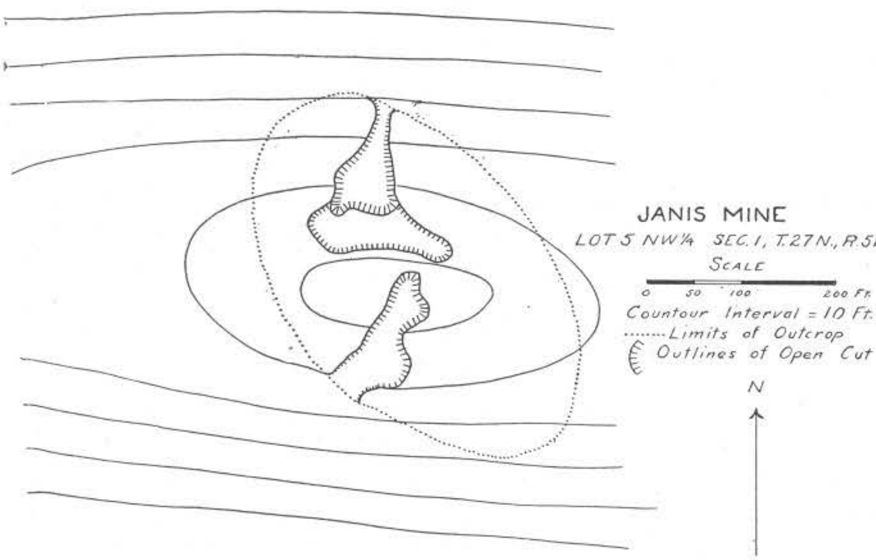

Fig. 28.

41. KEELE BANK.

Owned by Lucian Keele, Keener, Mo.

N. W. ¼, S. E. ¼, Sec. 1, T. 26 N., R. 5 E.

This bank, located about 2½ miles east of Keener, is situated on the east side and near the head of a small ravine. It has been opened by a cut 15 feet long, 10 feet wide and 8 feet deep, from which about 15 tons of ore have been mined.

The ore occurs as large and small boulders mixed with clay and flint. It is a light to dark brown, dense, secondary limonite, containing no sand and very little enclosed chert. Most of the associated chert occurs near the surface. The outcrop consists of occasional boulders and is restricted to the immediate vicinity of the pit. On the opposite side of the hill is a similar prospect also opened by a small pit. (C.—1910.)

42. KEENER MINE.

Owned by Mrs. L. Keener, Keener, Mo.

S. W. ¼, S. E. ¼, Sec. 3, T. 26 N., R. 5 E.

This mine, located half a mile east of Keener, is situated on the north slope of a high hill at the base of which brown ore outcropped in the bed of a small stream.

Developments consist of a 30 foot cut which has been made into the hill side on a level with the stream, exposing a face of 15 feet. The upper eight feet of this face consists of barren clay and flint. The lower six feet shows considerable limonite in the form of pipe, plate, and boulder ore, embedded in cherty clay. An eight foot pit, sunk in the bottom of this cut, shows similar ore throughout its depth. About one car load of ore was shipped during 1909. (C.—1910.)

43. KELLY LAND.

Owned by Thomas Kelly.

W. ½, N. E. ¼, Sec. 24, T. 30 N., R. 5 E.

This prospect, located eleven miles north of Greenville, is situated near the base of the south slope of a high granite hill where secondary limonite outcrops over an area of half an acre. The granite hill is the same as that associated with the Kinkad Land and the ore is of the same character and origin. No development work has been done. (C.—1910.)

44. KING MINE.

Owned by The Wayne Iron and Lumber Company, Greenville, Mo.

W. ½, S. W. ¼, Sec. 34, T. 28 N., R. 5 E.

This mine, located four miles southwest of Greenville and half a mile south of the Sawyer switch, is situated at the base of a north hill slope and near the head of a deep ravine. Developments consist of an irregular open pit, 100 feet long, 70 feet wide, and 20 feet deep, from which about 500 tons of ore have been mined and shipped.

The ore is chiefly of the pipe variety of secondary limonite, and occurs in large boulders and small fragments embedded in a red, cherty clay. There is also some massive boulder ore without marked stalactitic structure in the lower part of the deposit. In places the clayey gangue is replaced by a soft, red, ocherous limonite, enclosing the ore. Much of the ore consists of large bundles of slender, parallel pipes, about the size of knitting needles, which, when exposed to the air, slack and crumble into very small fragments. The dirt on the dump contains a large proportion of ore of this character, which can be saved only by washing.

This mine has produced in the neighborhood of 500 tons of ore. One hundred tons, shipped during 1909, averaged 55.41% iron, 7.55% silica, 0.074% Phos., 0.08% Mn., and 3.0% moisture. The ore was hauled by wagon half a mile and loaded at Sawyer switch. (C.—1910.)

45. KINKAD LAND.

Owned by Thomas Kinkad, Gays, Ill.

S. W. ¼, S. E. ¼, Sec. 13, T. 30 N., R. 5 E.

This property, located about 11½ miles due north of Greenville, is situated at the base of the west slope of a high, granite hill where brown ore outcrops in a ledge overhanging a small sink hole. The ore occurs as large massive boulders and rests directly upon the granite. The hill opposite is of Gasconade limestone and is chert covered. Chert fragments occur far above the ore upon the mountain side, indicating the height of the former limestone-granite contact. The ore is a secondary limonite, the original sulphides having been deposited at the former contact of the limestone with the granite. It is somewhat silicious, due to inclusions of grains of sand, but contains no chert. A small sample, analyzed with other ore of a similar character, showed 49.36% iron, 10.03% silica, 0.040% Phos., 0.155% Sul., 11.93% combined water, and 2.01% moisture. While additional ore may be located in the sink hole occurring below the outcrop, it is probable that most of the deposit is in sight. Some ore lies on the slope down to and in the sink, but this has probably fallen from the overhanging ledge of ore. (C.—1910.)

46. KISTER BANK.

N. E. ¼, N. W. ¼, Sec. 35, T. 30 N., R. 4 E.

This deposit is on the flank of the same hill as the Yancey Mountain bank described on p. 277 and similar to it in the absence of chert detritus. The ore lies some fifty or sixty feet higher on the hill, upon a ridge between two ravines, and running down into these ravines. At the bottom it is limonite of poor quality, being quite siliceous, but on ascending the hill it grows redder and leaner, and presents the same changes into an apparently decomposed red porphyry that were seen in the deposit above referred to. (M.—1873.)

47. KNOX MINE.

Owned by J. E. Knox, Granite Bend, Mo.

N. W. ¼, S. E. ¼, Sec. 3, T. 27 N., R. 4 E.

This mine, located one mile north of Granite Bend, was not visited by a member of this department, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened and worked during 1905 and 1906, at which time 46 tons of ore were mined and shipped. The ore ran 56.64% iron, 6.45% silica, 0.095% Phos., 0.19% Mn., and 3.00% moisture, indicating that it is of a secondary type of limonite. (C.—1910.)

48. LANDAU MINE.

Owned by S. Landau, Keener, Mo.

S. W. ¼, N. W. ¼, Sec. 1, T. 26 N., R. 5 E.

This mine, located two miles east of Keener, is situated in a small ravine draining to the southeast. Mining has been conducted by means of four small cuts, the largest of which is about 50 feet in diameter and shows a 12 foot face of ore bearing clay. A 25 foot pit in the bottom of this cut is said to have disclosed a nearly solid mass of ore to a depth of 12 feet. The remaining depth was in barren clay. The other three cuts are somewhat smaller and show less ore than the first. Surrounding the four cuts are 11 test pits ranging in depth from 6 to 12 feet, only two of which show a little ore.

The ore is a secondary limonite very largely in the pipe form and occurs as small fragments and large boulders embedded in cherty clay. During 1908 348 tons were shipped giving returns of 53.75% iron, 9.53% silica, 0.070% Phos., 0.12% Mn., and 5.0% moisture. (C.—1910.)

49. MANN BANK.

Sec. 21, T. 27 N., R. 6 E.

Limonite is found here on the land of Gildehaus, Wulfing and Company, covering an area about forty yards wide and eighty yards long, making up the cap of a steep hill. The ore occurs in fragments both large and small. It is ocherous and siliceous. Some of the fragments containing both chert and grains of sand, others only grains of sand. The slope of the hill is covered with chert fragments, but no bedded rock is visible. This locality is one-fourth of a mile from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

50. MAXFIELD MINE.

N. E. 1/4, N. E. 1/4, Sec. 18, T. 27 N., R. 6 E.

This mine, located about one mile northeast of Taskee, consists of an almost continuous succession of shallow cuts from 5 to 12 feet deep, extending for nearly 300 yards along the crest of a long ridge. A considerable amount of secondary pipe and lump ore has been mined and shipped from this place. The ore occurs embedded in flint and clay. The cuts are all badly filled by caving but are probably not worked out. The dumps show much good wash dirt. Some ore outcrops along the line of the workings. (C.—1910.)

51. McKENZIE BANK NO. 1.

Owned by Long and Colby Mining Company, Greenville, Mo.

N. E. 1/4, S. E. 1/4, Sec. 7, T. 29 N., R. 7 E.

This bank, located 1½ miles north of Hiram, is situated on the west bank of a small ravine. Developments consist of a cut 70 feet long by 6 feet wide, exposing a maximum face of 14 feet. Boulders and fine fragments of brown ore occur embedded in ferruginous clay and soft yellow ocher throughout the lower ten feet of the face. The upper four feet consist of barren, cherty clay.

The ore is a secondary limonite, although located in close proximity to several primary limonite deposits which occur nearer the crest of the same hill. It contains some chert but no sand. About 30 tons of ore have been mined, none of which has been shipped. (C.—1910.)

52. MORRIS BANK.

Owned by Joe Morris, Upalika, Mo.

N. W. 1/4, Sec. 21, T. 27 N., R. 4 E.

This bank, located three miles north of Upalika, is situated at the foot of a slope on the north side of a small ravine a quarter of a mile east of the Morris residence. There is practically no outcrop at this place, the presence of ore being disclosed by an open cut. The walls of the cut show pipe ore embedded in red clay. No shipments have been made, although several tons of ore were taken from the pit. (B.—1910.)

53. MORGAN MINE.

Owned by Chas. Morgan, Taskee, Mo.

N. 1/2, S. E. 1/4, Sec. 12, T. 27 N., R. 5 E.

This mine, located about one mile north of Taskee, is situated near the crest of a high hill. Developments consist of a large, irregular pit having a depth of from 10 to 12 feet.

The ore is secondary pipe and boulder limonite, enclosing occasional fragments of chert and some clay. Both the outcrop and pit have been robbed of the boulder ore and only small fragments remain. This fragmentary ore could be recovered by washing. Three car loads of ore are reported to have been shipped during 1909. (C.—1910.)

54. MOSS MINE.

Owned by John B. Fristo, St. Louis, Mo.

N. W. ¼, S. W. ¼, Sec. 20, T. 27 N., R. 6 E.

This mine, located one mile southeast of Taskee, lies near the base of a high, chert covered hill, overlooking Otter creek. It consists of a single cut, approximately 200 feet long with a maximum face of 12 to 16 feet. Several hundred tons of ore have been mined and shipped. That part of the face still exposed shows very little ore and the covered portion is reported to be equally lean. The original outcrop, which was small, occurred on the present site of the pit. The ore consists of secondary limonite of both the pipe and boulder varieties, and occurs embedded in cherty clay. There is considerable small ore mixed with the coarser lumps, and much of the dump is a good wash dirt. These developments were made from 1906 to 1908 and the ore was hauled by wagon to Taskee. (C.—1910.)

55. NELSON MINE.

Owned by Frank Nelson, Taskee, Mo.

N. E. ¼, S. W. ¼, Sec. 20, T. 27 N., R. 6 E.

This mine, located about 1½ miles southeast of Taskee, and a quarter of a mile south of Otter creek, is situated near the base of the north slope of a high hill where brown ore outcrops over an area of about an acre. Developments consist of seven shallow pits, the largest of which is about 25 feet in diameter and 10 feet deep. From these pits about 60 tons of ore are reported to have been mined and shipped. The ore is a secondary limonite, very largely of the pipe variety, containing no sand and but very little chert. (C.—1910.)

56. OJIBWAY MINE.

Owned by Alexander H. Handlin, St. Louis, Mo.

S. W. ¼, N. E. ¼, Sec. 21, T. 27 N., R. 6 E.

This mine, located half a mile north of Ojibway, is situated upon the crest of a high, chert covered hill which was capped by a strong outcrop of brown ore. The mine consists of two open cuts, one entering the hill from the north and one from the south. These cuts are about 60 feet in diameter and 14 feet deep. All the faces show considerable ore embedded in a red, cherty clay with ore still in the bottom. The depth of the deposit has not been determined.

The ore is a secondary limonite and occurs as boulders which are coated with a soft, red ocher. The surface ore contains some sand and chert but that from near the bottom of the pits is only slightly silicious. During 1906 and 1907, 1,186 tons of ore were mined and shipped, eight cars of which gave an average return of 53.24% iron, 9.63% silica, 0.055% Phos., 0.095% Mn., and 4.3% moisture. (C.—1910.)

Fig. 1. NORTH CUT OF THE OJIBWAY MINE; OJIBWAY, WAYNE COUNTY, SECONDARY LIMONITE.

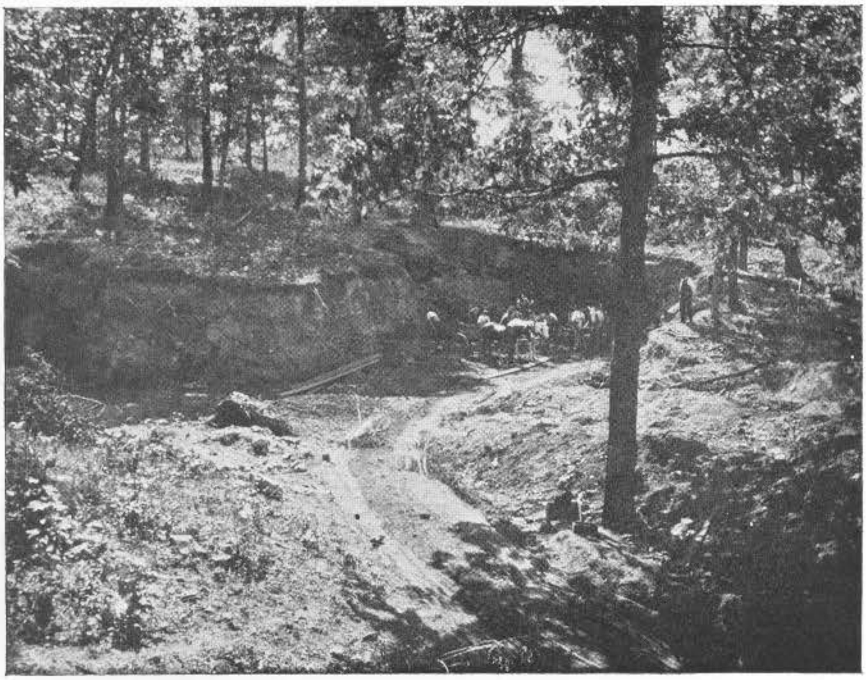

Fig. 2. KING MINE, GREENVILLE, WAYNE COUNTY, PIPE ORE.

57. O'KEEFE BANK, NO. 1.

Owned by P. O'Keefe, Granite Bend, Mo.

N. ½, S. E. ¼, Sec. 10, T. 27 N., R. 4 E.

This bank, located about three-quarters of a mile southeast of Granite Bend station, is situated in a deep ravine which pitches to the southeast from the old Granite Bend quarry. Developments consist of one shallow pit from which several tons of ore have been taken. The ore is a secondary limonite almost entirely of the pipe variety and occurs in both large and small boulders embedded in a cherty clay. The underlying formation is Roubidoux sandstone which, at this place, overlaps the granite and caps the neighboring hills. The Gasconade limestone outcrops only in the lower 40 feet of the valleys. No ore has been shipped. (C.—1910.)

58. O'KEEFE BANK NO. 2.

Owned by P. O'Keefe, Granite Bend, Mo.

S. E. ¼, N. W. ¼, Sec. 21, T. 27 N., R. 4 E.

This property, located three miles north of Upalika, has been opened by a small cut situated on the crest of a ridge.

The ore is secondary limonite of both the pipe and boulder form and occurs embedded in red clay. No shipments have been made. (B.—1910.)

59. O'KEEFE MINE NO. 1.

Owned by P. O'Keefe, Granite Bend, Mo.

N. E. ¼, N. W. ¼, Sec. 12, T. 27 N., R. 4 E.

This mine, located two miles east of Granite Bend, is situated near the head of a small northwest pitching ravine. It consists of one large cut 50 feet in diameter and 18 feet deep from which several car loads of ore have been mined and shipped. The outcrop consisted of a few boulders of ore lying in the immediate vicinity of the cut.

The ore is a secondary limonite occurring, for the most part, in large boulders which very frequently show cores of unaltered marcasite. It occurs in occasional runs and layers distributed irregularly through a large quantity of red, cherty clay which in places is very sandy and appears to have been derived from the weathering of the Roubidoux sandstone. Rounded Tertiary pebbles occur in a small pocket on the upper side of the pit. The bottom of the pit is in a light colored, sandy clay which bears very little ore. Ore is, however, reported below this. From this and mine No. 3 were shipped, during 1910, 704 tons of ore which gave returns of 53.75% iron, 9.72% silica, 0.067% Phos., 0.14% Mn., and 3.00% moisture. The ore was hauled by wagon to Williamsville, a distance of about four miles. (C.—1910.)

60. O'KEEFE MINE NO. 3.

Owned by P. O'Keefe, Granite Bend, Mo.

N. W. ¼, N. W. ¼, Sec. 12, T. 27 N., R. 4 E.

This mine, located two miles east of Granite Bend, is situated low on the south side of an east pitching ravine. It consists of an opening 40 feet long, 30 feet wide, and 10 feet deep, from which five cars of ore have been shipped.

The ore is a secondary limonite and occurs in large boulders, some of which weigh nearly a ton. The proportion of ore to dirt is larger at this place than at mine No. 1, although, with the exception of the Tertiary pebbles which were not observed here, the horizon and enclosing materials are the same. (C.—1910.)

61. OTTER CREEK BANK.

S. W. ¼, Sec. 3, and Lot 1, N. E. ¼, Sec. 4, T. 27 N., R. 5 E.

Along the top of the range of hills just north of Otter creek there are small outcrops of ore in scattered boulders, but the largest are situated in the N. E. ¼, Sec. 4. Here, upon the southern slope of the hill, near the summit, the ore covers an area about two hundred feet along the slope, and sixty to seventy-five feet wide. Over the crown of the hill, on the northern slope, a small amount of ore is seen. The ore is mostly in quite small pieces, and of poor quality, being sandy and cherty. Upon the S. W. ¼, Sec. 3, lying low on the hill there is a small outcrop of very good stalactitic ore. It is in small pieces. (M.—1873.)

62. PITTSBURG MINE.

Owned by Pittsburg Iron Mining Company, Williamsville, Mo.

E. ½, N. E. ¼, Sec. 6, T. 26 N., R. 5 E.

This mine, located 2½ miles south of Williamsville, is situated upon the crest of a high north and south ridge where fine and coarse fragments of brown ore outcrop almost continuously over an area 500 feet long by 70 feet wide. A 70 foot shaft at the south end of the deposit is said to have cut 18 feet of ore. A trench 10 feet deep and 20 feet long, on the west face of the hill, shows good ore throughout its length and depth. Each of three shallow pits at the north end of the deposit also encountered good ore. These developments were made during 1900 at which time 78 tons of ore were shipped.

The ore is a rather soft, dark brown, secondary limonite and occurs as large boulders and small fragments embedded in a cherty clay. While it contains some enclosed chert, it is entirely free from sand. Much of the ore is so small that it cannot be recovered except by washing. The ore shipped, most of which was gathered from the outcrop, gave returns of 55.57% iron, 7.10% silica, and 0.080% Phos. (C.—1910.)

63. PLETZ (F.) MINE.

N. E. ¼, S. W. ¼, Sec. 21, T. 27 N., R. 5 E.

This mine, located one mile east of Williamsville, was not visited by a member of this Bureau but, according to records submitted by the St. Louis Blast Furnace Company, it was opened during 1903, at which time 16 tons of ore were mined and shipped. The ore ran 58.33% iron, and 4.25% silica, indicating a secondary limonite, probably of the pipe variety. (C.—1910.)

64. PRATT MINE.

Owned by A. L. Pratt, Williamsville, Mo.

S. E. ¼, S. W. ¼, Sec. 21, T. 27 N., R. 5 E.

This property, located about 1½ miles east of Williamsville, is developed by four small pits situated on the west end of a chert covered hill. The ore is a secondary limonite very largely of the pipe variety and occurs embedded in a cherty clay. Some ore of a similar character outcrops over an area of about an acre in the immediate vicinity of the pits. Altogether about 30 tons of ore were mined and shipped during 1907.

Fig. 1. SAWYER MINE, WAYNE COUNTY, SECONDARY LIMONITE.

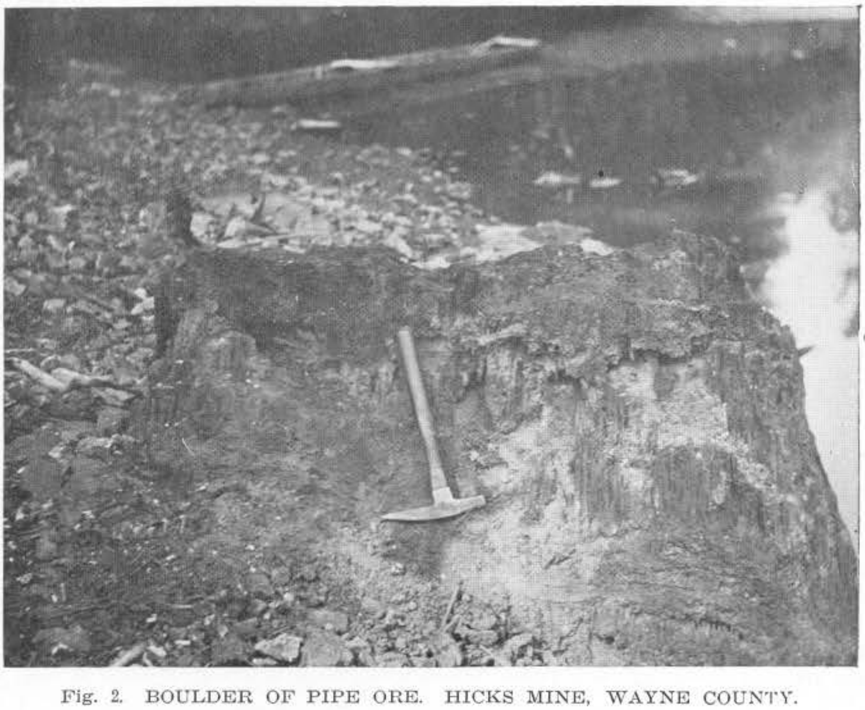

Fig. 2. BOULDER OF PIPE ORE. HICKS MINE, WAYNE COUNTY.

On the hillside, across the valley to the south of the above deposit, is a shallow pit 20 feet long and 15 feet wide from which about one car load of pipe ore has been shipped. Much of the ore at this place is so small that it can be recovered only by washing. (C.—1910.)

65. RAILROAD BANK, NO. 2.

S. E. ¼, Sec. 8, T. 27 N., R. 5 E.

Limonite, in the form of fragments, occurs here at the railroad cut near the top of the hill, in the form of small fragments and larger pieces. It covers several square yards but nothing in the cut indicates an extensive deposit, as no ore and only chert and yellow sandy clay are to be seen. Some chert lies on the hill around the area containing ore. It is only slightly siliceous. (L.—1892.)

66. RUBOTTOM (L.) LAND.

Sec. 10, T. 28 N., R. 5 E.

Here a few small masses of limonite are found mingled with many fragments of white chert. The ore is of a good quality, is pseudomorphous, probably after pyrite, and has resinous lustre. No bedded rock near. (L.—1892.)

67. SANDERS BANK.

Owned by E. F. Sanders, Taskee, Mo.

N. E. ¼, N. E. ¼, Sec. 24, T. 27 N., R. 5 E.

This bank, located half a mile southwest of Taskee, is situated near the top of the south point of a hill. Developments consist of a 10 foot pit which shows pipe and boulder ore embedded in cherty clay. This ore is the usual grade of secondary, stalactitic limonite, of which about 16 tons have been mined. Some pipe ore outcrops in the vicinity of this pit and extends 100 yards down the hillside. (C.—1910.)

68. SANDERSON LAND.

Owned by A. E. Sanderson, Chaonia, Mo.

N. E. ¼, Sec. 14, T. 27 N., R. 6 E.

This prospect, located about two miles north of Chaonia, consists of a few fragments and boulders of pipe limonite which have been exposed by the upturned roots of a tree. Occasional fragments of surface ore occur in the immediate vicinity. No developments have been made. (C.—1910.)

69. SAWYER MINE.

Owned by The Wayne Iron and Lumber Company, Greenville, Mo.

N. ½, N. W. ¼, Sec. 34, T. 28 N., R. 5 E.

This mine, located 3½ miles southwest of Greenville, is situated on the north slope of a chert covered hill. It consists of a relatively large cut 300 feet long, 100 feet wide and 50 feet deep, the base of which is about 10 feet above the level of a small ravine. The ore is secondary limonite of both the boulder and pipe variety and occurs embedded in cherty, residual clay. The materials shown in the face are as follows: (in descending order)

10 feet.	Residual clay and chert with very little ore.
15 "	Pipe ore, in large and small fragments, and ochre embedded in cherty clay.
6 "	Light-colored fire clay and sand, containing only a few fragments of ore.
20 "	Pipe ore in large and small fragments, and ochre embedded in clay; some cherty iron breccia.
5 "	White fire clay in part stained by iron.
5 "	Boulder ore is reported below this clay.

While the above succession is well marked, there are lateral variations and it is not exposed in all parts of the mine. The upper layer of fire clay pinches out near the west end of the cut at which place the ore in the upper 15 foot seam is mingled with the surface chert and clay. The mine has been bottomed on the lower layer of white fire clay, beneath which boulder ore is reported.

This mine was opened about 1905 and it has been worked intermittently up to the present time producing between ten and fifteen thousand tons of ore. It is connected by a spur to the main line of the Williamsville, Greenville and St. Louis R'y. Steam shovels have been employed for loading the dirt directly upon the cars in which it was delivered to the washer at Greenville.

The product consisted of wash and boulder ore. The wash ore averaged 50.31% iron, 13.37% silica, 0.069% Phos., 0.38% Mn., and 0.50% alumina, while the boulder ore averaged 57.26% iron, 2.87% silica, 0.064% Phos., 0.32% Mn., and 0.55% alumina. The high silica of the wash ore is due to the imperfect separation of the associated chert. (C.—1910.)

70. SCHAFER BANK.

N. ½, S. E. ¼, Sec. 2, T. 26 N., R. 5 E.

This bank, located 1½ miles east of Keener, is situated on the west slope of a chert covered hill. Developments consist of a shallow cut from which has been taken secondary limonite of both the pipe and boulder variety mixed with clay and chert. Some ore outcrops in the vicinity of the cut. On the N. ½ of the N. ½ of the S. E. ¼ of the same section a three foot pit developed a similar showing. (C.—1910.)

71. SCOTT BANK.

Owned by U. S. Scott, Hendrickson, Mo.

S. ½ Lot 1, S. W. ¼, Sec. 6, T. 26 N., R. 6 E.

This property, located about two miles northeast of Hendrickson, has been developed by two cuts 30 feet long, 10 to 12 feet wide, and 8 feet deep, from which about a car load of brown ore has been taken. The ore is a secondary limonite occurring for the most part in small lumps embedded in cherty clay. It is practically free from chert and contains no sand. The surface showing here consisted of a few loose boulders in the immediate vicinity of the pits. (C.—1910.)

72. SHIPTON MINE.

Owned by H. M. Shipton, Taskee, Mo.

S. W. ¼, S. E. ¼, Sec. 14, T. 27 N., R. 5 E.

This mine, located 1½ miles west of Taskee, is situated near the middle of the north slope of a high, chert covered hill. Developments consist of two small cuts, from which several car loads of secondary limonite, largely of the pipe variety, have been mined and shipped. Two pits, sunk a quarter of a mile to the east, in the S. E. ¼, S. E. ¼, Sec. 14, show similar ore. The mining on this property was done under lease at a royalty of ten cents per ton and the pits were left in a robbed condition. The outcrop in each case was confined to the immediate vicinity of the pits. (C.—1910.)

73. SINGER, NIMICK COMPANY LAND.

Sec. 5, T. 26 N., R. 5 E.

Here, around the summit and on the gradual slope, boulders and fragments of massive limonite appear. They extend over an area about fifty yards long and thirty yards wide. The ore is of a fair quality, containing some silica in the form of fine grains of sand and, rarely, a fragment of chert. A shallow hole was dug here, several years ago, from which some ore masses were removed but no solid body of ore was reached. Chert, as fragments and scattered boulders, is found on the surface with the ore. This deposit is three or four miles from the St. L., I. M. & S. Ry. (L.—1892.)

74. SMOOT MINE.

Owned by E. L. Smoot, Taskee, Mo.

S. ½, Sec. 1, T. 27 N., R. 5 E.

This mine, located two miles southeast of Taskee, consists of a large pit 80 by 40 by 15 feet, situated on the north slope of a hill. The ore is secondary limonite, very largely of the pipe variety, and occurs as fragments and boulders embedded in a reddish, cherty clay. Only the boulder ore has been loaded, leaving about a 40% wash dirt. There is from six to seven feet of clay overburden and occasionally a horse of barren clay extends from the surface to the bottom of the pit.

A narrow 40 foot cut on the hill to the north shows a 12 foot face of similar pipe ore at that place. There is at present some scattered float ore upon the surface in the vicinity of both pits, but the best of the outcrop has been picked up and shipped. (C.—1910.)

75. STAGGS MINE.

Owned by F. M. Staggs, Chaonia, Mo.

N. E. ¼, S. E. ¼, Sec. 23, T. 27 N., R. 6 E.

This mine is located 1½ miles west of Chaonia and is situated upon the end of a low, gravel covered ridge. Developments consist of three or more small cuts, opening up an area of about one acre. Pipe ore outcrops in the vicinity of these cuts, several of which are so low as to be occasionally flooded by high water. The upper two feet of the faces consists of waterworn gravel mixed with clay. Underneath this occurs eight to ten feet of secondary limonite, chiefly of the pipe variety, embedded in clay. A shallow pit in the bottom of the deepest cut uncovered pure marcasite underlain by fire clay, and it is probable that the ore does not extend below ground-water level.

The mine was opened in 1905-6, producing 791 tons of ore which averaged 57.20% iron, 6.51% silica, 0.109% Phos., 0.06% Mn., and 3.0% moisture.

(C.—1910.)

76. STEVENSON BANK.

Owned by Bowman-Fayne and Company.

N. W. ¼, N. W. ¼, Sec. 12, T. 27 N., R. 5 E.

This prospect, located 1½ miles northwest of Taskee, is marked by an outcrop of brown ore, covering an area of about an acre on the top and east slope of a secondary ridge. Developments consist of two 12 foot pits which show dirt that will average 50 to 75% ore.

The ore is secondary limonite very largely of the pipe variety much of which is so small that its recovery will require washing. No ore has been shipped. (C.—1910.)

77. SUTTON MINE.

Owned by Marcus Sutton, Greenville, Mo.

N. E. 1/4, Sec. 23, T. 28 N., R. 5 E.

This mine, located one mile southwest of Greenville and half a mile north of the Williamsville, Greenville, and St. Louis R'y., consists of three openings, one of which is situated on the east and two on the west side of a small valley. The opening on the east side of the valley is a narrow 40 foot cut, entering the hillside at a point about 40 feet above its base. The face of the cut shows very little ore and not more than 15 tons were obtained from it. The ore is a secondary limonite and occurs in large boulders embedded in red, cherty clay. It is entirely free from sand but contains a few fragments of enclosed chert. There is some small ore but not enough to make it a pay wash dirt.

The openings on the west side of the valley are somewhat larger and are arranged one above the other at a point about half way up the hillside. The lower cut has produced about one car load of ore. This ore consists chiefly of small pipes embedded in clay and flint, together with some dense, boulder ore which is massive in character and encloses chert. No sand appears in any of the ore and the large quantity of small fragmentary pipe ore makes a good wash dirt. Small fragments of pipe ore outcrop over the hillside in the vicinity of the pits. (C.—1910.)

78. WILLIAMSVILLE AND IRON MOUNTAIN ORE COMPANY BANK. NO. 1.

N. E. 1/4, N. E. 1/4, Sec. 19, T. 27 N., R. 5 E.

This bank, located one mile north of Williamsville, is situated upon the south face of a high, chert covered hill. Developments consist of six small pits all of which are confined to an area of about 1000 square yards over which boulders and fragments of pipe limonite outcrop quite generally. The largest cut is 12 feet wide and extends 20 feet into the hill, showing a face of about 9 feet. This the best face shown and consists mostly of fragments of pipe ore with a few larger boulders intimately mixed with fine, angular chert and clay. The ore runs in streaks and patches through the clay and at several points extends nearly to the surface. Much of the dirt removed would probably wash about 30% ore. The other five cuts are smaller and show less ore. (C.—1910.)

79. WILLIAMSVILLE AND IRON MOUNTAIN ORE COMPANY BANK NO. 2.

S. E. 1/4, Sec. 32, T. 27 N., R. 5 E.

This bank, located two miles south of Williamsville, and one mile west of Black river, is situated upon the crest and end of a narrow ridge, upon which occasional boulders of brown ore outcropped.

Developments consist of two small open cuts and several test pits. The cuts are about 15 feet in diameter, and 6 feet deep. Their faces show cherty clay carrying fine and coarse lumps of pipe ore which, in the bottom, are replaced by larger boulders of slightly cherty ore. One pit, sunk 26 feet in the bottom of one of the cuts, showed five feet of ore beneath which was barren cherty clay. A pit 12 feet deep, located on the south side of the ridge, cut no ore. A third pit, between those described above, showed the ore to be thin and to lie near the surface. A fourth pit, 50 yards to the east of the last, showed about the same conditions.

The ore is a secondary limonite, chiefly of the pipe variety with occasional boulders of massive ore. Several of the larger boulders, when broken, revealed an interior core of unaltered marcasite. The pipe ore is confined chiefly to the upper half of the ore horizon, but is not uncommonly found among the larger boulders. Much of it breaks into fine fragments, when exposed to the air, and can be saved only by washing.

The development work was done during the season of 1909. One car load of ore, which was shipped without washing, is reported to have given returns of 56% iron. (C.—1910.)

80. WILLIAMSVILLE MINE.

Owned by The Williamsville, Iron Mountain Ore Company, Williamsville, Mo.

W. ½, N. W. ¼, Sec. 20, T. 27 N., R. 5 E.

This property, located about half a mile northeast of Williamsville, consists of a tract of 70 acres of hill land lying contiguous to the St. Louis and San Francisco R'y. Fragments and boulders of pipe ore outcropped at intervals along the crest of one of the hills and, upon sinking a dozen or more test pits, ore of this type was found to occur embedded in the residual clays. Upon the strength of this showing a $100,000 stock company was formed and a 500 ton washing plant was erected. Several large openings were made upon the best outcrops. These, however, failed to supply a profitable wash dirt. The plant was operated for only a short period during the fall of 1909. After shipping 526 tons of ore the company went into bankruptcy. (C.—1910.)

81. YANCEY MOUNTAIN BANK.

N. W. ¼, N. E. ¼, Sec. 35, T. 30 N., R. 4 E.

Limonite ore is found here at the foot of a porphyry hill, lying scattered in large and small pieces upon the porphyry and porphyrytic detritus. Little or no chert or clay is present, and the ore is singularly free from chert. At the lower part of the outcrop the ore is brown in color, free from impurity. Higher up it grows more siliceous and darker in color, and finally has the appearance of a decomposed porphyry, highly ferruginous. (M.—1873.)

PRIMARY LIMONITE.

82. ANDERSON LAND.

Owned by Hugh Anderson.

S. E. ¼, Sec. 6, T. 27 N., R. 7 E.

This property, located three miles north of Chaonia, is marked by an outcrop of brown ore along the crests of two intersecting ridges. The outcrop consists of boulders thickly strewn over the surface of an area of approximately two acres.

The ore is a primary limonite varying from compact to cellular in texture and is silicious, due to the presence of sand and decomposed chert. Goethite is quite abundant lining cavities in the cellular ore. No developments have been made. (B.—1910.)

83. ATKINS ESTATE LAND.

N. W. 1/4, Sec. 19, T. 28 N., R. 6 E.

Limonite is found here and the main body of the exposed ore extends over an area of about fifty yards square. The ore is slightly siliceous, occurs as fragments on a moderate slope and mingled with many fragments of white chert. Some of the latter are quite large. This locality is about one mile and one-half from the W., G. & N. Ry. (L.—1892.)

84. BAILEY BANK.

Owned by T. G. Bailey, Chaonia, Mo.

N. W. 1/4, S. W. 1/4, Sec. 30, T. 27 N., R. 7 E.

This bank is located 1 1/4 miles south of Chaonia, and is situated near the foot of the west end of a hill where cherty, brown ore outcrops over an area of about one acre. Developments consist of four small cuts and three shallow pits. The largest cut, which is 12 feet in diameter and four feet deep, encountered ore throughout its depth. Seven tons of fair grade, silicious, primary limonite were mined from the opening. The other pits are small and shallow and produced but a small quantity of sandy, cherty ore similar to that in the outcrop. The depth of the ore has not been determined. No shipments have been made. (C.—1910.)

85. BAKER MINE.

Owned by the South Missouri Pine Lumber Company, Upalika, Mo.

N. E. 1/4, S. W. 1/4, Sec. 5, T. 26 N., R. 4 E.

This mine, located one mile west of Upalika, and joining the St. Louis and San Francisco R'y. on the south, is situated near the head of a small ravine about 50 feet below the crest of the divide. It consists of an open cut 40 feet long, 30 feet wide, and 10 feet deep, from which several car loads of ore have been mined. The upper three to five feet of the face shows clay and chert carrying very little ore, while the remainder of the face exhibits a nearly solid bed of porous, silicious, primary limonite mixed with soft, ocherous material and some clay and chert. A seven foot pit in the bottom of the cut is reported to have encountered similar ore throughout its depth.

The above development work has not determined the thickness nor lateral extent of the ore body. There is practically no outcrop in the immediate vicinity of the mine.

Forty feet above the mine, and near the crest of the ridge, an eight foot pit shows some ore embedded in cherty clay. In a small ravine 200 feet north of this pit is a heavy outcrop of cherty, cellular ore. South of this outcrop numerous test pits show the presence of considerable ore close to the surface.

Thirty-five tons of ore, shipped from this property in 1909 ran 46.47% iron, 18.6% silica, 0.52% Mn., and 4.0% water. (C.—1910.)

86. BARKER BANK.

Owned by Wayne Iron and Lumber Co., Greenville, Mo.

S. W. ¼, N. E. ¼, Sec. 31, T. 29 N., R. 7 E.

This deposit, located 2½ miles south of Hiram, is situated upon the crest of a high, chert covered hill. The outcrop consists of boulders of cherty, primary limonite scattered over an area of about half an acre. It has been opened by a 10 foot pit, which showed massive boulders of porous, cherty ore in the upper five feet, below which the face was obscured by caving. The ore taken from the pit is highly silicious, due to the presence of some sand and many partly replaced and iron stained chert fragments. (C.—1910.)

87. BENNETT-SMITH MINE.

Owned by the Sneathern Estate.

W. ½, N. E. ¼, Sec. 8, T. 28 N., R. 6 E.

This mine, located three miles northeast of Greenville, is situated about 30 feet below the crest of the south slope of a high hill. It consists of a single cut 30 feet long, 20 feet wide, and 8 feet deep, from which 900 tons of ore were mined and shipped in 1907. The face of the cut shows massive boulders of primary limonite separated by thin, vertical seams of clay and chert. The ore is exceedingly porous and rather silicious, due to the presence of sand and small fragments of chert. The presence of goethite occurring in the form of botryoidal growths, lining and filling cavities in the ore, materially improves its quality. (C.—1910.)

88. BERRY (WM.) LAND NO. 1.

Sec. 15, T. 28 N., R. 6 E.

Here, near the base, on the northeastern slope of a large flat topped hill, occur large and small fragments of hard iron ore, the greater portion of which has a rather light brown color, the remainder being of the variety turgite. Some chert fragments are mingled with the ore but no bedded rock is visible. About forty yards east of this deposit a well was sunk and, at a depth of twenty-two feet, four feet of hard red iron ore was found. It was supposed that the well just touched the eastern portion of the deposit of iron. This information was furnished by Mr. Berry. The distance of this locality from the W., G. & N. Ry. is about five miles. (L.—1892.)

89. BERRY (WM.) LAND NO. 2.

S. W. ¼, Sec. 15, T. 28 N., R. 6 E.

Limonite is exposed here over an area thirty yards long and forty yards wide. Within this area little else than iron ore is to be seen. The ore occurs in fragments and boulders at the foot of the hill. The greater portion is siliceous, containing silica both in the form of small fragments of chert and grains of sand, yet some specimens contain only a small per cent. of silica. About one hundred yards east of this deposit there is a deposit of similar ore. This area is only about twenty yards square. Again, about three hundred yards east, on the same range of hills, a heavy bed of limonite makes up the entire cap of the hill, the exposure being several yards in diameter. Here, again, large boulders and fragments occur, and the ore is quite siliceous. This deposit is seventy-five or one hundred feet higher than either of the other deposits just described. In each case white chert is the only associated surface rock. These localities are about five miles from the Williamsville, Greenville and Northern Ry. (L.—1892.)

90. BOWMAN LAND.

S. W. ¼, Sec. 9, T. 27 N., R. 5 E.

This property is located 2½ miles northeast of Williamsville and about 200 yards south of the Williamsville, Greenville and St. Louis R'y. Cherty limonite of the primary type outcrops over an area of several acres along the crest of a high hill. Considerable fair grade ore occurs among the float boulders. No developments have been made. (C.—1910.)

91. BURTON MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

W. ½, S. W. ¼, Sec. 21, T. 29 N., R. 6 E.

This mine is located six miles northeast of Greenville and is situated upon the crest of a high, chert covered hill where silicious brown ore outcrops over an area of about half an acre. Developments consist of an open cut 100 feet long, 70 feet wide, and 15 feet deep, (Fig. 29,) from which about 680 tons of brown ore have been mined and shipped. A large part of the face of the pit shows ore.

The ore is typical, primary limonite. That nearest the surface occurs in small fragments mixed with surface clay. With depth it becomes nearly solid, occurring in large massive boulders with very little clay intermixed. It is very porous or cellular, breaking with a rough craggy surface, and is silicious, due to the presence of both grains of sand and small fragments of chert. Locally it has a dark bluish color due to the presence of oxide of manganese. Manganese occurs commonly in quantities varying from ½ to 2%.

This mine was opened in 1907. The ore shipped gave returns of 47.51% iron, 15.31% silica, 0.058% Phos., 1.24% Mn., and 4.0% moisture. (C.—1910.)

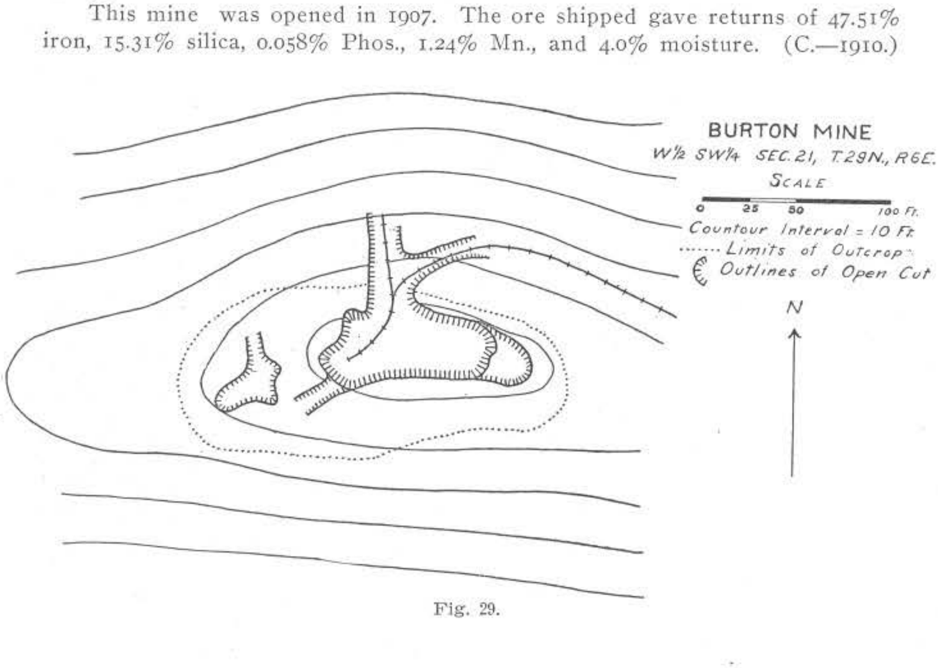

Fig. 29.

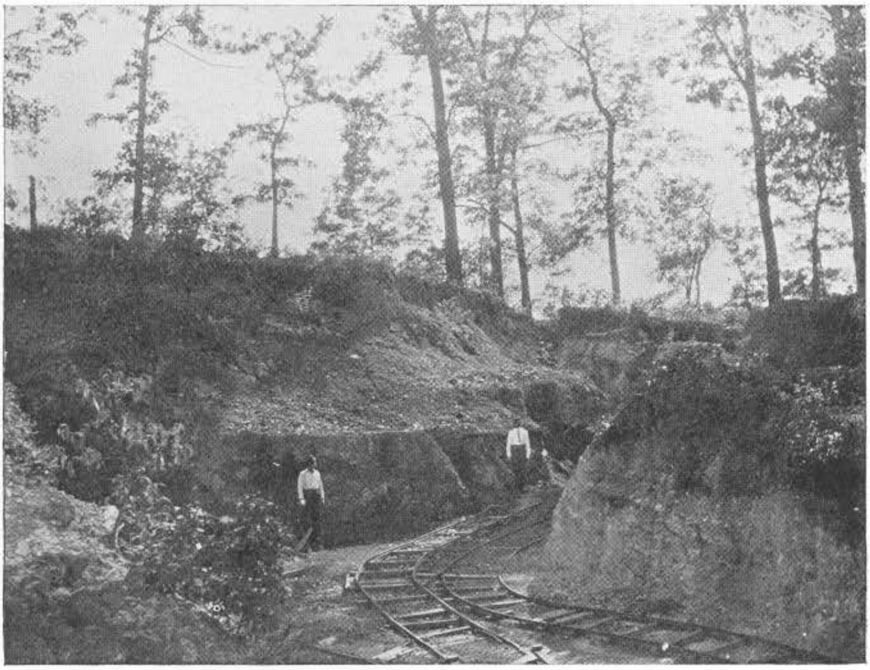

Fig. 1. BURTON PRIMARY LIMONITE MINE, WAYNE COUNTY.

Fig. 2. ZIPPY PRIMARY LIMONITE MINE, WAYNE COUNTY.

92. CHAONIA MERCANTILE AND IRON COMPANY BANK.

N. E. 1/4, N. E. 1/4, Sec. 36, T. 27 N., R. 6 E.

This bank, located one mile due south of Chaonia, is situated at the base of the west slope of a high hill. Developments consist of an opening 50 feet long, 12 to 18 feet wide, and 10 feet deep, from which about 30 tons of ore have been mined. The ore is a porous, primary limonite and is silicious, due to the presence of sand and fragments of chert. The depth of the ore is not known, and the outcrop was confined to the immediate vicinity of the pit. No shipments have been made. (C.—1910.)

93. CRAWFORD MINE.

W. 1/2, N. E. 1/4, Sec. 17, T. 27 N., R. 5 E.

This mine, located 1½ miles north of Williamsville, is situated on the crest of a high, chert covered ridge where silicious brown ore outcrops over an area of about one acre. Developments consist of an irregular, shallow pit 100 feet long, 50 feet wide, and 10 feet deep from which several car loads of ore have been shipped. The exposed faces of the pit show boulders of rather cherty, sandy, primary limonite embedded in clay. The depth of the ore is not known. (C.—1910.)

94. FOLSOM (ALEXANDER) LAND.

Between Secs. 10 & 11, T. 28 N., R. 6 E.

Massive limonite is found here covering an area ten yards square. The surface ore is in the form of large boulders. It is found to be of a very fair quality. The boulders are at the foot of a long point and mingled with and above these boulders many large fragments of white chert are found. This deposit is six miles from the Williamsville, Greenville and Northern Ry. (L.—1892.)

95. GARRISON TRACT.

Owned by D. L. Garrison, Chaonia, Mo.

Lots 2, 3, and 4, N. E. 1/4, Sec. 2, T. 27 N., R. 6 E.

This property, located about four miles north of Chaonia, is characterized by an extensive outcrop of porous, cherty, primary limonite covering an area of 20 acres or more. In Lot 2 there is approximately 10 acres of nearly continuous outcrop, and apparently as much more in lot 3. A high dividing ridge crosses these lots from north to south and puts out several secondary ridges and many smaller spurs, both to the east and to the west. The outcropping ore is confined chiefly to the crests of these secondary ridges and spurs but in places extends well down the slopes to 50 feet or more below the crest of the divide. At widely scattered points over the outcrop, several shallow pits have been dug, which show the ore to have very little overburden and to be rather uniform in character .In lot 3, a 13 foot pit near the crest of the main ridge showed the ore to improve slightly in quality with depth. Nowhere has the thickness of the ore been determined.

On the extreme northwest corner of lot 3, two small pits in a ravine developed secondary limonite which has a dense even texture and is quite free from chert or sand. The outcrop in this vicinity is small and the deposit is probably unimportant as compared to the porous, cherty ores to the southeast. (C.—1910.)

96. GARY (A.) AND MOSS (T. J.) LANDS.

N. W. ¼, Sec. 25, T. 27 N., R. 6 E.

Limonite is found here in masses over an area about four hundred yards long and nearly fifty yards wide. Within this area three or four small patches are covered with fragments and boulders of limonite. The most southern is at the summit of a rather steep hill next to the St. L., C. G. & Ft. S. Ry., and here the ore is very siliceous, bearing both grains of sand and fragments of chert. Then, in a slight depression just north of this hill, there is another area of ore of slightly better quality; and, again about the same distance north, on a lower summit than the first, is still another area of a somewhat superior quality of ore. This area extends about one-hundred yards northward, to the north side of Sec. 25, and continues about seventy yards down a moderate slope in Sec. 24. Here again chert is the only associated rock. The chert occurs on the surface in the form of small chips and boulders.

(L.—1892.)

97. GREEN TRACT.

Owned by J. W. Green, Chaonia, Mo.

S. E. ¼, S. E. ¼, Sec. 25, T. 27 N., R. 6 E.

This tract, located 1½ miles southwest of Chaonia, is marked by an outcrop of silicious primary limonite, scattered at intervals over an area of nearly 20 acres. Upon the north end of a hill, located near the extreme northeast corner of the tract, the outcrop embraces an area of about an acre. This has been opened by one cut 30 feet long, 12 feet wide, and 6 feet deep, and two shallow pits, each of which produced considerable porous, cherty, primary limonite of fair grade. The depth of the ore was not determined.

Forty to fifty feet higher, near the crown of the hill, is a narrow 30 foot cut which shows a six foot face of nearly solid ore of the same porous, silicious character. Twelve to fifteen tons of fair grade ore were taken from this cut.

Near the south edge of the tract is a 35 foot cut, 12 feet wide and 10 feet deep from which considerable ore is reported to have been shipped. The greater part of the ore was porous and silicious like that described above, but it also consisted in part of a hard, dense, finely silicious, and in part of the thin, laminated, argillaceous type.

On the extreme southwest corner of the tract are four pits of about the same character as those described above from which similar ore has been mined and shipped. Each of the above described cuts were made upon, or in the vicinity, of outcropping ore.

On the S. W. ¼, S. E. ¼, Sec. 25, T. 27 N., R. 6 E., which is the forty acres just west of the above, are six pits near the top of the north point of a hill. Each of these showed a rather sandy, cherty ore at the surface, which improved at a depth of a few feet to an ore of merchantable grade. With depth the ore became very porous, containing many pot-like cavities lined wih a thin coating of goethite. (C.—1910.)

98. HAGGARD LAND.

S. W. ¼, S. W. ¼, Sec. 28, T. 29 N., R. 6 E.

This prospect, located 4½ miles northeast of Greenville and less than half a mile north of the Williamsville, Greenville, and St. Louis R'y., consists of a heavy outcrop of porous, cherty, primary limonite, covering an area of about 30 square yards, along the lower slope of an east hillside and in the bed of a small ravine. No developments have been made. (C.—1910.)

99. HILDA MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

S. W. ¼, Sec. 28, T. 28 N., R. 5 E.

This mine, located four miles southwest of Greenville, was not visited by a member of this Bureau, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened during 1910 when 26 tons of ore were mined and shipped. The ore ran 45.14% iron, 20.26% silica, and 0.14% Mn., indicating it to be a primary limonite. (C.—1910.)

100. JENNIE MINE.

Owned by Wayne Iron and Lumber Company, Greenville, Mo.

S. W. ¼, Sec. 5, T. 29 N., R. 6 E.

This mine, located about eight miles north of Greenville and a quarter of a mile west of a logging branch of the Williamsville, Greenville, and St. Louis R'y., is situated upon the crest of a high, flat divide where boulders of silicious brown ore outcropped at intervals over an area of half an acre. Developments consist of an open cut approximately 35 feet long, 20 feet wide and 10 feet deep, from which about one car load of ore has been shipped. At the time it was visited, the cut was nearly filled with water. However, that part of the face exposed showed numerous large boulders of brown ore embedded in cherty clay.

The ore is a primary limonite and is highly silicious, due to the presence of both chert and sand. (C.—1910.)

101. JINES BANK.

Owned by F. Jines, Chaonia, Mo.

N. W. ¼, Sec. 28, T. 28 N., R. 7 E.

This property, located seven miles northeast of Chaonia, is marked by an outcrop of brown ore covering an area of 40 acres on the south slope and crest of a ridge. Half way down the slope the outcrop occurs in the form of a ledge which extends for a distance of 75 feet along the hillside. A 20 foot pit, sunk on the crest of the ridge, shows layers of cellular limonite in bands from four to six inches in thickness alternating with layers of yellowish, decomposed chert having an average thickness of three feet. The pit bottomed in dense, low grade ore.

The ore is a primary limonite including both the cellular and dense varieties. It is highly silicious, due to the presence of both sand and chert. That in the ledge is hard and dense and breaks with smooth fracture. Though it has the appearance of a good ore, analysis shows it to contain but 42% iron. The cellular ore is somewhat better in quality. (B.—1910.)

102. JOHNSON (LEWIS) BANK.

N. E. ¼, S. W. ¼, Sec. 15, T. 28 N., R. 6 E.

This ore is on the property of Geo. D. Saxton. It is found here covering several square yards on a rather steep slope of a hill. Only a few boulders and chips of ore occur on the surface. This is quite siliceous, containing fine grains of sand. Chert fragments both large and small are found within and adjacent to the area containing surface ore. This deposit is about five miles from the W., G. & N. Ry. (L.—1892.)

103. JONES LAND.

Owned by H. S. Jones, Wappapello, Mo.

S. W. ¼, Sec. 3, T. 27 N., R. 7 E.

This property, located approximately five miles northeast of Chaonia, is marked by an extensive outcrop of brown ore extending for a distance of 300 yards along the west slope and crest of a high ridge. Several shallow pits near the base of the slope show boulders of ore embedded in residual material.

The ore is a cellular primary limonite, the cavities of which are often lined with goethite. It encloses considerable hard chert and some sand.

Half a mile east of this deposit, a similar outcrop of cellular cherty ore covers an area 40 yards square. No developments have been made at this place. (B.—1910.)

104. LAMBERT MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

N. W. ¼, S. W. ¼, Sec. 5, T. 29 N., R. 7 E.

This mine, located 2½ miles north of Hiram and a quarter of a mile west of the Williamsville, Greenville and St. Louis R'y., is situated near the crest of the main divide between Bear and another large branch of the Castor river. It consists of one long cut and three small pits which were sunk upon a strong outcrop of primary limonite covering an area of several acres near the crest of a divide. The cut, which is about 40 feet wide, shows an eight foot face of solid boulders of porous, cherty ore. The three shallow pits were sunk at about the same horizon and show similar ore. The surface ore is porous and rather cherty, but the amount of chert present diminishes with depth. No shipments have been made. (C.—1910.)

105. LILLY HOLLOW MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

S. W. ¼, S. E. ¼, Sec. 9, T. 29 N., R. 7 E.

This mine, located two miles northeast of Hiram, is situated near the brow of the east slope of a high chert covered hill over which brown ore outcrops quite generally, embracing an area of several acres.

This property was opened during 1907. The developments consist of an open cut 100 feet long, 60 to 70 feet wide, and 12 feet deep from which 378 tons of ore have been mined and shipped. The greater portion of the face of the pit shows ore. The ore is a primary limonite, and occurs as large and small boulders embedded in clay. For the most part it runs in streaks and pockets, but at several points forms an almost solid mass from the floor of the pit to the top of the face. At other points large clay pockets replace the ore bearing dirt and form absolutely barren ground.

The ore is uniformly porous and somewhat sandy and cherty. That shipped gave returns of 46.39% iron, 14.92% silica, 0.045% Phos., 0.42% Mn., and 5.0% moisture.

The mine was once connected with the Williamsville, Greenville and St. Louis R'y. by a logging spur, which has since been removed. (C.—1910.)

106. LONG AND COLBY BANK.

Owned by Long and Colby, Greenville, Mo.

N. W. ¼, N. E. ¼, Sec. 18, T. 29 N., R. 7 E.

This bank, located one mile north of Hiram, is situated on the north face of a hill, over which brown ore outcrops quite generally. Developments consist of an open cut 30 feet long, 6 feet wide, and 10 feet deep, from which about 30 tons of porous, primary limonite have been mined. The ore occurs in large blocks or boulders, associated with some clay, and forms about 80% of the material in the face.

Over the hill, 150 yards to the west of the cut, is a shallow pit from which several tons of ore of the same silicious character have been taken.

On the crest of the hill, and about 100 yards to the north of the cut described above, is a shallow pit which has been sunk upon a continuation of the same outcrop of cherty ore. This pit is about 30 feet in diameter and nowhere over three feet deep. Operations here have little more than uncovered the ore, which makes up the greater part of the floor of the pit. These developments are half a mile west of the nearest point on the Williamsville, Greenville and St. Louis R'y.

(C.—1910.)

107. MAGILL LAND.

Owned by Wm. Magill, Taskee, Mo.

N. E. ¼, N. E. ¼, Sec. 6, T. 26 N., R. 6 E.

This prospect, located about three miles south of Taskee, consists of a circular outcrop of primary limonite covering between two and three acres upon the crest of a ridge. The ore is exceedingly porous and somewhat silicious, containing minor quantities of sand and chert. No development work has been done.

(C.—1910.)

108. MASON AND CLARKSON LAND.

E. ½, Sec. 16, T. 27 N., R. 7 E.

Limonite occurs here over a small area, on a gradual slope of a cherty spur. It is siliceous, silica occurring generally as fine grains of sand. This deposit is about six miles distant from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

109. MAYBERRY TRACT.

Center of E. ½, Sec. 6, T. 27 N., R. 8 E.

This property is located approximately eight miles north of Wappapello, the nearest shipping point. The outcrop consists of boulders of brown ore thickly strewn over an area of forty acres, on the south slope and crest of a secondary ridge. It has been developed by four pits having a maximum depth of 33 feet, sunk at intervals of about 100 yards. These pits expose thin layers of limonite interbedded with decomposed chert and dolomite to a depth of 12 feet. This material is underlain by stratified clay, which occasionally carries a thin seam of limonite.

The ore is a cellular, primary limonite, containing sand and fragments of chert. Much of it is sufficiently free from impurities, however, to be of commercial value. (B.—1910.)

110. McKENZIE BANK NO. 2.

S. W. ¼, N. E. ¼, Sec. 7, T. 29 N., R. 7 E.

This deposit is located 1½ miles north of Hiram and half a mile west of the Williamsville, Greenville and St. Louis R'y. It is situated near the head of a small ravine, about which boulders of brown ore outcrop at frequent intervals. Two pits have been sunk, both of which produced large boulders of silicious, primary limonite of the extremely cellular type. No ore has been shipped. (C.—1910.)

111. MORRIS CREEK BANK.

S. E. ¼, Sec. 35, T. 27 N., R. 4 E.

Here, on the slope of a low hill, about seventy-five feet high, and scattered in the bed of the creek, limonite is found. It lies thickly, about two hundred feet along the slope and extending up to the forty foot level. All the ore is lean and cherty and often little more than ferruginous chert. It seems to have come from a ledge of cherty ore which shows a persistent outcrop at the forty foot level, for about one hundred and fifty feet. The broken surface ore shows a larger proportion of good ore than the old solid mass, but even in this there are irregular masses of better ore. (M.—1873.)

112. MOSS AND CLARKSON LAND.

N. ½, Sec. 10, T. 27 N., R. 7 E.

Here scattered limonite boulders and fragments occur on the surface over an area about seven hundred yards long and from fifty to one hundred yards wide, lying, principally, on or near the broad summit of a cherty range. Towards the eastern limit scattered boulders are on the slope and near the crest in an aggregation of boulders and probable ledge. Again, towards the western limit, in the bank of the ravine, not far from the summit, is another ledge-like outcrop more distinctly shown than the ledge near the highest part of the eastern slope. There has been a shallow hole dug from which some ore was taken in clay, but no extensive development of the mode of occurrence of the ore has been made. Some scattering chert fragments are on the hill. This ore is said to be on the land of Mr. T. J. Moss and the heirs of Judge J. G. Clarkson. It is situated about six miles from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

113. MOSS (T. J.) LAND.

Sec. 19, T. 27 N., R. 6 E.

Siliceous limonite is found covering an area about fifteen yards square. The ore here is in the form of large boulders. It is siliceous, silica occurring both in the form of chert fragments and grains of sand. Chert fragments occur mingled with the ore boulders but no bedded rock is observed. This locality is but little more than one mile from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

114. MYERS MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

E. ½, S. E. ¼, Sec. 20, T. 29 N., R. 6 E.

This mine, located 5½ miles northeast of Greenville and three-quarters of a mile west of Burton switch, is situated near the west end of a high hill, over which brown ore outcrops quite generally. The area of outcrop is about ten acres.

Developments consist of an open cut 60 feet long, 30 feet wide, and 20 feet deep, from which 531 tons of ore have been mined and shipped. In addition to the cut, there are about 15 shallow pits scattered over the area of outcrop, all of which show ore and none of which have been sunk through the deposit. The face of the large cut, at one place, shows nearly 20 feet of solid ore.

The ore is a dense, dark brown, primary limonite, containing cavities lined with films of goethite and is remarkably free from both chert and sand. The average analyses of the ore shipped from this cut shows 49.23% iron, 13.59% silica, 0.059% Phos., 0.64% Mn., and 4.00% moisture.

The ore from the several test pits is very much more porous, and somewhat more silicious than that from the mine, silica occurring in the form of both chert and sand. While much of the surface ore is low grade, it usually improves with depth and it is probable that the deposit represents a large tonnage of merchantable ore. (C.—1910.)

115. NEIGHBORS (JOHN) LAND.

S. E. ¼, Sec. 6, T. 27 N., R. 7 E.

Limonite is found here covering an area about seventy yards long and thirty yards wide. The ore is in the form of large boulders and fragments and at the southern or lower end of the deposit there appears a reef-like mass or ledge of ore. The deposit is on a divide, sloping southward, between two ridges. The ore is somewhat siliceous, silica occurring both in the form of fine fragments of white chert and grains of sand. The upper portion of this deposit seems to be less cherty than is the ledge. Other boulders of similar ore are seen on the hill at the northern end of the area which bears ore. The hills here have rather steep slopes and, on the surface, scattered fragments of chert are found. The land upon which the ore is located was once homesteaded by Mr. L. T. Dondore with the view of mining the iron ore, but no work has yet been done. This locality is six or eight miles from the St. L., C. G. & Ft. S. Ry., and about the same distance from W., G. & N. Ry. (L.—1892.)

116. NORTHWESTERN CONSOLIDATED LAND NO. 1.

Owned by the Northwestern Consolidated Land, Lumber and Iron Ore Company, Wappapello, Mo.

N. E. ¼, Sec. 9, T. 27 N., R. 7 E.

This property, located five miles northeast of Chaonia, is marked by an outcrop of brown ore covering an area 300 feet long by 75 feet wide situated on the crest of a ridge. No development work has been done. The outcrop consists of cellular, primary limonite sufficiently free from chert and sand to be of commercial value. (B.—1910.)

117. NORTHWESTERN CONSOLIDATED LAND NO. 2.

S. W. ¼, Sec. 10, T. 27 N., R. 7 E.

This property, located five miles northeast of Chaonia, is marked by an excellent outcrop of brown ore on the point of a secondary ridge. The ore consists of primary limonite which is fairly free from chert and sand.

Southeast of this exposure, and in the same quarter section, primary limonite outcrops intermittently along the crest of a ridge for a distance of 400 yards. These exposures are from 50 to 100 yards wide and indicate a good quality of ore. A small amount of chert is contained in the larger boulders. (B.—1910.)

118. NORTHWESTERN CONSOLIDATED LAND NO. 3.

Center Sec. 14, T. 27 N., R. 7 E.

This property, located 3½ miles north of Wappapello, is marked by an outcrop of brown ore, covering an area 125 yards long by 50 yards wide, on the north side of a ravine. The ore is a cellular primary limonite containing lenses of sand and scattered fragments of chert. No developments have been made. (B.—1910.)

119. NORTHWESTERN CONSOLIDATED LAND NO. 4.

Secs. 15 & 16, T. 27 N., R. 7 E.

This property is located five miles northeast of Chaonia and is marked by an extensive outcrop of brown ore. In the east half of Sec. 16 boulders of primary limonite occur scattered over an area 600 feet wide and 2,500 feet long; and in the west half of the section similar outcrop covers an area a quarter of a mile wide and half a mile long. These outcrops are not continuous areas of good ore but are separated by belts showing only slight surface indications.

Some development work has been done along a small ravine in the S. W. ¼ of the S. W. ¼ of the N. W. ¼ Sec. 15. The outcrop at this place is poor and the surface ore is very cherty and sandy. The development work consists of a trench, two test pits, and a small amount of surface stripping. The trench is 80 feet long, 20 feet wide, and exposes ore embedded in clay. The quality of the ore improves with depth and at the head of the trench a ledge of ore, which is exposed along the bottom, will run approximately 45% iron.

The smaller of the two test pits is located at the head of the ravine, about 50 yards from the trench. It has a depth of 10 feet and exposes a ledge of ore containing some sand and hard chert. The other pit is situated near the mouth of the ravine and is reported to have penetrated ore throughout its entire depth of 32 feet. The surface stripping was done at the mouth of the ravine and exposes a ledge of slightly cellular, primary limonite containing some sand. Several car loads have been mined from this pit although no shipments have been made.

The outcrops on these properties consist entirely of primary limonite which is sufficiently free from chert and sand to be of commercial value. (B.—1910.)

120. NORTHWESTERN CONSOLIDATED LAND NO. 5.

Sec. 35, T. 27 N., R. 7 E.

This property, located half a mile northwest of Wappapello, is marked by an outcrop of cherty brown ore covering an area 400 feet long by 100 feet wide on the crest of a high, narrow ridge. A 12 foot pit, near the western edge of the outcrop, shows boulders of ore embedded in red clay. The ore consists of cellular primary limonite containing decomposed and hard chert. Blocks of sandstone, which probably belong to the Roubidoux formation, cap the neighboring hill. (B.—1910.)

121. O'KEEFE MINE NO. 2.

Owned by P. O'Keefe, Granite Bend, Mo.

S. W. ¼, S. W. ¼, Sec. 2, T. 27 N., R. 4 E.

This mine, located about one mile northeast of Granite Bend station, lies upon the top of a high ridge at an elevation of about 300 feet above Black river. The outcrop covers an area of about one acre. It has been opened by two small cuts 15 to 20 feet in diameter, from which a car load or more of ore has been mined.

The ore is a primary limonite and occurs embedded in a cherty red clay overlying the Roubidoux sandstone. Some of the ore is very clean while much of it contains small fragments of unreplaced chert and a few grains of sand. (C.—1910.)

122. O'KEEFE MINE NO. 4.

Owned by P. O'Keefe, Granite Bend, Mo.

N. W. ¼, S. E. ¼, Sec. 16, T. 27 N., R. 4 E.

This mine, located two miles southwest of Granite Bend, was not visited by a member of this department, but, according to records submitted by the St. Louis Blast Furnace Company, it was opened in 1907 at which time 34 tons of ore running 41.38% iron, 24.94% silica, 0.062% Phos., 0.32% Mn., and 4.00% moisture, were mined and shipped. Judging from the analysis, both as regards iron and manganese, it is almost certain that the ore is a limonite of the cherty, primary type.

123. OZARK LAND COMPANY LAND.

Sec. 17, T. 27 N., R. 6 E.

Two or three small exposures of limonite are found here. The surface ore is in the form of small fragments and boulders. The fragments are very fair in quality but the boulders are quite siliceous, silica occurring as sand and small chert fragments.

These deposits are about one-half of a mile distant from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

124. PETIT LAND.

S. E. ¼, Sec. 19, T. 27 N., R. 7 E.

This property, located one mile southeast of Chaonia, is marked by an outcrop of boulders and fragments of brown ore which are strewn for a distance of 200 yards along the crest of a secondary ridge. No development work has been done.

The outcrop consists of cellular primary ore, the cavities of which are often lined with goethite. The ore contains some chert and sand. (B.—1910.)

125. SHAW (DAVID) LAND.

W. ½, Lot 1, S. E. ¼, Sec. 6, T. 27 N., R. 7 E.

A few, slightly cherty and non-siliceous irregularly-shaped masses of hard limonite occur here on the gentle slope. No rock except scattered fragments of chert can be seen in this locality. (L.—1892.)

126. SMITH (PLEASANT) LAND.

W. ½, Lot 1, N. W. ¼, Sec. 6, T. 27 N., R. 7 E.

Here there is a deposit of limonite, the surface showing of which occupies about half of an acre. This deposit is found on a rather steep slope. Many boulders and chips of ore containing insoluble material, such as grains of sand and small particles of chert, are on the surface. There are fragments of chert lying within the ore area and on adjacent portions of the hill. This deposit is about seven miles from the St. L., C. G. & Ft. S. Ry. (L.—1892.)

127. SNEATHEN AND COMPANY LAND NO. 1.

S. W. ¼, Sec. 8, T. 28 N., R. 6 E.

Massive limonite occurs here, making up the cap of a hill. The main body of the ore covers nearly an acre of land and this entire area is made up almost wholly of limonite in the form of rough masses and fragments. About fifty yards further east, along the ridge, a smaller area of similar ore occurs and at many places on the hills in this neighborhood scattered masses of ore occur with the chert. This chert is found on all of the hills near here. Much of the ore is of a good quality and contains coatings and thin layers of limonite with a silky to submetallic lustre. There is pseudomorphous ore here. Some fragments contain fine grains of sand. (L.—1892.)

128. SNEATHEN AND COMPANY LAND NO. 2.

Sec. 22, T. 28 N., R. 6 E.

Massive limonite again occurs here, covering an area of about eighty yards in length and thirty yards in width. The ore here is in the form of large scattered boulders again, making up the cap of the hill. This deposit is two hundred yards southeast of the deposit in Sec. 15 of this same township and the quality of the ore and the mode of occurrence is almost identical in the two localities. Small fragments of ore are found between the deposits but no continuous ledge is apparent.

About one hundred and fifty yards southeast of this deposit, in Sec. 22, there is another, similar deposit, covering an area of perhaps forty yards in width, and twenty yards in length. This ore is also somewhat siliceous, silica occurring as small angular chert particles and as grains of sand. These localities are nearly five miles from the W., G. & N. Ry. Fragments of similar ore may be found in many places on the hills in Sec. 15, 16, and 22, T. 28 N., R. 6 E. (L.—1892.)

129. SNEATHEN AND COMPANY LAND NO. 3.

Near the line between Secs. 15 and 22, T. 28 N., R. 6 E.

Massive limonite is found here, covering an area about one hundred yards long and fifty yards wide, making up the southern portion of a large, flat-topped hill. Many huge boulders, small fragments and an apparent ledge are found within this area. The ore is somewhat siliceous, bearing small fragments of chert and grains of sand. Some of the boulders are porous. On the northern slope of the hill on which this deposit is situated some fragments of chert and water-worn pebbles are found, on other slopes much chert occurs. The main portion of the top of the hill near the ore-bearing area is quite flat, made up of heavy soil and but few rocks. This locality is five miles from the W., G. & N. Ry. (L.—1892.)

130. SNEATHEN AND COMPANY LAND NO. 4.

Owned by the Sneathen Estate.

S. W. ¼, N. W. ¼, Sec. 21, T. 29 N., R. 6 E.

Here, primary limonite of the porous, silicious type outcrops in the road on the crest of a ridge. The outcrop is not large but it is one of several occurring in the immediate vicinity of the two deposits described as the Myers and the Burton mines. (C.—1910.)

131. SOLLARS BANK.

Owned by A. J. Sollars, Chaonia, Mo.

N. W. ¼, S. E. ¼, Sec. 25, T. 27 N., R. 6 E.

This bank, located about three quarters of a mile south of Chaonia, is situated on the southeast face of a chert covered hill, upon which silicious brown ore outcrops over an area of several hundred square yards. Developments consist of three small cuts from which twenty tons of fair grade ore have been mined.

The ore consists of a porous, cherty, primary limonite containing cavities lined with goethite and occurs as large boulders embedded in cherty clay. Much of the surface ore is cherty and sandy, while that from the bottom of the pits is comparatively free from these materials. (C.—1910.)

132. SOUTH MISSOURI PINE LUMBER COMPANY LAND NO. 1.

Owned by the South Missouri Pine Lumber Company, Upalika, Mo.

S. E. ¼, Sec. 5, T. 26 N., R. 4 E.

This deposit is located three quarters of a mile south of Upalika. The outcrop consists of large boulders and fragments of ore covering an area of two acres along the crest of a ridge. Two pits, each three feet deep, show fragments of ore embedded in clay.

The deposit consists of primary limonite. The larger boulders usually contain angular fragments of chert and all of the ore is somewhat sandy. (B.—1910.)

133. SOUTH MISSOURI PINE LUMBER COMPANY LAND NO. 2

N. W. ¼, N. W. ¼, Sec. 21, T. 27 N., R. 4 E.

This deposit, located three miles north of Upalika, is situated near the crest of a high hill where brown ore outcrops over an area of about one acre. No development work has been done. The deposit consists of primary limonite and contains much chert. (B.—1910.)

134. SOUTH MISSOURI PINE LUMBER COMPANY LAND NO. 3.

N. W. ¼, Sec. 33, T. 27 N., R. 4 E.

This deposit is located one mile north of Upalika. The outcrop consists of boulders and fragments of brown ore exposed for a distance of 130 yards along the west slope of a secondary ridge. A pit 14 feet square and 10 feet deep shows layers of ore embedded in clay throughout its depth.

The ore is a primary limonite which is both compact and cellular in texture. The former variety contains fragments of hard chert, while the cavities in the latter are partly filled with decomposed chert. (B.—1910.)

135. SOUTH MISSOURI PINE LUMBER COMPANY LAND NO. 4.

S. E. ¼, Sec. 33, T. 27 N., R. 4 E.

This deposit is located half a mile northeast of Upalika. The outcrop consists of boulders and fragments of brown ore scattered over an area of five acres on the crest of a secondary ridge. A two-foot pit shows boulders of compact, sandy ore embedded in clay.

The ore is a primary limonite some of which is very silicious owing to the presence of much chert. A portion of it is quite cellular and the cavities are partly filled with decomposed chert. (B.—1910.)

136. SOUTH MISSOURI PINE LUMBER COMPANY LAND NO. 5.

S. E. ¼, Sec. 35, T. 27 N., R. 4 E.

This prospect is located 2½ miles east of Upalika and three quarters of a mile south of the St. Louis and San Francisco R'y. The outcrop consists of boulders and fragments of cherty brown ore scattered for a distance of 100 yards along the sides of a small ravine. At the southern edge of the outcrop a ledge of ferruginous sandstone, containing fragments of chert, is exposed along the ravine. The ore consists of primary limonite containing a small amount of sand and some goethite. The larger boulders are usually cellular, the cavities being partly filled with decomposed chert. (B.—1910.)

137. SOUTH MISSOURI PINE LUMBER COMPANY LAND NO. 6.

Sec. 35, T. 27 N., R. 4 E.

This deposit is located 2½ miles east of Upalika and approximately one mile south of the St. Louis and San Francisco R'y. The outcrop consists of boulders and fragments of brown ore covering an area 50 yards long and 30 yards wide on the crest and gentle south slope of a ridge. Tertiary pebbles are scattered over the hilltop. No development work has been done. The outcrop consists of massive primary limonite containing fragments of hard chert. (B.—1910.)

138. SPEER'S MOUNTAIN.

W. ½, Lot 2, N. W. ¼, Sec. 3, T. 29 N., R. 7 E.

Limonite occurs here almost exactly on the top or inclining a little towards the eastern slope of a hill. It is in almost solid masses lying irregularly over an area about forty-five feet wide and one hundred and fifty feet along the ridge, while the broken pieces extend down the hill about one hundred feet. The ore is porous and contains chert in small pieces, which occurs at pretty regular intervals. The surface of the hill is covered with soil, and no rock is seen, save occasional chert lumps. (M.—1873.)

139. ST. FRANCOIS MINE.

Owned by St. Francois Iron and Land Company, Greenville, Mo.

W. ½, Lot 1, N. E. ¼, Sec. 5, T. 28 N., R. 6 E.

This mine, located 3½ miles northeast of Greenville, is situated upon the crest of a high east and west ridge. It was opened in 1907 by a circular cut 100 feet in diameter and from 2 to 13 feet in depth from which 717 tons of ore were mined and shipped. The ore occurs as large boulders and small fragments embedded in cherty clay. It is a primary limonite and is highly silicious due to the presence of sand, finely divided quartz, and fragments of partly replaced chert. The ore shipped during 1907 showed an average analysis of 45.13% iron, 18.56% silica, 0.075% Phos., 0.955% Mn., and 5.00% moisture.

Two years later this mine was purchased by the St. Francois Iron and Land Company. It was connected by a short spur to the Williamsville, Greenville, and St. Louis R'y. Steam shovels were introduced for loading purposes and a new 500 ton washer, equipped with logs, crusher, and jigs was erected at Greenville by the company to clean the ore. After mining and washing 538 tons of ore, which averaged 45.22% iron, 18.93% silica, 0.056% Phos., 0.55% Mn. and 5.0% moisture, the mine and washer were both abandoned. A comparison of the analyses of the washed and unwashed product shows that the quality of the ore was not materially improved by the special treatment.

The total production of the mine to Dec. 31st, 1910, is 1,255 tons. (C.—1910.)

140. SWITCHBACK MINE.

N. E. ¼, S. W. ¼, Sec. 28, T. 28 N., R. 5 E.

This mine, located four miles S. W. of Greenville, is situated near the base of the north slope of a chert covered hill. It consists of a cut 50 feet long, 40 feet wide, and 6 feet deep, the face and bottom of which show an abundance of ore. One hundred feet east of this cut is a narrow opening 40 feet long, and seven feet deep which shows about five feet of fragmentary ore mixed with a large proportion of cherty clay.

The ore is a primary limonite and occurs mainly as large, porous, silicious boulders containing much partly replaced chert and some sand. It is low grade and is not well adapted to washing. About two cars of ore were shipped from this property during 1909. The ore was hauled half a mile to the Williamsville, Greenville, and St. Louis R'y. (C.—1910.)

141. TALLEY LAND.

Owned by J. H. Talley, Greenville, Mo.

S. W. ¼, N. E. ¼, Sec. 20, T. 29 N., R. 6 E.

This property, located six miles northeast of Greenville and one mile west of the Williamsville, Greenville and St. Louis R'y., has been opened by four shallow pits, each of which disclosed porous, silicious, primary limonite containing both chert and fine grains of sand. Ore of the same character outcrops quite generally, though not prominently, in the immediate vicinity of the pits. (C.—1910.)

142. TOWER (GEO. F.) LAND.

S. E. ¼, Sec. 16, T. 28 N., R. 6 E.

Massive limonite makes up an area, here, about ten yards across. Large and small fragments of the ore are found on the gradual slope of a large hill. These fragments are siliceous, silica occurring in the form of partly decomposed chert and fine grains of sand. Small pieces of such ore are found mingled with the chert in many localities on this and neighboring hills. This is nearly five miles from the W., G. & N. Ry. (L.—1892.)

143. TWIDWELL BANK.

N. E. ¼, S. W. ¼ & N. W. ¼, S. E. ¼ } Sec. 30, T. 29 N., R. 6 E.

This bank, located about four miles north of Greenville, is situated upon the west slope of a high hill, at a place where brown ore outcrops over an area of about two acres. Developments consist of a single cut 70 feet long, 15 feet wide, and 8 feet deep. All parts of the face of this cut show an abundance of boulder ore embedded in cherty clay. A five-foot pit sunk in the bottom of the cut showed ore to that depth.

The ore is a primary limonite and is silicious, due to the presence of enclosed fragments of chert and grains of sand. A mine sample, taken and analyzed by the Wayne Iron and Lumber Company, showed 47.58% iron, 21.05% silica, 0.083% Phos., 0.43% Mn., 0.71% Alumina, and 3.00% moisture.

The above developments were made in 1907. Some ore has been shipped.

(C.—1910.)

144. WARMUCK LAND.

Owned by Wm. Warmuck.

N. E. ¼, S. E. ¼, Sec. 8, T. 28 N., R. 6 E.

This prospect, located three miles northeast of Greenville, consists of an outcrop of large and small boulders of silicious primary limonite, extending for about 300 feet along the flank of a ridge. No development work has been done.

(C.—1910.)

145. WAYNE IRON AND LUMBER COMPANY LAND NO. 1.

Owned by Wayne Iron and Lumber Company, Greenville, Mo.

N. E. ¼, N. W. ¼, Sec. 8, T. 29 N., R. 7 E.

This prospect, located two miles north of Hiram, is situated in a small cut made by the Williamsville, Greenville and St. Louis R'y. where it crosses the east point of a hill. The ore is a silicious primary limonite. It is exposed at intervals for 100 feet in the west face of the cut and occurs in large and small boulders embedded in a cherty clay. A 12 foot pit sunk in the bottom of the cut is reported to show ore in clay to that depth. No shipments have been made. (C.—1910.)

146. WAYNE IRON AND LUMBER COMPANY LAND NO. 2.

S. E. ½, S. E. ¼, Sec. 23, T. 27 N., R. 5 E.

This prospect, located 1½ miles southwest of Taskee, consists of a small outcrop of cherty primary limonite, situated on the north side and near the top of a chert covered ridge. A small pit 10 feet in diameter and 4 feet deep, sunk upon the outcrop, produced 6 to 8 tons of silicious, but merchantable ore. (C.—1910.)

147. WHITE LAND.

Owned by W. E. White, Greenville, Mo.

N. W. ¼, S. E. ¼, Sec. 29, T. 29 N., R. 6 E.

This prospect, located 4½ miles northeast of Greenville, and about one mile west of the Williamsville, Greenville and St. Louis R'y., consists of an outcrop of cherty brown ore over an area about 100 feet in diameter. The only development consists of a four foot pit from which several boulders of hard, cherty, primary limonite were taken. (C.—1910.)

148. WHITE (R.) MINE.

Owned by R. White, Greenville, Mo.

N. E. ¼, S. W. ¼ & N. W. ¼, S. E. ¼ } Sec. 19, T. 29 N., R. 6 E.

This mine, located 5½ miles north of Greenville, is situated upon the crown of a high hill which is capped by an outcrop of cherty brown ore. Developments consist of an open cut 30 feet long, 15 feet wide, and 10 feet deep, from which about 30 tons of ore have been mined. The ore is a cherty primary limonite, and occurs as large, massive, porous boulders with pot-like cavities embedded in clay and chert. It is somewhat cherty and sandy but fair in grade.

One hundred yards west of the above described cut is a 10 foot pit from which ore of much the same character has been taken. The ore was hauled by wagon to Burton Switch two miles to the east, on the Williamsville, Greenville and St. Louis R'y. (C.—1910)

149. WHITE (W.) MINE.

Owned by Wilson White, Greenville, Mo.

S. ½, N. W. ¼, Sec. 20, T. 29 N., R. 6 E.

This mine, located six miles northeast of Greenville and about one mile west of a logging spur of the Williamsville, Greenville and St. Louis R'y. is situated near the crest of the south slope of a high hill where cherty primary limonite outcrops over an area of about two acres. Developments consist of two pits, one of which is about 40 feet long, 30 feet wide, and 10 feet deep, while the other is 20 feet long, 10 feet wide, and 6 feet deep. From these cuts 206 tons of ore were mined and shipped in 1907 and the face and bottom of both pits still show boulder ore embedded in cherty clay. Though the ore is rather cherty at the surface, it appears to become less so with depth. The ore shipped gave returns of 45.73% iron, 15.23% silica, 0.060% Phos., 0.35% Mn., and 3.00% moisture. (C.—1910.)

150. WOODEN SHOE MINE.

Owned by the Wayne Iron and Lumber Company, Greenville, Mo.

E. ½, S. E. ¼, Sec. 33, T. 28 N., R. 5 E.

This mine, located about three quarters of a mile south of Sawyer Switch, is situated near the crest of the south slope of a high hill where boulders of silicious brown ore outcrops over an area about 100 feet in diameter. Developments consist of an open cut 20 feet long, 15 feet wide, and 6 feet deep, from which 154 tons of ore have been mined and shipped. The ore is a porous, silicious, primary limonite and occurs as large and small boulders embedded in cherty clay. The surface outcrop contains considerable unreplaced chert, while the ore taken from the cut was not noticeably cherty. Two shallow pits on the west face of the hill show some ore of a similar character overlain by about two feet of Tertiary gravel and clay.

On the north side of the same hill, about 200 yards north of the main cut, is an opening from which about 10 tons of ore of very much the same character has been taken. The ore shipped gave returns of 46.20% iron, 16.30% silica, 0.09% Phos., 1.20% Mn., and 5.0% moisture. (C.—1910.)

151. ZIPPY MINE.

Owned by John Zippy, Livingston, Ill.

N. W. ¼, S. W. ¼, Sec. 27, T. 29 N., R. 6 E.

This mine, located 5½ miles northeast of Greenville and less than a quarter of a mile north of the Williamsville, Greenville and St. Louis R'y., is situated on the northeast face of a hill near the crest of the main divide between the St. Francois river and Bear creek. The mine consists of an open cut 30 feet long, 15 feet wide and 12 feet deep, from which 55 tons of ore have been mined and shipped. The entire face of the cut shows numerous large and small boulders of porous, primary limonite embedded in clay. Although quite cherty at the outcrop, the ore improves with depth. The ore shipped gave returns of 44.62% iron, 17.40% silica, 0.054% Phos., 2.00% Mn., and 3.00% moisture. (C.—1910.)

WAYNE COUNTY.

SPECULAR ORES IN PORPHYRY.

No.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
1	Cheeney Bank	29	4 E.	21	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
2	Clarks Mountain	29	4 E.	5	W. $\frac{1}{2}$, S. E. $\frac{1}{4}$.

SECONDARY LIMONITE.

3	Alley, P. B., Mine	28	5 E.	23	E. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
4	Anderson, N. M., Bank	29	3 E.	3	S. W. $\frac{1}{4}$.
5	Anderson, N. M., Mine	29	3 E.	2	
6	Bailey, Henry, Mine	27	6 E.	29	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
7	Bear Mountain Bank	29	3 E.	2	N. W. $\frac{1}{4}$.
8	Bingham Mine	28	5 E.	27	S. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
9	Bowman Bank	27	5 E.	15	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
10	Buffington Mine	27	4 E.	13	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
11	Burkett Mine No. 1	27	5 E.	32	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
12	Burkett Mine No. 2	27	5 E.	32	S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
13	Cady Mine	27	5 E.	22	S. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
14	Cedar Bay Mine	28	3 E.	14, 23	
15	Childress Mine	27	5 E.	11	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
16	Clubb Mine	28	5 E.	23	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
17	Cullnan, Pat, Bank	26	6 E.	6	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
18	Dalton, Mrs. N. T., Land	28	5 E.	11	
19	Daniel Mine	29	3 E.	25	S. E. $\frac{1}{4}$.
20	Dickson Mine	27	6 E.	6	Lot 7, N. W. $\frac{1}{4}$.
21	Durrow, John, Land	27	5 E.	26	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
22	Early, James, Bank	28	4 E.	6	S. E. $\frac{1}{4}$.
23	Eastman, F. W., Mine	26	5 E.	2	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
24	Estes Mine	27	6 E.	19	S. $\frac{1}{2}$ Lot 1, N. W. $\frac{1}{4}$.
25	Ethridge, M., Mine	26	5 E.	1	S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
26	Forbes Mine	27	5 E.	12	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
27	Foster Mine	27	6 E.	31	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
28	Fredrick, James, Mine	27	6 E.	18	S. $\frac{1}{2}$ Lot 2, S. W. $\frac{1}{4}$.
29	Guest, W. S., Bank	29	3 E.	35	N. E. $\frac{1}{4}$.
30	Guest, W. S., Land	29	3 E.	36	N. E. $\frac{1}{4}$.
31	Harness and Lundy Mine	28	5 E.	34	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
32	Haynie Hollow Bank	27	5 E.	5	
33	Haynie, S. C., Land	27	5 E.	17	S. W. $\frac{1}{4}$.
34	Hicks, Andrew, Mine	27	6 E.	23	Lot 2, N. W. $\frac{1}{4}$.
35	Higgins Mine	29	7 E.	5	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
36	Holliday, H. N., & Haynie, S. C.	27	5 E.	20	
37	Holliday-Klotz Mine	27	5 E.	34	E. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
38	Hughes, W. H., Mine No. 1	27	6 E.	19	N. $\frac{1}{2}$, Lot 1, N. W. $\frac{1}{4}$.
39	Hughes, W. H., Mine No. 2	27	6 E.	19	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
40	Janis Mine	27	5 E.	1	Lot 5, N. W. $\frac{1}{4}$.
41	Keele, Lucian, Bank	26	5 E.	1	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
42	Keener, Mrs. L., Mine	26	5 E.	3	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
43	Kelly, Thomas, Land	30	5 E.	24	W. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
44	King Mine	28	5 E.	34	W. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
45	Kinkad, Thomas, Land	30	5 E.	13	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.

SECONDARY LIMONITE—Continued.

No.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
46	Kister Bank....................	30	4 E.	35	N. E. ¼, N. W. ¼.
47	Knox, J. E., Mine...............	27	4 E.	3	N. W. ¼, S. E. ¼.
48	Landau, S., Mine................	26	5 E.	1	S. W. ¼, N. W. ¼.
49	Mann Bank.......................	27	6 E.	21	
50	Maxfield Mine...................	27	6 E.	18	N. E. ¼, N. E. ¼.
51	McKenzie Bank No. 1............	29	7 E.	7	N. E. ¼, S. E. ¼.
52	Morris, Joe, Bank...............	27	4 E.	21	N. W. ¼.
53	Morgan, Chas., Mine............	27	5 E.	12	N. ½, S. E. ¼.
54	Moss Mine.......................	27	6 E.	20	N. W. ¼, S. W. ¼.
55	Nelson, Frank, Mine............	27	6 E.	20	N. E. ¼, S. W. ¼.
56	Ojibway Mine....................	27	6 E.	21	S. W. ¼, N. E. ¼.
57	O'Keefe, P., Bank No. 1.........	27	4 E.	10	N. ½, S. E. ¼.
58	O'Keefe, P., Bank No. 2.........	27	4 E.	21	S. E. ¼, N. W. ¼.
59	O'Keefe, P., Mine No. 1.........	27	4 E.	12	N. E. ¼, N. W. ¼.
60	O'Keefe, P., Mine No. 3.........	27	4 E.	12	N. W. ¼, N. W. ¼.
61	Otter Creek Bank................	27	5 E.	3 4	S. W. ¼. Lot 1, N. E. ¼.
62	Pittsburg Mine..................	26	5 E.	6	E. ½, N. E. ¼.
63	Pletz, F., Mine.................	27	5 E.	21	N. E. ¼, S. W. ¼.
64	Pratt, A. L., Mine..............	27	5 E.	21	S. E. ¼, S. W. ¼.
65	Railroad Bank No. 2............	27	5 E.	8	S. E. ¼.
66	Rubottom, L., Land..............	28	5 E.	10	
67	Sanders, E. F., Bank............	27	5 E.	24	N. E. ¼, N. E. ¼.
68	Sanderson, A. E., Land..........	27	6 E.	14	N. E. ¼.
69	Sawyer Mine.....................	28	5 E.	34	N. ½, N. W. ¼.
70	Schafer Bank....................	26	5 E.	2	N. ½, S. E. ¼.
71	Scott, U. S., Bank..............	26	6 E.	6	S. ½ Lot 1, S. W. ¼.
72	Shipton, H. M., Mine...........	27	5 E.	14	S. W. ¼, S. E. ¼.
73	Singer, Nimick Co., Land........	26	5 E.	5	
74	Smoot, E. L., Mine..............	27	5 E.	1	S. ½.
75	Staggs, F. M., Mine.............	27	6 E.	23	N. E. ¼, S. E. ¼.
76	Stevenson Bank..................	27	5 E.	12	N. W. ¼, N. W. ¼.
77	Sutton, Marcus, Mine...........	28	5 E.	23	N. E. ¼.
78	Williamsville & Iron Mt. Ore Co. Bank No. 1.................	27	5 E.	19	N. E. ¼, N. E. ¼.
79	Williamsville & Iron Mt. Ore Co. Bank No. 2.................	27	5 E.	32	S. E. ¼.
80	Williamsville Mine..............	27	5 E.	20	W. ½, N. W. ¼.
81	Yancey Mountain Bank.........	30	4 E.	35	N. W. ¼, N. E. ¼.

PRIMARY LIMONITE.

82	Anderson, Hugh, Land.........	27	7 E.	6	S. E. ¼.
83	Atkins Estate Land............	28	6 E.	19	N. W. ¼.
84	Bailey, T. G., Bank............	27	7 E.	30	N. W. ¼, S. W. ¼.
85	Baker Mine.....................	26	4 E.	5	N. E. ¼, S. W. ¼
86	Barker Bank....................	29	7 E.	31	S. W. ¼, N. E. ¼.
87	Bennett-Smith Mine............	28	6 E.	8	W. ½, N. E. ¼.
88	Berry, Wm., Land No. 1........	28	6 E.	15	
89	Berry, Wm., Land No. 2........	28	6 E.	15	S. W. ¼.
90	Bowman Land...................	27	5 E.	9	S. W. ¼.
91	Burton Mine....................	29	6 E.	21	W. ½, S. W. ¼.
92	Chaonia Merc. & Iron Co. Bank.	27	6 E.	36	N. E. ¼, N. E. ¼.
93	Crawford Mine..................	27	5 E.	17	W. ½, N. E. ¼.

PRIMARY LIMONITE—Continued.

No.	Name of Mine or Owner.	Twp.	R.	Sec.	Fractional.
94	Folsom, Alex., Land............	28	6 E.	10, 11	Line between.
95	Garrison, D. L., Tract..........	27	6 E.	2	Lots 2, 3, 4, N. E. ¼.
96	Gary, A., & Moss, T. J., Land...	27	6 E.	25	N. W. ¼.
97	Green, J. W., Tract............	27	6 E.	25	S. E. ¼, S. E. ¼.
98	Haggard Land..................	29	6 E.	28	S. W. ¼, S. W. ¼.
99	Hilda Mine....................	28	5 E.	28	S. W. ¼.
100	Jennie Mine....................	29	6 E.	5	S. W. ¼.
101	Jines, F., Bank................	28	7 E.	28	N. W. ¼.
102	Johnson, Lewis, Bank...........	28	6 E.	15	N. E. ¼, S. W. ¼.
103	Jones, H. S., Land.............	27	7 E.	3	S. W. ¼.
104	Lambert Mine..................	29	7 E.	5	N. W. ¼, S. W. ¼.
105	Lilly Hollow Mine.............	29	7 E.	9	S. W. ¼, S. E. ¼.
106	Long & Colby Bank............	29	7 E.	18	N. W. ¼, N. E. ¼.
107	Magill, Wm., Land.............	26	6 E.	6	N. E. ¼, N. E. ¼.
108	Mason & Clarkson Land........	27	7 E.	16	E. ½.
109	Mayberry Tract................	27	8 E.	6	E. ½, center of.
110	McKenzie Bank No. 2...........	29	7 E.	7	S. W. ¼, N. E. ¼.
111	Morris Creek Bank.............	27	4 E.	35	S. E. ¼.
112	Moss & Clarkson Land.........	27	7 E.	10	N. ½.
113	Moss, T. J., Land..............	27	6 E.	19	
114	Myers Mine...................	29	6 E.	20	E. ½, S. E. ¼.
115	Neighbors, John, Land.........	27	7 E.	6	S. E. ¼.
116	Northwestern Cons. Land No. 1.	27	7 E.	9	N. E. ¼.
117	Northwestern Cons. Land No. 2.	27	7 E.	10	S. W. ¼.
118	Northwestern Cons. Land No. 3.	27	7 E.	14	Center.
119	Northwestern Cons. Land No. 4.	27	7 E.	15 16	W. ½. E. ½.
120	Northwestern Cons. Land No. 5.	27	7 E.	35	
121	O'Keefe, P., Mine No. 2........	27	4 E.	2	S. W. ¼, S. W. ¼.
122	O'Keefe, P., Mine No. 4........	27	4 E.	16	N. W. ¼, S. E. ¼.
123	Ozark Land Co. Land..........	27	6 E.	17	
124	Petit Land....................	27	7 E.	19	S. E. ¼.
125	Shaw, David, Land............	27	7 E.	6	W. ½, Lot 1, S. E. ¼.
126	Smith, Pleasant Land..........	27	7 E.	6	W. ½, Lot 1, N. W. ¼.
127	Sneathen & Co. Land No. 1.....	28	6 E.	8	S. W. ¼.
128	Sneathen & Co. Land No. 2.....	28	6 E.	22	
129	Sneathen & Co. Land No. 3.....	28	6 E.	15, 22	Line between.
130	Sneathen & Co. Land No. 4.....	29	6 E.	21	S. W. ¼, N. W. ¼.
131	Sollars, A. J., Bank............	27	6 E.	25	N. W. ¼, S. E. ¼.
132	S. Mo. Pine Lum. Co. Land No.1.	26	4 E.	5	S. E. ¼.
133	S. Mo. Pine Lum. Co. Land No.2.	27	4 E.	21	N. W. ¼, N. W. ¼.
134	S. Mo. Pine Lum. Co. Land No.3.	27	4 E.	33	N. W. ¼.
135	S. Mo. Pine Lum. Co. Land No.4.	27	4 E.	33	S. E. ¼.
136	S. Mo. Pine Lum. Co. Land No.5.	27	4 E.	35	S. E. ¼.
137	S. Mo. Pine Lum. Co. Land No.6.	27	4 E.	35	
138	Speer's Mountain.............	29	7 E.	3	W. ½ Lot 2, N. W. ¼.
139	St. Francois Mine..............	28	6 E.	5	W. ½ Lot 1, N. E. ¼.
140	Switchback Mine..............	28	5 E.	28	N. E. ¼, S. W. ¼.
141	Talley, J. H., Land............	29	6 E.	20	S. W. ¼, N. E. ¼.
142	Tower, Geo. F., Land..........	28	6 E.	16	S. E. ¼.
143	Twidwell Bank................	29	6 E.	30	N. E. ¼, S. W. ¼. N. W. ¼, S. E. ¼.

PRIMARY LIMONITE—Continued.

No.	Name of Mine or Owner.	Twp.	R.	Sec.	Fractional.
144	Warmuck, Wm., Land..........	28	6 E.	8	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
145	Wayne Iron & Lumber Co. Land No. 1......................	29	7 E.	8	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
146	Wayne Iron & Lumber Co. Land No. 2......................	27	5 E.	23	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
147	White, W. E., Land............	29	6 E.	29	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
148	White, R., Mine...............	29	6 E.	19	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$. N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
149	White, W., Mine...............	29	6 E.	20	S. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
150	Wooden Shoe Mine............	28	5 E.	33	E. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
151	Zippy, John, Mine.............	29	6 E.	27	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.

REPORTED OCCURRENCES.

	Bennett, Perry................	28	7 E.	30	
	Cross, Wilson.................	29	6 E.	16	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
	Cross, Wilson.................	29	6 E.	21	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
	Deaton, Jos. D................	27	6 E.	7	
	Estes, J. A.....................	27	5 E.	24	S. W. $\frac{1}{4}$.
	Garry, A.......................	27	6 E.	26	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
	Holladay, H. N................	28	6 E.	5	S. W. $\frac{1}{4}$.
	Mason & Clarkson.............	28	5 E.	35	
	Moss, T. J.....................	27	6 E.	25	W. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
	Northwestern Cons. Bank.......	27	7 E.	13	
	Northwestern Cons. Bank.......	27	7 E.	24	
	Osgood, L. S...................	27	6 E.	36	N. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
	Pletz, F.......................	27	6 E.	36	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
	Sneathen Estate...............	29	7 E.	7	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	Williamsville Iron Mt. Ore Co...	27	5 E.	32	S. E. $\frac{1}{4}$.
	Owner unknown...............	26	4 E.	2	N. W. $\frac{1}{4}$.
	" "	26	5 E.	3	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	13	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
	" "	27	4 E.	13	W. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
	" "	27	4 E.	13	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
	" "	27	4 E.	13	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	13	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	14	N. E. $\frac{1}{4}$.
	" "	27	4 E.	16	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	19	N. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
	" "	27	4 E.	19	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	21	N. E. $\frac{1}{4}$.
	" "	27	4 E.	24	N. W. $\frac{1}{4}$.
	" "	27	4 E.	25	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
	" "	27	4 E.	25	N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
	" "	27	4 E.	25	S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
	" "	27	4 E.	26	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
	" "	27	4 E.	29	S. E. $\frac{1}{4}$.
	" "	27	4 E.	30	E. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
	" "	27	4 E.	31	S. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
	" "	27	4 E.	32	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
	" "	27	4 E.	32	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	35	N. W. $\frac{1}{4}$.
	" "	27	4 E.	36	N. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
	" "	27	4 E.	36	S. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.

REPORTED OCCURRENCES—Continued.

Name of Mine or Owner.	*Twp.*	*R.*	*Sec.*	*Fractional.*
Owner unknown................	27	5 E.	3	S. W. ¼.
" "	27	5 E.	4	
" "	27	5 E.	4	Lot 3, N. W. ¼.
" "	27	5 E.	4	N. ½, S. E. ¼.
" "	27	5 E.	5	S. ½.
" "	27	5 E.	9	S. E. ¼.
" "	27	5 E.	16	N. E. ¼.
" "	27	5 E.	21	N. E. ¼, S. E. ¼.
" "	27	5 E.	29	
" "	27	6 E.	2	W. ½ Lot 5, N. E. ¼.
" "	27	6 E.	2	S. ½ Lot 5, N. E. ¼.
" "	27	6 E.	19	S. ½ Lot 2, N. W. ¼.
" "	27	6 E.	24	S. W. ¼.
" "	27	6 E.	35	S. E. ¼.
" "	28	4 E.	1	S. W. ¼.
" "	28	4 E.	18	
" "	28	4 E.	19	
" "	28	5 E.	6	N. E. ¼.
" "	28	5 E.	15	
" "	28	5 E.	26	
" "	28	5 E.	30	
" "	28	6 E.	6	S. W. ¼.
" "	28	6 E.	27	N. ½, S. W. ¼.
" "	28	6 E.	27	S. W. ¼, S. W. ¼.
" "	28	6 E.	27	N. W. ¼, S. E. ¼.
" "	29	3 E.	4	W. ½ Lot 1, N. E. ¼.
" "	29	3 E.	4	N. E. ¼, N. W. ¼.
" "	29	3 E.	4	S. W. ¼.
" "	29	3 E.	4	S. ½, S. W. ¼.
" "	29	3 E.	4	S. ½, S. E. ¼.
" "	29	4 E.	25	S. E. ¼.
" "	29	5 E.	31	S. E. ¼.
" "	29	6 E.	32	
" "	29	7 E.	2	W. ½ Lot 2, N. W. ¼.

TABLE OF ANALYSES.

In order to indicate the relative value of the various types of ore the analyses in the following table have been arranged alphabetically according to districts, counties, and mines.

As designated in the column headed "Remarks" most of the analyses represent the average of one or more shipments. Those designated "Mine Sample" were made from samples collected at the mine; usually obtained from the face of the pit or from stock piles. The "Test Pit Samples" were taken from the dumps occurring at the test pits of partially developed properties. Where the property has not been developed the sample taken from the surface is designated as "Outcrop Sample." Where samples have been taken to represent various phases of the ore body they are so designated.

The analyst or source of the analyses is designated as follows· A. B. = A. A. Blair, C. = R. Chauvenet, St. Louis, Mo., G. S. = Geological Survey (Missouri Bureau of Geology and Mines), M. B. = Midland Blast Furnace Company, Steelville, Mo., O. W. = Otto Wuth, Pittsburg, Pa., S. F. = Sligo Furnace Company, Sligo, Mo., St. J. = St. Joseph Lead Company, Bonneterre, Mo., St. L. B. = St. Louis Blast Furnace Company, St. Louis, Mo., St. L. S. = St. Louis Testing and Sampling Works, St. Louis, Mo., W. = August Wendel, Troy, New York, W. I. = Wayne Iron and Lumber Company, Greenville, Mo., 10-Cen. = Tenth Census, 1880.

SPECULAR ORES IN PORPHYRY.

IRON COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Buford Mountain	47.81		0.044	0.017	12.32						C.	262	Sample, average.
Cedar Hill	65.47	5.62	0.039	0.000							A. B.	137	Sample, average of vein.
Cuthbertson	2.31	0.44			52.47						A. B.	262	Manganese ore, sample.
"	68.49	2.45			Trace						A. B.	262	Specular ore, sample.
Lewis Mountain	59.22	14.45	0.027			0.51	0.060	0.040			A. B.	262	Sample.
Pilot Knob	46.00	30.38				0.00					C.	129	Float ore, average.
" "	52.60	19.70				0.00					C.	129	Float ore, selected.
" "	49.60	23.20				3.76					St. L. B.	129	Float ore, hand-picked.
" "	56.03	10.15	0.021			4.37					St. L. B.	128	Shipment, conglomerate ore.
" "	58.11	17.02	0.013	0.077	Trace	2.59	0.150	0.015			C.	121	Main seam, shipment.
" "	49.30	16.46	0.068	0.203							G. S.	130	Upper ore bed, average 20 ft. face.
Shepherd Mountain	65.63	3.19	0.013	0.077	Trace	1.37	0.430	0.100	1.00		10 Cen.	134	Ore from north cut.
" "	64.31	6.76	0.017	0.000	0.000	1.55	0.350	0.040			A. B.	134	Lower part of main vein.
" "	66.52	5.15	0.011	0.000							A. B.	134	Upper part of main vein.
" "	67.69		0.014	0.000							A. B.	134	Soft ore, lower part of main vein.
" "	66.63		0.017	0.000							A. B.	134	Magnetic ore, north vein.
" "	61.48	5.65	0.010	0.560	0.37						St. L. B.	134	Stock pile at north cut.
" "	47.02		0.290	0.176							C.	135	Samples of cores from holes 30, 34, 37 and 38, which show 18½ ft. ore.

ST. FRANCOIS COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Iron Mountain	65.68	3.91	0.026								C.	114	Surface ore, jigged.
" "	66.51	3.80	0.020								C.	114	Surface ore, lump.
" "	62.19	6.60	0.028								C.	114	Shaft No. 1 ore, jigged.
" "	63.79	4.92	0.093								C.	114	Inclines Nos. 1 and 2, jigged.
" "	63.08	6.11	0.060								C.	114	Shaft No. 1, incline No. 1, jigged.
" "	65.13	4.47	0.034								C.	114	Shaft No. 1, lump ore.
" "	62.50	6.40	0.038								C.	114	Shaft No. 1, jigged ore.

Iron Mountain	62.81	6.46	0.063								C.	114	Shaft No. 1, incline No. 1.
" "	63 68	4.87	0.070								C.	114	Incline No. 2, jigged ore.
" "	61.45	7.12	0.105								C.	114	Furnace jigged.
" "	55.22	11.68	0.026								C.	114	Shaft No. 2, bluff ore.
" "	63.00	5.86	0.389								C.	114	S. E. mine, bluff ore.
" "	59.64	8.69	0.226								C.	114	S. E. mine, bluff ore.
" "	66.80	2.51	0.058								C.	114	Incline No. 3, soft lump.
" "	65.75	4.08	0.095								C.	114	Incline No. 2, soft lump.
" "	64.12	5.44	0.013								C.	114	Shaft No. 2, special ore.

HEMATITES OF THE CARBONIFEROUS.

CALLAWAY COUNTY.

Bartlett	56.93	8.20	0.049						2.23	0.20	G. S.	182	Sample of hard blue hematite.
"	58.69	6.26	0.018						3.22	0.68	G. S.	182	Sample of earthy red hematite.
Dunn, Ralph	43.17	6.95	1.290								St. L. S.	182	Shaley gangue.
" "	57.20	9.66	0.07								St. L. S.	182	Hard blue hematite.

FRANKLIN COUNTY.

Kleinsorde	50.08	13.16	Trace	0.17							G. S.	240	Sample.

HEMATITES OF THE FILLED SINKS.

CRAWFORD COUNTY.

Benton Creek	56.01	17.97	0.098	0.21		0.05	0.19	0.08			W.	205	Sample of outcrop.
Cherry Valley	57.98	9.375				1.60					S. F.	205	Average of 6 analyses.
Clark	55.37		0.075								10 Cen.	211	Sample of soft red ore.
Copper Hill	53.61	9.00	0.125		0.15						St. L. B.	212	Average of several shipments.
Griffith	53.70	12.14		0.030							S. F.	214	Average of 5 shipments.
Iron Ridge	61.36	8.39	0.091	Trace		1.17			3.09		A. B.	216	Average sample.
Marsh	57.24	6.77		0.030							S. F.	217	Average of 5 shipments.
Scotia No. 1	69.37	0.59	0.016	0.058		0.11				0.20	W.	219	Sample of specular ore.
Scotia No. 1	63.15	1.52	0.105	0.095		0.76					W.	219	Sample of soft red ore.
Zane	59.20		0.080								C.	220	Shipment.

HEMATITES OF THE FILLED SINKS—Continued.

DENT COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Arnold	66.66	4.12	0.023	0.00	....	0.11	0.33	0.15	....	....	O. W.	224	Shipment.
Fitzwater	62.95	....	0.035	....	....	....	....	....	....	....	C.	225	Average sample.
Hawkins	52.86	8.28	0.087	0.123	....	2.58	0.87	0.457	....	9.02	M. B.	226	Shipment.
"	49.03	17.51	0.110	0.079	....	3.96	0.80	0.72	....	4.66	M. B.	226	Sample of 2nd class ore.
"	51 35	8 40	0.123	0.038	0.099	3.84	0.55	0.04	....	10.28	M. B.	226	Sample of soft porous ore.
Jamison	69.03	0.94	0.031	0 00	....	0.06	0.23	0.08	....	....	O. W.	228	Sample.
Nova Scotia	65.39	....	0.043	....	....	....	....	....	....	....	10 Cen.	229	Average sample.
Orchard	57.96	....	0.067	....	....	....	....	....	....	....	10 Cen.	229	" "
Pomeroy	59.99	....	0.079	....	....	....	....	....	....	....	10 Cen.	230	" "
Riverside	63.90	7.15	0.029	0.02	....	0.81	0.34	0.09	0.15	....	10 Cen.	231	Sample of specular ore.
"	64.05	2.56	0.063	0.179	....	1.35	0.13	0.06	3.45	0.40	10 Cen.	231	Sample of soft ore.
Simmons Mountain	68.69	1.41	0.016	0.00	....	0.06	0.24	0.11	....	....	O. W.	231	Sample, average.
Sligo	65.92	....	0.040	....	....	....	....	....	....	....	10 Cen.	232	" "
Stephens-Woodside	58.40	7.43	0.112	....	....	....	....	....	....	12.30	St. L. B.	232	Shipment.
Thomas	57.78	....	0.127	....	....	....	....	....	....	....	10 Cen.	232	Average sample.
Watkins	59.30	....	0.079	0.069	....	....	....	....	....	....	10 Cen.	233	Sample of soft hematite.

FRANKLIN COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Leslie	44.49	5.17	0.074	0.274	....	2.15	7.94	Trace	....	5.31	St. L. B.	242	Average of 24 shipments.
St. Clair	60.13	....	0.058	....	....	....	....	....	....	....	10 Cen.	246	Average sample.

PHELPS COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Brady	62.66	....	0.026	....	....	....	....	....	....	....	10 Cen.	290	Average sample.
Clinton	63.13	....	0.048	....	....	....	....	....	....	....	10 Cen.	291	" "
Cooper	54.84	8.05	0.101	....	....	....	....	....	....	11.00	St. L. B.	291	Shipment.
DeCamp	57.20	6.53	....	0.025	....	0.86	7.23	....	....	7.60	S. F.	291	Average of 7 shipments.
"	58.10	7.61	0.106	....	0.13	....	....	....	....	7.00	St. L. B.	291	Average of 5 shipments.

Horse Hollow	55.73		0.032								10 Cen.	293	Sample of red ore.
Lamb	63.38		0.022								10 Cen.	294	Sample of specular ore.
Meramec	68.06	2.06	0.040	0.00					0.47		A. B.	294	Average sample.
"	61.54	11.32	0.039	0.00					0.03		A. B.	294	Sample of silicious specular ore.
"	60.76	9.78	0.051	0.126	0.00	0.97	0.12	0.07	0.46		A. B.	294	Sample of greasy paint ore.
Ozark	45.76		0.042								10 Cen.	296	Sample of mixed ore.
Stimson	54.90		0.017								10 Cen.	297	Sample of earthy hematite.
Winkler	54.01	12.32	0.079		0.12					5.00	St. L. B.	298	Shipment.

SECONDARY LIMONITE.

BENTON COUNTY.

Indian Creek	58.87	3.59	0.034						11.60		A. B.	152	Sample.
Smith	55.57	3.42	0.145	0.040	2.04				11.04	1.335	G. S.	153	"

BOLLINGER COUNTY.

Myers, W. C.	61.32	0.86	0.041	0.007					10.74	0.10	G. S.	156	Type sample.
Whitener	55.70	7.46	0.141	0.017							C.	158	Mine sample.

BUTLER COUNTY.

Hendrickson	57.58	3.16	0.374	0.171					10.09	0.93	G. S.	165	Mine sample.
Kauffman	50.25	15.00	0.068		0.17					3.00	St. L. B.	165	Average of 2 shipments.
Luke	52.65	11.60	0.080		0.11					4.00	St. L. B.	166	26 shipments of washed ore.
Magill	46.53										St. L. B.	166	Shipment.
Pletz No. 1	56.69	8.54	0.056		0.25						St. L. B.	167	Average of 3 shipments.
Pletz No. 2	56.89	5.71	0.056								St. L. B.	167	Average of 2 shipments.
Turner	56.04	7.90	0.103		0.11					3.00	St. L. B.	168	1 shipment.

CAMDEN COUNTY.

White Bank	57.41	5.13	0.041	0 015						12.80	A. B.	184	Sample.

SECONDARY LIMONITE—Continued.

CARTER COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Holland	51.87	10.87	0.052								St. L. B.	187	Shipment.
Mo. L. & M. Co. No. 18	58.11	3.908	0.094	0.37					11.22		G. S.	188	Sample from pit No. 1.
" No. 18	48.69	13.27	0.063						10.55		G. S.	188	Sample from pits Nos. 2, 3 and 4.
" No. 18	49.54	10.90	0.115	0.151							G. S.	188	Sample from pit No. 5.
" No. 20	56 37	6.20	0.106		0.11	1.07					St. L. B.	189	Shipment.
" No. 22	58.81	3.34	0.116	0.369					10.75		G. S.	189	Sample from pit No. 2.
" No. 22	59.29	2.99	0.096	0.299					11.25		G. S.	189	Sample from pits Nos. 5, 6, 7, and 8.
" No. 23	53.77	9.40	0.107	0.082							G. S.	191	Sample from pit No. 1.
" No. 23	56.14	4.80	0.158	0.055							G. S.	191	Sample from pit No. 3.
" No. 23	57.19	4.20	0.121	0.068							G. S.	191	Sample from pit No. 5.
" No. 24	59.93	3.80	0.079		0.09						St. L. B.	192	Sample from pits Nos 1, 2, 3, 6, and 8.
" No. 26	59.77	2.63	0.062		0.07						St. L. B.	192	Sample from pits Nos. 3, 5, and 6.
" No. 27	57.91	5.30	0.167		0.14						St. L. B.	193	Sample from pits Nos. 3, 4, and 8.
" No. 29	58.73	2.90	0.053		0.07						St. L. B.	193	Sample from pits Nos. 3, 5, 8, and 9.
Snyder	54.90	8.15	0.083								St. L. B.	194	1 shipment.

FRANKLIN COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Bartle	52.64	11.50	0.089								St. L. B.	247	1 shipment.
Bowlen Bank	56.97	2.88	0.120	0.130					11.70		W.	247	Sample.
Pletz	57.85	4.19									St. L. B.	247	1 shipment.

GREENE COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Helm	56.28	5.63	0.16		0.26					4.00	St. L. B.	250	Average of 12 shipments.
Pollack	56.25	5.99	0.063		0.177					3.83	St. L. B.	251	Shipment.

HOWELL COUNTY.

Anderson	55.72	6.66	0.113	....	0.06	....	....	....	....	3.0	St. L. B.	256	Average of 2 shipments.
Carson	53.83	9.85	0.115	....	0.124	....	....	....	....	5.30	St. L. B.	256	Average of 33 shipments.
Gilmour	57.09	5.44	0.105	....	....	....	....	....	....	....	St. L. B.	257	Shipment.
House	56.70	Insoluble 4.70%	....	....	....	....	....	....	....	....	G. S.	258	Sample of outcrop.
Kingsbury	55.35	7.02	0.179	....	0.126	....	....	....	....	3.00	St. L. B.	258	Average of 6 cars of boulder ore.
"	53.49	9.04	0.159	....	....	....	....	....	....	3.50	St. L. B.	258	Average of 10 cars boulder and wash ore.
Livingston No. 1	51.58	12.23	0.050	....	....	....	....	....	....	....	St. L. B.	259	Shipment.
Wood	50.84	10.20	0.137	....	....	....	....	....	....	....	St. L. B.	260	"

IRON COUNTY.

Graves	52.85	9.86	0.030	....	0.12	....	....	....	....	....	St. L. B.	264	Average of 12 shipments.

LINCOLN COUNTY.

Morris	57.28	11.58	....	....	....	....	....	....	....	....	A. B.	265	Sample.

MADISON COUNTY.

Clay	51.25	9.10	0.038	....	0.12	....	....	....	....	2.80	St. L. B.	267	1 shipment.

OREGON COUNTY.

Burgesser	52.84	8.50	0.026	....	0.05	....	....	....	....	3.00	St. L. B.	274	Sample of outcrop.
Old, J. B.	59.02	2.49	0.077	0.066	....	0.78	....	....	12.16	....	St. L. S.	276	" "

POLK COUNTY.

Henney	53.75	5.95	0.044	....	0.11	....	....	....	....	3.00	St. L. B.	302	Shipment.

SECONDARY LIMONITE—Continued.

RIPLEY COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Mo. L. & M. Co. No. 1	49.58	9.20	0.163	0.112					10.70		G. S.	309	Average sample of boulder ore.
" No. 1	41 17	23.31	0.272	0.177					9.55		G. S.	309	Average sample of ocherous ore.

SHANNON COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Chilton	59.47	3.14	0.161	0.076					8.45	1.07	G. S.	324	Average sample of outcrop.
Cordz-Fischer	49.95	14.13	0.094		0.145					4.95	St. L. B.	324	Average of 11 shipments.
Hearst	53.15	11.93	0.103		0.06					7.30	St. L. B.	326	Shipment.
Melton	53.93	9.68	0.005	0.063					12.47	0.78	G. S.	328	Sample of boulder ore.
"	42.28	26.16	0.028	0.134					8.04	1.08	G. S.	328	Sample of boulder ore and ocher.
"	48.00	16.70	0.063		0.11					5.00	St. L. B.	328	Average of 6 shipments.
Mo. L. & M. Co. No. 15	47.59	16.20	0.116		0.15					4.00	St. L. B.	329	Shipment.
" No. 32	58.67	3.92	0.142	0.083					10.72	0.455	G. S.	329	Sample of outcrop.
" No. 33	59.01	2.70	0.08		0.10						St. L. B.	330	Sample from pits Nos. 1, 2, and 3.
" No. 34	58.10	3.98	0.15		0.11						St. L. B.	330	Sample from pits Nos. 1, 2, and 3.
Ozark L. & Lum. Co. No. 1	51.41	12.47	0.078	0.43					6.87	0.02	G. S.	331	Average sample.
Willis	43.33	25.24	0.03	0.35					8.76	0.65	G. S.	332	Sample of ore face.

ST. CLAIR COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Green	53.31	6.26	0.075	0.044	0.675				10.98		G. S.	320	Sample of outcrop.
Sheldon	54.19	8.05	0.034	0.147					12.49		A. B.	321	" "

ST. FRANCOIS COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Mar's Hill	56.79	4.80	0.052		0.10						St. L. B.	322	Mine sample.
" "	54.45	8.30			0.40	1.20					St. J.	322	" "

WAYNE COUNTY.

Alley	55.40	6.90	0.070		0.11					5.00	St. L. B.	347	Shipment.
Bear Mountain	52.41	15.29	0.067	0.037					8.99		C.	348	Sample.
Bingham	59.74	1.45	0.040							3.50	W. I.	348	Mine sample.
Buffington	53.46	9.45	0.097		0.10					3.26	St. L. B.	349	Average of 7 shipments.
Burkett No. 1	56.11	6.60	0.070		0.18					2.00	St. L. B.	349	1 shipment.
" No. 2	50.95	11.94	0.070		0.18					4.00	St. L. B.	350	1 "
Cady	55.51	7.55	0.078							3.30	St. L. B.	350	Average of 11 shipments.
Dickson	52.21	11.00	0.17		0.10					3.00	St. L. B.	352	1 shipment.
Eastman	53.48	11.00	0.104		0.10					3.00	St. L. B.	353	1 "
Estes	55.13	8.31	0.087		0.10					4.10	St. L. B.	353	Average of 6 shipments.
Ethridge	51.63	13.16	0.060							3.00	St. L. B.	353	1 shipment.
Harness and Lundy	54.61	8.76	0.088		0.215					3.50	St. L. B.	355	Average of 12 shipments.
Higgins	51.29	13.05	0.063		0.10					4.00	St. L. B.	356	Shipment.
Holliday-Klotz	52.08	11.79	0.083		0.17					3.70	St. L. B.	356	Average of 7 shipments.
Janis	54.11	8.74	0.092		0.12					3.70	St. L. B.	357	Average of 3 shipments.
"	52.16	11.58	0.013	0.025		1.502			10.74	0.647	G. S.	357	Average mine sample.
King	55.41	7.55	0.074		0.08					3.00	St. L. B.	359	Shipment.
Kinkad	49.36	10.03	0.040		0.155				11.93	2.01	G. S.	359	Sample.
Knox	56.64	6.45	0.095		0.19					3.00	St. L. B.	360	Shipment.
Landau	53.75	9.53	0.070		0.12					5.00	St. L. B.	360	"
Ojibway	53.24	9.63	0.055		0.095					4.30	St. L. B.	362	Average of 8 shipments.
O'Keefe Nos. 1 and 3	53.75	9.72	0.067		0.14					3.00	St. L. B.	363	Average of 9 shipments.
Pittsburg	55.57	7.10	0.080								St. L. B.	364	Shipment.
Pletz	58.33	4.25									St. L. B.	364	"
Sawyer	57.26	2.87	0.064		0.32	0.55					W. I.	365	Average of 10 shipments of boulder ore.
"	50.31	13.37	0.069		0.38	0.50					W. I.	365	Average of 13 shipments of washed ore.
Staggs	57.20	6.51	0.109		0.06					3.00	St. L. B.	367	Shipment.

SOUTHEAST DISTRICT.

PRIMARY LIMONITE.

BUTLER COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Deal No. 1	48.60	14.96	0.067		0.49					3.60	St. L. B.	169	Average of 6 shipments.
Deal No. 2	39.91	16.70	0.066		6.42					3.00	St. L. B.	169	1 shipment.
Hillis	47.96	14.30	0.089		1.50					3.50	St. L. B.	171	1 "
Hooper	44.71	18.70	0.080		2.10					4.00	St. L. B.	172	1 "
Mo. L. & M. Co. No. 10	41.67	21.60	0.044	0.083							St. L. B.	174	Sample from pits Nos. 1, 2, 3, and 4.
" No. 12	40.84	24.90	0.081	0.069							St. L. B.	176	Sample from pit No. 3.
" No. 12	31.54	30.67	0.029	0.025					9.90		G. S.	176	Sample from pit No. 5.
" No. 12	31.43	30.10	0.044	0.136							St. L. B.	176	Sample from pits Nos. 6 and 10.
" No. 12	48.10	16.74	Trace	0.025					10.30		G. S.	176	Sample of outcrop.
St. Francois	44.27	25.88	0.064	Trace					9.58		C.	179	Mine sample.
Shrout's	44.93	25.97	0.066	0.003					8.57		C.	178	" "

CARTER COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Crescent	44.85	22.61	0.100							8.00	St. L. B.	194	1 shipment.
Hutchinson	47.84	15.77	0.063								St. L. B.	195	1 "
Malin	42.58	19.15	0.070		2.85					3.00	St. L. B.	195	1 "
Mo. L. & M. Co. No. 5	39.18	32.45	0.043	0.618					8.39		G. S.	195	Mine sample.
" No. 7	44.47	17.62	0.045	0.055							G. S.	196	Sample from pit No. 4.
" No. 7	41.42	21.46	0.038	0.145					10.06		G. S.	196	Sample from pits Nos. 3 and 9.
" No. 8	46.56	17.80	0.056	0.048							G. S.	197	Sample from pit No. 2.
" No. 8	45.08	18.50	0.045	0.052							G. S.	197	Sample from pits Nos. 8 and 9.
" No. 17	40.18	18.20	0.061	0.076							G. S.	198	Sample from pit No. 2.
" No. 17	44.20	17.60	0.042	0.151							G. S.	198	Sample from pit No. 3.
" No. 17	24.73	37.63	0.063	0.108					9.138		G. S.	198	Sample from pits Nos. 10 and 11.
Orchard	47.23	17.08	0.060		1.38					4.50	St. L. B.	199	12 shipments washed ore.
"	47.21	16.30	0.072		1.08					3.00	St. L. B.	199	5 shipments unwashed ore.

PERRY COUNTY.

Gerler	48.90	21.62	0.183	0.018					9.49	0.68	G. S.	288	Mine sample.

RIPLEY COUNTY.

Mo. L. & M. Co. No. 2	44.26	20.65	0.038	0.107					9.70		G. S.	312	Sample of hard dense ore.
" No. 2	45.44	21.46	0.038	0.145					10.06		G. S.	312	Sample of hard porous ore.
" No. 2	52.86	9.88	Trace	0.048	2.68		0.151	0.52	8.21	1.29	G. S.	312	Sample of soft earthy ore.
" No. 4	43.49	26.24	0.041	0.041							G. S.	314	Mine sample.
" No. 9	36.16	33.58	0.040	0.054					8.78		G. S.	315	Sample from pits Nos. 1 and 2.
" No. 13	41.17	25.00	0.014	0.399							G. S.	315	Sample from pits Nos. 1, 3, and 4.
" No. 13	38.42	22.10	0.070	0.213							G. S.	315	Sample from pit No. 5.
" No. 14	50.86	11.96	0.071	0.151							G. S.	315	Sample from pit No. 1.
" No. 14	37.98	25.10	0.045	0.076							G. S.	315	Sample from pit No. 11.
" No. 3	46.40	14.90	0.087	0.041							G. S.	314	Mine sample.

STODDARD COUNTY.

Pico	48.00	16.59	0.041		0.770					3.38	G. S.	338	Average of 10 shipments.
Smith	42.91	19.73	0.217		1.44					3.00	St. L. B.	339	1 shipment.

WAYNE COUNTY.

Baker	46.47	18.60			0.52					4.00	St. L. B.	370	1 shipment.
Burton	47.51	15.31	0.058		1.24					4.00	St. L. B.	372	Average of 4 shipments.
Hilda	45.14	20.26			0.14						St. L. B.	375	1 shipment.
Lilly Hollow	46.39	14.92	0.045		0.42					5.00	St. L. B.	376	1 shipment.
Myers	49.23	13.59	0.059		0.64					4.00	St. L. B.	378	Average of 4 shipments.
O'Keefe No. 4	41.38	24.94	0.062		0.32					4.00	St. L. B.	381	1 shipment.
Twidwell	47.58	21.05	0.083		0.43	0.71				3.00	W. I.	385	Sample.
White, W	45.73	15.23	0.060		0.35					3.00	St. L. B.	387	1 shipment.
Wooden Shoe	46.20	16.30	0.090		1.20					3.00	St. L. B.	387	1 "
Zippy	44.62	17.40	0.054		2.00					3.00	St. L. B.	387	1 "

SOUTHWEST DISTRICT.

CHRISTIAN COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Angus	50.60	13.04	0.102	....	0.50	....	....	....	....	3.87	St. L. B.	203	Average of 8 shipments.
Arnt	49.94	12.10	0.092	....	0.448	....	....	....	....	3.41	St. L. B.	203	Average of 11 shipments.
Frisco	51.05	10.49	0.199	....	0.609	....	....	....	....	5.14	St. L. B.	203	Average of 18 shipments.

DADE COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Compton	47.03	11.00	0.103	....	0.86	....	....	....	....	....	St. L. B.	223	1 shipment.

GREENE COUNTY.

Name of Mine.	Iron.	Silica.	Phos.	Sul.	Mang.	Alumina.	Lime.	Magnesia.	Combined water.	Moisture.	Analyst.	Described on page	Remarks.
Clutter	47.65	13.40	0.450	....	1.67	....	....	....	....	4.00	St. L. B.	251	Mine sample.
Jackson	51.03	10.97	0.279	....	0.51	....	....	....	....	5.00	St. L. B.	252	Average of 11 shipments.
Noble	51.71	8.53	0.238	....	0.86	....	....	....	....	4.00	St. L. B.	252	Average of 3 shipments.
Studley	50.82	11.46	0.172	....	0.66	....	....	....	....	6.00	St. L. B.	253	Average of 2 shipments.
Welsh	54.29	7.90	....	....	....	....	....	....	....	....	St. L. B.	253	1 shipment.

GEOGRAPHIC INDEX.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Howell	Reported	21 N.	10 W.	7	S. W. ¼.
Ozark	Glazier, L. E., Bank	21 N.	11 W.	1	S. E. ¼.
"	Glazier, L. E., Land	21 N.	11 W.	1	S. W. ¼.
"	Steel, Wm., Bank	21 N.	11 W.	3	E. ½, S. W. ¼.
"	Buttrom, Freeman, Land No. 1	21 N.	11 W.	9	S. E. ¼.
"	Buttrom, Freeman, Land No. 2	21 N.	11 W.	9	N. W. ¼.
"	Chilton, Henry, Land	21 N.	11 W.	9	S. W. ¼.
Ripley	Dalton, Levi C., Land	22 N.	1 E.	9	S. E. ¼.
"	Williams, J. T., Land	22 N.	1 E.	10	S. ½, S. W. ¼.
"	Reported	22 N.	1 E.	14	
"	Government Land No. 2	22 N.	1 E.	16	
"	Ripley County Land	22 N.	1 E.	16	
"	Stephens, W. W., Land	22 N.	1 E.	19	W. ½.
"	Towell, I. M., Land	22 N.	1 E.	19	E. ½, S. E. ¼.
"	Reported	22 N.	1 E.	20	
"	Stoops, P., Land	22 N.	1 E.	23	N. ½, N. W. ¼.
"	Reported (Herr, C. B.)	22 N.	1 E.	24	N. ½.
"	Reported	22 N.	2 E.	1	Lot 1, N. W. ¼.
"	Government Land No. 3	22 N.	2 E.	7	W. ½, S. E. ¼.
"	Reported	22 N.	2 E.	7	N. E. ¼, S. E. ¼.
"	Martin, C. H., Land No. 2	22 N.	2 E.	12	S. ½, S. W. ¼, N. W. ¼.
"	Booker, J. S., Land	22 N.	2 E.	12	N. W. ¼, S. E. ¼.
"	Martin Land No. 3	22 N.	2 E.	13	S. E. ¼, S. E. ¼.
"	Herr, C. B., Land	22 N.	2 E.	24	N. E. ¼.
"	Current River Land	22 N.	2 E.	24	N. ½, N. W. ¼.
"	King, E. M., Land	22 N.	2 E.	24	S. W. ¼.
"	Reported	22 N.	3 E.	18	S. E. ¼, N. E. ¼.
"	Agricultural Col. Land No. 2.	22 N.	3 E.	19	N. ½.
"	Wilson, R., Land	22 N.	3 E.	32	S. E. ¼.
Oregon	Reported	22 N.	3 W.	2	
"	St. Joe Mine	22 N.	5 W.	22 27	S. W. ¼, S. W. ¼. N. W. ¼, N. W. ¼.
"	Boyd, T. J., Land	22 N.	5 W.	29	N. W. ¼, N. W. ¼.
"	Ragan, T. B., Mine	22 N.	5 W.	33	N. E. ¼, N. W. ¼.
"	Murray Land	22 N.	5 W.	33	N. E. ¼, S. W. ¼.
"	Huff, L. S., Bank	22 N.	6 W.	18	S. E. ¼, N. E. ¼.
"	Reported	22 N.	6 W.	30	
Howell	Fruitville Bank No. 2	22 N.	7 W.	7	N. W. ¼.
"	Kingsbury, J. C., Bank	22 N.	8 W.	7	N. ½.
"	Fruitville Bank No. 4	22 N.	8 W.	11	N. W. ¼.
"	Fruitville Bank No. 1	22 N.	8 W.	12	N. E. ¼.
"	Red Ranch Bank	22 N.	8 W.	26	N. E. ¼.
"	Harden, J. C., Bank	22 N.	10 W.	19	S. W. ¼.
Ozark	Price, T. L., Land	22 N.	11 W.	9	N. W. ¼.
"	Reported	22 N.	11 W.	16, 17	
"	Reported	22 N.	12 W.	8	
"	Garrett, G. R., Bank	22 N.	12 W.	14	S. E. ¼, S. E. ¼.
"	Reported	22 N.	12 W.	36	S. E. ¼.
"	Reported	22 N.	13 W.	2	
"	Reported	22 N.	15 W.	34	
Taney	Reported (Branson Tract)	22 N.	21 W.	6	N. W. ¼.
Ripley	McGonigal, E., Land	23 N.	2 E.	3	S. E. ¼.
"	Reported	23 N.	2 E.	4	N. E. ¼, N. E. ¼.
"	Mabrey Land No. 2	23 N.	2 E.	13	S. ½, S. W. ¼.
"	Young, D. B., Bank	23 N.	2 E.	23	S. E. ¼, S. W. ¼.
"	Ponder, Asel, Land	23 N.	2 E.	26	S. E. ¼, S. W. ¼.
"	Ponder, D. K., Land	23 N.	2 E.	26	S. W. ¼, S. E. ¼.
"	Reported	23 N.	3 E.	21	N. W. ¼, N. E. ¼.
"	Mabrey Land No. 1	23 N.	3 E.	23	W. ½, N. E. ¼.
"	Eaton, Z. A., Land	23 N.	3 E.	25	

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Ripley	Gray, Mrs. Lydia, Land	23 N.	3 E.	31	Lot 2, S. W. $\frac{1}{4}$. Lot 2, N. W. $\frac{1}{4}$.
"	Government Land No. 4	23 N.	1 W.	1	
"	Ranken, Thomas, Land	23 N.	1 W.	35	S. $\frac{1}{2}$.
Oregon	Mt. Nebo	23 N.	3 W.	8 17	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$. N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Heiskell, Wade, Land	23 N.	4 W.	4	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
"	Norman, E. P., and Martin, A., Bank	23 N.	4 W.	16	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Winner, Albert, Bank	23 N.	6 W.	1	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Reported	23 N.	6 W.	23	
"	Wilkerson, W. B., Land	23 N.	6 W.	34	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
Howell	Fruitville Bank No. 3	23 N.	7 W.	30	N. W. $\frac{1}{4}$.
"	Kingsbury, J. C., Mine	23 N.	8 W.	23	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Ozark	Wells Land	23 N.	11 W.	5	
"	Mattney, J., Land	23 N.	11 W.	6	
"	Owens, J., Land	23 N.	11 W.	6	
"	More Land	23 N.	11 W.	35	
"	Martin, Andrew, Land	23 N.	12 W.	1	
"	Mahan Land	23 N.	12 W.	1	N. $\frac{1}{2}$
"	Cobb, H. C., Land	23 N.	12 W.	23	N. W. $\frac{1}{4}$.
"	Lamb, John, Land	23 N.	12 W.	25	
"	Reported	23 N.	12 W.	23	
"	Reported	23 N.	12 W.	29	
"	Reported	23 N.	13 W.	3-4, and 7.	
"	Reported	23 N.	14 W.	2	
"	Bradley Land	23 N.	16 W.	5	N. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
Taney	Syler Land	23 N.	20 W.	18	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$. N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
Ripley	Mo. Lum. & Min. Co. No. 1.	24 N.	1 E.	1	S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
"	Reported	24 N.	2 E.	7	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
"	Reported	24 N.	2 E.	7	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Reported	24 N.	2 E.	18	N. E. $\frac{1}{4}$.
"	Reported	24 N.	2 E.	19	E. $\frac{1}{2}$.
"	Reported	24 N.	2 E.	28	N. W. $\frac{1}{4}$.
"	Martin (C. H.) Land No. 1	24 N.	2 E..	33	S. E. $\frac{1}{4}$.
Butler	Allen Bank	24 N.	6 E.	4	E. $\frac{1}{2}$ Lot 2, N. W. $\frac{1}{4}$.
Oregon	Burgesser Mine	24 N.	2 W.	28	N. W. $\frac{1}{4}$.
"	Whitten, Drew, Land	24 N.	3 W.	19	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Brocius, S. T., Land	24 N.	3 W.	20	
"	Simpson, S. M., Bank	24 N.	4 W.	4	N. W. $\frac{1}{4}$.
"	Ward, W. M., Land	24 N.	4 W.	12	S. $\frac{1}{2}$, S. W. $\frac{1}{4}$.
"	Simpson, L. W., Land	24 N.	4 W.	23	W. $\frac{1}{2}$, S. E. $\frac{1}{4}$.
"	Reported	24 N.	4 W.	31	N. W. $\frac{1}{4}$.
"	Ridington, A. Blain, Bank	24 N.	4 W.	32	N. W. $\frac{1}{4}$.
"	Reported	24 N.	4 W.	32	S. E. $\frac{1}{4}$.
"	Thayer Bank	24 N.	4 W.	34	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
"	Moser, Georgia, Land	24 N.	4 W.	36	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Reported	24 N.	5 W.	22	
"	Reported	24 N.	6 W.	1	N. E. $\frac{1}{4}$.
"	Reported	24 N.	6 W.	12	
"	Reported	24 N.	6 W.	23	
"	Reported	24 N.	6 W.	35	N. W. $\frac{1}{4}$.
Howell	Anderson Mine	24 N.	8 W.	23	N. E. $\frac{1}{4}$.
"	Carson Mine	24 N.	8 W.	35	E. $\frac{1}{2}$.
"	House, James, Bank	24 N.	9 W.	5	N. W. $\frac{1}{4}$.
Ozark	Pratt, Wallace, Land	24 N.	11 W.	17	
"	James, Wm., Land	24 N.	11 W.	27 and 34.	
"	S. Mo. Land Co. Land No. 1.	24 N.	11 W.	29	
"	Collins, Lowell, Land	24 N.	11 W.	30	
"	Reported	24 N.	11 W.	12, 32, 33 and 35.	
"	S. Mo. Land Co. Land No. 2.	24 N.	11 W.	34	
"	Luna, Richard, Land	24 N.	12 W.	21	
"	Tanner Land	24 N.	12 W.	34	
"	Petecock Land	24 N.	12 W.	36	N. W. $\frac{1}{4}$.
"	Mahan Land	24 N.	12 W.	36	S. $\frac{1}{2}$.
"	Warren, Judge P., Land	24 N.	12 W.	36	
"	Reported	24 N.	13 W.	25 and 35.	

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Ozark	Newton Mining Co., Land	24 N.	15 W.	17	N. E. ¼, N. W. ¼.
"	Pennsylvania Land	24 N.	16 W.	5	E. ½ Lot 2, N. W. ¼.
Carter	Mo. Lum. & Min. Co. No. 21.	25 N.	2 E.	4	S. ½.
"	Mo. Lum. & Min. Co. No. 20.	25 N.	2 E.	12	N. E. ¼, S. W. ¼. S. E. ¼, N. W. ¼.
"	Mo. Lum. & Min. Co. No. 6.	25 N.	2 E.	18	S. W. ¼, N. E. ¼.
Ripley	Mo. Lum. & Min. Co. No. 3.	25 N.	2 E.	31	S. E. ¼, N. E. ¼.
"	Mo. Lum. & Min. Co. No. 4.	25 N.	2 E.	31	S. W. ¼, N. E. ¼.
"	Mo. Lum. & Min. Co. No. 2.	25 N.	2 E.	32	S. E. ¼, S. W. ¼.
Carter	Mo. Lum. & Min. Co. No. 7.	25 N.	3 E.	2	S. E. ¼, S. E. ¼.
"	Mo. Lum. & Min. Co. No. 5.	25 N.	3 E.	7	S. W. ¼, N. E. ¼.
"	Mo. Lum. & Min. Co. No. 18.	25 N.	3 E.	16	N. W. ¼, N. E. ¼.
Ripley	Holland Tract	25 N.	3 E.	19	N. ½.
"	Mo. Lum. & Min. Co. No. 9.	25 N.	4 E.	21	N. E. ¼, S. W. ¼.
Butler	Government Land No. 1	25 N.	4 E.	24	S. E. ¼, S. E. ¼.
"	Mo. Lum. & Min. Co. No. 10.	25 N.	4 E.	27	S. W. ¼, N. W. ¼. N. W. ¼, S. W. ¼.
Ripley	Mo. Lum. & Min. Co. No. 13.	25 N.	4 E.	28	S. W. ¼, S. E. ¼. S. E. ¼, S. W. ¼.
"	Mo. Lum. & Min. Co. No. 14.	25 N.	4 E.	30	S. ½, N. E. ¼.
"	Reported	25 N.	4 E.	33	N. E. ¼, N. W. ¼.
"	Reported	25 N.	4 E.	33	N. W. ¼, N. E. ¼.
Butler	Reported	25 N.	4 E.	35	N. W. ¼, S. W. ¼.
"	Mo. Lum. & Min. Co. No. 11.	25 N.	4 E.	25	S. W. ¼, N. W. ¼.
"	Mo. Lum. & Min. Co. No. 12.	25 N.	4 E.	36	N. E. ¼, S. W. ¼.
"	Reported	25 N.	4 E.	36	S. W. ¼, N. E. ¼.
"	Reported	25 N.	4 E.	36	S. E. ¼, N. W. ¼.
"	Reported	25 N.	4 E.	36	N. W. ¼, S. W. ¼.
"	Reported	25 N.	4 E.	36	S. ½, S. W. ¼.
"	Reported	25 N.	4 E.	36	N. W. ¼, S. E. ¼.
"	Reported	25 N.	5 E.	2	S. W. ¼, S. W. ¼.
"	Mo. University Land No. 1.	25 N.	6 E.	3	S. W. ¼, S. W. ¼.
"	Hill, David, Mine	25 N.	6 E.	4	N. W. ¼.
"	Deal, E. E., Mine No. 1	25 N.	6 E.	9	N. E. ¼, S. E. ¼.
"	Deal, E. E., Mine No. 2	25 N.	6 E.	9	N. W. ¼, S. E. ¼.
"	Mo. University Land No. 2	25 N.	6 E.	15	S. W. ¼, N. W. ¼.
"	Mo. University Land No. 3	25 N.	6 E.	15	N. E. ¼.
"	Reported	25 N.	6 E.	16	N. E. ¼, S. E. ¼.
"	Shrout's Bank	25 N.	6 E.	16	N. E. ¼, N. E. ¼.
"	Dover, G. W., Mine	25 N.	6 E.	17	S. E. ¼, N. E. ¼.
"	Smith & Co. Bank	25 N.	6 E.	17	S. ½.
"	St. Francois River Land & Iron Co., Tract	25 N.	6 E.	18	S. ½, S. E. ¼.
"	Turk, John, Land	25 N.	6 E.	19	N. W. ¼, S. E. ¼.
"	Reported (J. C. Corrigan)	25 N.	6 E.	27	N. W. ¼, N. W. ¼.
"	Hooper Mine	25 N.	6 E.	28	N. E. ¼, N. W. ¼.
"	Lieb, Frank, Bank	25 N.	6 E.	28	N. W. ¼, S. W. ¼.
Oregon	Reported	25 N.	6 W.	8	
"	Reported	25 N.	6 W.	23	
"	Old, J. B., Bank	25 N.	6 W.	25	N. W. ¼, N. W. ¼.
"	Reported	25 N.	6 W.	35	N. E. ¼.
"	Russel, J., Bank	25 N.	6 W.	36	S. E. ¼.
Howell	Livingston, A. H., Mine No. 1	25 N.	9 W.	6	N. E. ¼, N. E. ¼.
"	Wood, Wm., Bank	25 N.	9 W.	9	N. W. ¼, N. W. ¼.
Douglas	Reported	25 N.	14 W.	28	
"	Hare, Evelyn, Land	25 N.	15 W.	1	N. W. ¼, N. W. ¼.
"	Mapes Land	25 N.	15 W.	17	S. ½, N. E. ¼, and N. ½, S. E. ½.
"	Robison, Albert, Land	25 N.	15 W.	19	S. ½ Lot 1 of S.W. ½.
"	Able, V. R., Land	25 N.	15 W.	29	W. ½, S. E. ¼.
Carter	Reported (Jaque, Jos.)	26 N.	1 E.	2	S. E. ¼, S. E. ¼.
"	Mo. Lum. & Min. Co. No. 22.	26 N.	1 E.	2	S. ½, S. W. ¼.
"	Mo. Lum. & Min. Co. No. 23.	26 N.	1 E.	2	N. E. ¼, N. W. ¼.
"	Mo. Lum. & Min. Co. No. 26.	26 N.	1 E.	11	S. E. ¼, S. W. ¼.
"	Mo. Lum. & Min. Co. No. 24.	26 N.	1 E.	13	S. E. ¼, N. E. ¼.
"	Mo. Lum. & Min. Co. No. 29.	26 N.	1 E.	12	W. ½, S. W. ¼.
"	Reported	26 N.	1 E.	12	S. E. ¼, S. E. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Carter	Reported (Mrs. Kelley)	26 N.	1 E.	13	S. E. ¼.
"	Carter, A., and Mo. Lumber & Min. Co	26 N.	1 E.	13	N. W. ¼, center of.
"	Mo. Lum. & Min. Co. No. 27.	26 N.	1 E.	14	E. ½, N. E. ¼.
"	Reported (Mo. Lum. & Min. Co.)	26 N.	2 E.	6	S. W. ¼, S. E. ¼.
"	Mo. Lum. & Min. Co. No. 24.	26 N.	2 E.	7	S. W. ¼, S. W. ¼.
"	Reported (Smith, D.)	26 N.	2 E.	17	E. ½.
"	Reported (Mo. Lum. & Min. Co.)	26 N.	2 E.	18	S. E. ¼, N. W. ¼.
"	Mo. Lum. & Min. Co. No. 17.	26 N.	2 E.	25	N. ½.
"	Reported	26 N.	3 E.	9	N. W. ¼.
"	Mo. Lum. & Min. Co. No. 19.	26 N.	3 E.	32	N. E. ¼, S. E. ¼.
Wayne	Reported	26 N.	4 E.	2	N. W. ¼.
"	S. Mo. Pine Lum. Co. No. 1.	26 N.	4 E.	5	S. E. ¼.
"	Baker Mine	26 N.	4 E.	5	N. E. ¼, S. W. ¼.
Butler	Reported	26 N.	4 E.	9	S. W ¼, S. W. ¼.
"	Sheets, M. M., Land	26 N.	4 E.	12	W. ½.
Carter	Mo. Lum. & Min. Co. No. 8.	26 N.	4 E.	31	N. E. ¼, S. E. ¼. S. E. ¼, N. E. ¼.
Wayne	Keele, Lucian, Bank	26 N.	5 E.	1	N. W. ¼, S. E. ¼.
"	Ethridge, Mathew, Mine	26 N.	5 E.	1	S. W. ¼, S. W. ¼.
"	Landau, S., Mine	26 N.	5 E.	1	S. W. ¼, N. W. ¼.
"	Schafer Bank	26 N.	5 E.	2	N. ½, S. E. ¼.
"	Eastman, F. W., Mine	26 N.	5 E.	2	S. E. ¼, S. W. ¼.
"	Keener, Mrs. L., Mine	26 N.	5 E.	3	S. W. ¼, S. E. ¼.
"	Reported	26 N.	5 E.	3	N. E. ¼, S. E. ¼.
"	Singer, Nimick & Co., Land.	26 N.	5 E.	5	
"	Pittsburg Mine	26 N.	5 E.	6	E. ½, N. E. ¼.
Butler	Pletz, F., Mine No. 2	26 N.	5 E.	11	N. W. ¼, N. W. ¼.
"	Kauffman Mine	26 N.	5 E.	11	N. E. ¼, N. E. ¼.
"	Turner, Henry, Mine	26 N.	5 E.	11	S. W. ¼, N. E. ¼.
"	Luke Mine	26 N.	5 E.	11	S. W. ¼, N. W. ¼.
"	Thomas, J. P., Land	26 N.	5 E.	11	S. E. ¼, N. W. ¼.
"	Burkett, W. R., Bank	26 N.	5 E.	22	N. E. ¼, N. E. ¼.
"	Hillis Mine	26 N.	5 E.	23	N. W. ¼, N. E. ¼.
"	Reported	26 N.	5 E.	27	N. W. ¼.
Wayne	Magill, Wm	26 N.	6 E.	6	N. E. ¼, N. E ¼.
"	Cullnan, Pat., Bank	26 N.	6 E.	6	N. W. ¼,S. E. ¼.
"	Scott, U. S., Bank	26 N.	6 E.	6	S. ½ Lot 1, S. W. ¼.
Butler	Thompson, M. M., Bank	26 N.	6 E.	7	N. ½ Lot 1, N. W. ¼.
"	Thompson, G. E., Bank	26 N.	6 E.	7	N. E. ¼, N. E. ¼.
"	Sexton, A. W., Bank	26 N.	6 E.	7	Lot 2, N. W. ¼.
"	Hendrickson Mine	26 N.	6 E.	18	S. E. ¼, N. W. ¼.
"	Pletz, F., Mine No. 1	26 N.	6 E.	19	S. W. ¼, S. W. ¼.
"	Magill, H., Mine	26 N.	6 E.	19	E. ½ Lot 1, N. W. ¼.
"	Hendrickson, N. W., Land	26 N.	6 E.	20	
"	Agriculture Col. Land No. 1.	26 N.	6 E.	21	
"	Miller Land	26 N.	6 E.	35	N. W. ¼, N. E. ¼.
"	Sharp, Boyd E., Land	26 N.	6 E.	35	N. W. ¼.
"	Reported	26 N.	7 E.	16	N. W. ¼, S. W. ¼. S. E. ¼, N. W ¼.
"	Reported	26 N.	7 E.	16	N. W. ¼.
"	Indian Ford Bank No. 4	26 N.	7 E.	22	S. ½, N. W. ¼.
"	Indian Ford Bank No. 2	26 N.	7 E.	23	N. E. ¼.
"	Indian Ford Bank No. 3	26 N.	7 E.	23	S. ½, N. W. ¼.
"	Indian Ford Bank No. 1	26 N.	7 E.	24	N. ½, N. E. ¼.
"	St. Francois Bank	26 N.	7 E.	24	S. ½, N. W. ¼.
"	George, Ed, Tract No. 1	26 N.	7 E.	24	S. W. ¼.
"	George, Ed, Tract No. 2	26 N.	7 E.	24	N. E. ¼.
"	George, Ed, Tract No. 3	26 N.	7 E.	25	N. W. ¼, N. W. ¼.
"	Blue Springs Bank	26 N.	7 E.	26	S. E. ¼, S. E ¼.
"	Reported	26 N.	7 E.	27	N. W. ¼.
"	Reported	26 N.	7 E.	28	N. E. ¼.
"	Reported	26 N.	7 E.	33	
"	Reported	26 N.	7 E.	35	N. E. ¼.
Stoddard	Goforth, Mrs. R. A., Land	26 N.	8 E.	2	N. W. ¼.
"	Hall, H. E., Land	26 N.	8 E.	3	W. ½.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Stoddard	Reported	26 N.	8 E.	3	S. E. ¼.
"	Harty, J. H., Land	26 N.	8 E.	4	N. E. ¼.
"	McGown, Joseph, Land	26 N.	8 E.	10 and 11 (line between).	
"	Tertiary Land	26 N.	10 E.	2	W. ½ Lot 1, N. W. ¼.
Carter	Reported (Mo. Lum. & Min. Co)	26 N.	1 W.	8	S. W. ¼, N. E. ¼.
"	Reported (Mo. Lum. & Min. Co)	26 N.	1 W.	9	S. W. ¼, N. E. ¼.
"	Hahn Bank	26 N.	1 W.	13	W. ½, S. W. ¼.
"	Holland Mine	26 N.	2 W.	4	N. W. ¼, S. W ¼.
"	Carter Co. Milling & Mercantile Co	26 N.	2 W.	4	S. E. ¼.
Shannon	Ozark Land & Lumber Co., Tract No. 1	26 N.	4 W.	13	W. ½.
"	Reported (Phennighausen)	26 N.	5 W.	11	N. E. ¼.
"	Cordz-Fischer Mine	26 N.	5 W.	14	S. W. ¼.
"	Reported	26 N.	5 W.	23	
"	Talkington, T. A., Bank	26 N.	6 W.	4	S. E. ¼, S. E. ¼.
"	Melton Mine	26 N.	6 W.	9	N. E. ¼, N. E. ¼.
"	Reported (Biser, C. T.)	26 N.	6 W.	10	S. W. ¼.
"	Woods, W. W., Mine	26 N.	6 W.	12	N. E. ¼, S. E. ¼.
"	Reported	26 N.	6 W.	13	N. W. ¼, N. W. ¼.
Howell	Pearson Mine	26 N.	9 W.	23	S. W. ¼.
"	Livingston Mine No. 2	26 N.	9 W.	31	S. E. ¼.
"	Gilmour, J. T., Bank	26 N.	9 W.	32	N. W. ¼, S. W. ¼.
Douglas	Reported	26 N.	11 W.	6	
"	Tettrick, Henry, Land	26 N.	11 W.	25	
"	Beasley, W. R., Land	26 N.	12 W.	1	S. W. ¼, S. E. ¼.
"	Reported	26 N.	12 W.	3	
"	Reported	26 N.	12 W.	11	
"	Henson, James, Land	26 N.	14 W.	1	N. E. ¼, N. E. ¼.
"	Allen, J. B., Land	26 N.	15 W.	4	W. ½, N. E. ¼.
"	Browning, C. C., Land	26 N.	15 W.	4	E. ½, S. W. ¼.
"	Hoffman, E., Land	26 N.	16 W.	20	W. ½, S. E. ¼.
Carter	Brown Bank No. 1	27 N.	1 E.	35	N. ½.
"	Reported (O'Reiley, Pat)	27 N.	2 E.	2	E. ½.
"	Reported (Carnahan, L. T.)	27 N.	3 E.	22	S. ½, S. W. ¼.
"	Reported	27 N.	3 E.	26	S. W. ¼, S. E. ¼.
"	Reported	27 N.	3 E.	26	E. ½, S. W. ¼.
"	Reported (Carnahan, L. T.)	27 N.	3 E.	27	N. W. ¼, N. E. ¼.
"	Crommer & McPherson Bank	27 N.	3 E.	27	W. ½, S. W. ¼.
"	Moreland Bank	27 N.	3 E.	28	N. E. ¼, N. E. ¼.
"	Hutchinson Mine	27 N.	3 E.	33	S. W. ¼, S. W. ¼.
"	Crescent Mine	27 N.	3 E.	33	S. E. ¼, S. W. ¼.
"	Malin Mine	27 N.	3 E.	33	S. E. ¼.
"	Reported	27 N.	3 E.	35	N. W. ¼, N. E. ¼.
"	Orchard Mine	27 N.	3 E.	35	E. ½.
Wayne	O'Keefe, P., Mine No. 2	27 N.	4 E.	2	S. W. ¼, S. W. ¼.
"	Knox, J. E., Mine	27 N.	4 E.	3	N. W. ¼, S. E. ¼.
"	O'Keefe, P., Bank No. 1	27 N.	4 E.	10	N. ½, S. E. ¼.
"	O'Keefe, P., Mine No. 1	27 N.	4 E.	12	N. E. ¼, N. W. ¼.
"	O'Keefe Mine No. 3	27 N.	4 E.	12	N. W. ¼, N. W. ¼.
"	Reported	27 N.	4 E.	13	N. E. ¼, N. W. ¼.
"	Reported	27 N.	4 E.	13	S. E. ¼, S. W. ¼.
"	Reported	27 N.	4 E.	13	W. ½, S. W. ¼.
"	Reported	27 N.	4 E.	13	S. E. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	13	N. E. ¼, S. E. ¼.
"	Buffington Mine	27 N.	4 E.	13	N. W. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	14	N. E. ¼.
"	O'Keefe, P., Mine No. 4	27 N.	4 E.	16	N. W. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	16	S. E. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	19	S. W. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	19	N. ½, N. W. ¼.
"	Reported	27 N.	4 E.	21	N. E. ¼.
"	Morris, Joe, Bank	27 N.	4 E.	21	N. W. ¼.
"	South Mo. Pine Lumber Co., Land No. 2	27 N.	4 E.	21	N. W. ¼, N. W. ¼.
"	O'Keefe, P., Bank No. 2	27 N.	4 E.	21	S. E. ¼, N. W. ¼.

County.	Name of Mine or Owner.	Twp.	R.	Sec.	Fractional.
Wayne	Reported	27 N.	4 E.	24	N. W. ¼.
"	Reported	27 N.	4 E.	25	N. E. ¼, S. W. ¼.
"	Reported	27 N.	4 E.	25	S. E. ¼, N. W. ¼.
"	Reported	27 N.	4 E.	25	S. W. ¼, S. W. ¼.
"	Reported	27 N.	4 E.	26	N. E. ¼, N. E. ¼.
"	Reported	27 N.	4 E.	29	S. E. ¼.
"	Reported	27 N.	4 E.	30	E. ½, N. E. ¼.
"	Reported	27 N.	4 E.	31	S. W. ¼, N. W. ¼.
"	Reported	27 N.	4 E.	32	S. E. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	32	N. W. ¼, N. E. ¼.
"	South Mo. Pine Lumber Co. No. 3	27 N.	4 E.	33	N. W. ¼.
"	South Mo. Pine Lumber Co. No. 4	27 N.	4 E.	33	S. E. ¼.
"	Morris Creek Bank	27 N.	4 E.	35	S. E. ¼.
"	South Mo. Pine Lumber Co. No. 6	27 N.	4 E.	35	
"	South Mo. Pine Lumber Co. No. 5	27 N.	4 E.	35	S. E. ¼.
"	Reported	27 N.	4 E.	35	N. W. ¼.
"	Reported	27 N.	4 E.	36	N. W. ¼, S. E. ¼.
"	Reported	27 N.	4 E.	36	S. E. ¼, S. E. ¼.
"	Smooth, E. L., Mine	27 N.	5 E.	1	S. ½.
"	Janis Mine	27 N.	5 E.	1	Lot 5, N. W. ¼.
"	Reported	27 N.	5 E.	3	S. W. ¼.
"	Otter Creek Bank	27 N.	5 E.	3 4	S. W. ¼. Lot 1, N. E. ¼.
"	Reported	27 N.	5 E.	4	Lot 3, N. W. ¼.
"	Reported	27 N.	5 E.	4	N. ½, S. E. ¼.
"	Reported	27 N.	5 E.	4	
"	Reported	27 N.	5 E.	5	S. ½.
"	Haynie Hollow Bank	27 N.	5 E.	5	
"	Railroad Bank No. 2	27 N.	5 E.	8	S. E. ¼.
"	Bowman Land	27 N.	5 E.	9	S. W. ¼.
"	Reported	27 N.	5 E.	9	S. E. ¼.
"	Childress Mine	27 N.	5 E.	11	N. E. ¼, N. E. ¼.
"	Stevenson Bank	27 N.	5 E.	12	N. W. ¼, N. W. ¼.
"	Forbes Mine	27 N.	5 E.	12	S. E. ¼, N. W. ¼.
"	Morgan, Chas., Mine	27 N.	5 E.	12	N. ½, S. E. ¼.
"	Shipton, H. M., Mine	27 N.	5 E.	14	S. W. ¼, S. E. ¼.
"	Bowman Bank	27 N.	5 E.	15	N. W. ¼, N. E. ¼.
"	Reported	27 N.	5 E.	16	N. E. ¼.
"	Haynie, S. C., Land	27 N.	5 E.	17	S. W. ¼.
"	Crawford Mine	27 N.	5 E.	17	W. ½, N. E. ¼.
"	Williamsville Iron Mt. Ore Co., Bank No. 1	27 N.	5 E.	19	N. E. ¼, N. E. ¼.
"	Williamsville Mine	27 N.	5 E.	20	W. ½, N. W. ¼.
"	Holliday, H. N., & Haynie	27 N.	5 E.	20	
"	Pratt, A. L., Mine	27 N.	5 E.	21	S. E. ¼, S. W. ¼.
"	Reported	27 N.	5 E.	21	N. E. ¼, S. E. ¼.
"	Pletz, F., Mine	27 N.	5 E.	21	N. E. ¼, S. W. ¼.
"	Cady Mine	27 N.	5 E.	22	S. ½, S. E. ¼.
"	Wayne Iron & Lumber Co. No. 2	27 N.	5 E.	23	S. E. ¼, S. E. ¼.
"	Reported (Estes, J. A.)	27 N.	5 E.	24	S. W. ¼.
"	Sanders, E. F., Bank	27 N.	5 E.	24	N. E. ¼, N. E. ¼.
"	Durrow, John, Land	27 N.	5 E.	26	N. E. ¼, S. E. ¼.
"	Reported	27 N.	5 E.	29	
"	Williamsville Iron Mt. Ore Co., Bank No. 2	27 N.	5 E.	32	S. E. ¼.
"	Burkett Mine No. 1	27 N.	5 E.	32	N. E. ¼, S. W. ¼.
"	Burkett Mine No. 2	27 N.	5 E.	32	S. W. ¼, S. W. ¼.
"	Reported (Iron Mt. Ore Co.)	27 N.	5 E.	32	S. E. ¼.
"	Holladay-Klotz Mine	27 N.	5 E.	34	E. ½, S. E. ¼.
"	Reported	27 N.	6 E.	2	S. ½ Lot 5, N. E. ¼.
"	Reported	27 N.	6 E.	2	W. ½ Lot 5, N. E. ¼.
"	Garrison, D. L., Tract	27 N.	6 E.	2	Lots 2, 3, 4, N. E. ¼.
"	Dickson Mine	27 N.	6 E.	6	Lot 7, N. W. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Wayne	Reported (Deaton, Jos. D.)	27 N.	6 E.	7	
"	Sanderson, A. E., Land	27 N.	6 E.	14	N. E. ¼.
"	Ozark Land Co.. Land	27 N.	6 E.	17	
"	Frederick, James, Mine	27 N.	6 E.	18	S. ½ Lot 2, S. W. ¼.
"	Maxfield Mine	27 N.	6 E.	18	N. E. ¼, N. E. ¼.
"	Moss, T. J., Land	27 N.	6 E.	19	
"	Hughes, W. H., Mine No. 2	27 N.	6 E.	19	N. E. ¼, N. E. ¼.
"	Hughes, W. H., Mine No. 1	27 N.	6 E.	19	N. ½ Lot 1, N. W. ¼.
"	Estes Mine	27 N.	6 E.	19	S. ½ Lot 1, N. W. ¼.
"	Reported	27 N.	6 E.	19	S. ½ Lot 2, N. W. ¼.
"	Moss Mine	27 N.	6 E.	20	N. W. ¼, S. W. ¼.
"	Nelson, Frank, Mine	27 N.	6 E.	20	N. E. ¼, S. W. ¼.
"	Ojibway Mine	27 N.	6 E.	21	S. W. ¼, N. E. ¼.
"	Mann Bank	27 N.	6 E.	21	
"	Hicks, Andrew, Mine	27 N.	6 E.	23	Lot 2, N. W. ¼.
"	Staggs, F. M., Mine	27 N.	6 E.	23	N. E. ¼, S. E. ¼.
"	Reported	27 N.	6 E.	24	S. W. ¼.
"	Gary & Moss, T. J., Land	27 N.	6 E.	25	N. W. ¼.
"	Sollars, A. J., Bank	27 N.	6 E.	25	N. W. ¼, S. E. ¼.
"	Green, J. W., Tract	27 N.	6 E.	25	S. E. ¼, S. E. ¼.
"	Reported (Moss, T. J.)	27 N.	6 E.	25	W. ½, N. E. ¼.
"	Reported (Garry, A.)	27 N.	6 E.	26	S. W. ¼, N. E. ¼.
"	Bailey, Henry, Mine	27 N.	6 E.	29	N. E. ¼, N. W. ¼.
"	Foster Mine	27 N.	6 E.	31	N. E. ¼, S. E. ¼.
"	Reported	27 N.	6 E.	35	S. E. ¼.
"	Reported (Pletz, F.)	27 N.	6 E.	36	N. E. ¼, N. W. ¼.
"	Chaonia Iron & Merc. Co. Bank	27 N.	6 E.	36	N. E. ¼, N. E. ¼.
"	Reported (Osgood, L. S.)	27 N.	6 E.	36	N. ½, N. W. ¼.
"	Jones, H. S., Land	27 N.	7 E.	3	S. W. ¼.
"	Anderson, Hugh, Land	27 N.	7 E.	6	S. E. ¼.
"	Neighbors, John, Land	27 N.	7 E.	6	S. E. ¼.
"	Smith, Pleasant, Land	27 N.	7 E.	6	W. ½ Lot 1, N. W. ¼.
"	Shaw, David, Land	27 N.	7 E.	6	W. ½ Lot 1, S. E. ¼.
"	N. W. Consol. Land No. 1	27 N.	7 E.	9	N. E. ¼.
"	N. W. Consol. Land No. 2	27 N.	7 E.	10	S. W. ¼.
"	Moss & Clarkson Land	27 N.	7 E.	10	N. ½.
"	Reported (N. W. Consol. Bk)	27 N.	7 E.	13	
"	N. W. Consol. Land No. 3	27 N.	7 E.	14	Center.
"	N. W. Consol. Land No. 4	27 N.	7 E.	15 16	W. ½. E. ½.
"	Mason & Clarkson Land	27 N.	7 E.	16	E. ½.
"	Pettit Land	27 N.	7 E.	19	S. E. ¼.
"	Reported (N. W. Consol. Bk)	27 N.	7 E.	24	
"	Bailey, T. G., Bank	27 N.	7 E.	30	N. W. ¼, S. W. ¼.
"	N. W. Consolidated Bank	27 N.	7 E.	35	
"	Mayberry Tract	27 N.	8 E.	6	E. ½, center of.
Stoddard	Hawks, F. T., & Houck, S., Land	27 N.	8 E.	25	
"	Pico Mine	27 N.	8 E.	26	N. E. ¼.
"	Smith Mine	27 N.	8 E.	33	N. E. ¼.
"	Murphy, L. T., Mine No. 1	27 N.	8 E.	34	N. W. ¼.
"	Murphy, L. T., Mine No. 2	27 N.	8 E.	34	N. E. ¼.
"	Purcell, H. B., Land	27 N.	8 E.	36	
"	Wilhelm, John, Land	27 N.	8 E.	36	N. W. ¼.
"	Leora Land	27 N.	9 E.	1 and 2.	
"	Murphy, Mine No. 3	27 N.	9 E.	8	
"	Burge, Wm., Land	27 N.	9 E.	17	
"	Reported	27 N.	10 E.	5	N. W. ¼.
Carter	Reported	27 N.	2 W.	4	S. W. ¼, N. W. ¼.
"	Reported (Carter Co. Milling & Merc. Co	27 N.	2 W.	5	S. E. ¼, N. E. ¼.
"	Reported (Carter Co. Milling & Merc. Co	27 N.	2 W.	6	S. W. ¼.
"	Reported (Carter Co. Milling & Merc. Co	27 N.	2 W.	7	S. W. ¼, S. W. ¼.
"	Reported (Carter Co. Milling & Merc. Co	27 N.	2 W.	16	S. E. ¼, N. W. ¼.

County.	Name of Mine or Owner.	Twp.	R.	Sec.	Fractional.
Carter	Reported (Carter Co. Milling & Merc. Co	27 N.	2 W.	17	N. E. ¼.
"	Snyder Mine	27 N.	2 W.	22	S. ½.
"	Reported (Snyder, J. B.)	27 N.	2 W.	34	W. ½, N. W. ¼.
Shannon	Willis, J. R., Mine	27 N.	3 W.	9	N. E. ¼, S. E. ¼.
"	Hearst, James, Mine	27 N.	3 W.	16	N. E. ¼, S. W. ¼.
"	Reported (Collins, G. W.)	27 N.	3 W.	27	N. E. ¼, N. W. ¼.
"	Reported (S. Mo. Land Co.).	27 N.	4 W.	4	S. ½.
"	Reported (Livesay Land)	27 N.	4 W.	28	N. W. ¼, S. W. ¼.
"	Reported (Ozark L. & L. Co.)	27 N.	4 W.	34	W. ½.
"	Iron Hill Mine	27 N.	5 W.	14	N. E. ¼, S. W. ¼.
"	Reported (Thomas, Wm.)	27 N.	5 W.	15	S. W. ¼.
"	Reported (Gov. Land)	27 N.	5 W.	19	S. W. ¼, S. W. ¼.
"	Bryson, A. L., Bank	27 N.	5 W.	22	N. E. ¼, N. E. ¼.
"	Reported	27 N.	5 W.	24	S. E. ¼, N. E. ¼.
"	Reported (Knight, S. H.)	27 N.	5 W.	27	S. W. ¼, N. E. ¼.
"	Reported (Butler, D.)	27 N.	5 W.	28	N. ½.
"	Cutler Land	27 N.	5 W.	33	N. ½, N. E. ¼, S.W.¼.
"	Reported	27 N.	6 W.	19	S. ½ Lot 2, N. W. ¼.
"	Reported (Gov. Land)	27 N.	6 W.	24	S. E. ¼, S. E. ¼.
Howell	Godsey, D., Land	27 N.	9 W.	26	
Douglas	McCrary, R. R., Land	27 N.	11 W.	14	W. ½, N. W. ¼.
"	Woods, D. S., Land	27 N.	12 W.	27	S. W. ¼.
"	Reported	27 N.	12 W.	34	E. ½.
"	Basher Land	27 N.	15 W.	29	S. E. ¼, S. W. ¼.
Christian	Angus, Thomas, Mine	27 N.	23 W.	18	E. ½, S. W. ¼.
"	Frisco Mine	27 N.	24 W.	4	Center.
"	Arnt Mine	27 N.	24 W.	24	S. E. ¼, S. E. ¼.
Reynolds	Reported (Lone Star Mine)	28 N.	1 E.	2	S. W. ¼.
Wayne	Cedar Bay Mine	28 N.	3 E.	14 and 23.	
"	Reported	28 N.	4 E.	1	S. W. ¼.
"	Early, James, Bank	28 N.	4 E.	6	S. E. ¼.
"	Reported	28 N.	4 E.	18	
"	Reported	28 N.	4 E.	19	
"	Reported	28 N.	5 E.	6	N. E. ¼.
"	Rubottom, L., Land	28 N.	5 E.	10	
"	Dalton, Mrs. N. T., Land	28 N.	5 E.	11	
"	Reported	28 N.	5 E.	15	
"	Clubb Mine	28 N.	5 E.	23	N. W. ¼, N. W. ¼.
"	Sutton, Marcus, Mine	28 N.	5 E.	23	N. E. ¼.
"	Alley, P. B., Mine	28 N.	5 E.	23	E. ½, S. E. ¼.
"	Reported	28 N.	5 E.	26	
"	Bingham Mine	28 N.	5 E.	27	S. ½, S. W. ¼.
"	Hilda Mine	28 N.	5 E.	28	S. W. ¼.
"	Switchback Mine	28 N.	5 E.	28	N. E. ¼, S. W. ¼.
"	Reported	28 N.	5 E.	30	
"	Wooden Shoe Mine	28 N.	5 E.	33	E. ½, S. E. ¼.
"	King Mine	28 N.	5 E.	34	W. ½, S. W. ¼.
"	Sawyer Mine	28 N.	5 E.	34	N. ½, N. W. ¼.
"	Harness and Lundy Mine	28 N.	5 E.	34	N. E. ¼, N. W. ¼.
"	Reported (Mason & Clarkson)	28 N.	5 E.	35	
"	St. Francois Mine	28 N.	6 E.	5	W. ½ Lot 1, N. E. ¼.
"	Reported (Holladay, H. N.).	28 N.	6 E.	5	S. W. ¼.
"	Reported	28 N.	6 E.	6	S. W. ¼.
"	Warmuck, Wm., Land	28 N.	6 E.	8	N. E. ¼, S. E. ¼.
"	Sneathen & Co., Land No. 1.	28 N.	6 E.	8	S. W. ¼.
"	Bennett-Smith Mine	28 N.	6 E.	8	W. ½, N. E. ¼.
"	Folsom, Alex., Land	28 N.	6 E.	10 and 11 (line between).	
"	Berry, Wm., Land No. 1	28 N.	6 E.	15	
"	Berry, Wm., Land No. 2	28 N.	6 E.	15	S. W. ¼.
"	Johnson, Lewis, Bank	28 N.	6 E.	15	N. E. ¼, S. W. ¼.
"	Sneathen & Co., Land No. 3.	28 N.	6 E.	15 and 22 (line between).	
"	Tower, Geo. F., Land	28 N.	6 E.	16	S. E. ¼.
"	Atkins Estate Land	28 N.	6 E.	19	N. W. ¼.
"	Sneathen & Co., Land No. 2.	28 N.	6 E.	22	
"	Reported	28 N.	6 E.	27	S. W. ¼, S. W. ¼ and N. W. ¼, S. E. ¼.
"	Reported	28 N.	6 E.	27	N. ½, S. W. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Wayne	Jines, F., Bank	28 N.	7 E.	28	N. W. ¼.
"	Reported (Bennett, Perry)	28 N.	7 E.	30	
Bollinger	Dondore, L. T., Land	28 N.	8 E.	7, 8, 17 and 18.	
"	Reported	28 N.	8 E.	17	N. W. ¼, N. W. ¼.
Carter	Reported (Abbott, M.)	28 N.	2 W.	31	S. E. ¼, S. E. ¼.
Shannon	Reported (Deweese, J. N.)	28 N.	3 W.	6	S. W. ¼, N. E. ¼.
"	Reported	28 N.	3 W.	7	N. E. ¼, S. W. ¼.
"	Reported (Munsell, L. L.)	28 N.	3 W.	17	N. ½, N. E. ¼.
"	Reported (Munsell, L. L.)	28 N.	3 W.	22	S. W. ¼, N. E. ¼.
"	Dean, J. H., Land	28 N.	3 W.	30	S. ½ Lot 2, N. W. ¼.
"	Embree Land	28 N.	4 W.	12	N. W. ¼, N. W. ¼.
"	Government Land No. 5	28 N.	4 W.	24	S. E. ¼, N. E. ¼.
"	Government Land	28 N.	4 W.	25	S. E. ¼, N. E. ¼.
Texas	Reported	28 N.	7 W.	36	
"	Reported	28 N.	11 W.	18	N. E. ¼ and S. E. ¼.
"	Smalley, H. H., Land	28 N.	11 W.	36	
Greene	Studley, Jos., Mine	28 N.	23 W.	4	S. E. ¼.
"	Bayliss Land	28 N.	23 W.	16	W. ½, S. W. ¼.
"	Jackson, Geo., Bank	28 N.	24 W.	11	N. E. ¼, S. E. ¼. S. W. ¼, S. E. ¼.
"	Jackson, Jno., Mine	28 N.	24 W.	12	N. W. ¼, S. E. ¼.
Reynolds	Evans, A. J., Land	29 N.	1 E.	8	S. E. ¼, S. W. ¼.
"	Evans-Johnson Land	29 N.	1 E.	8	N. W. ¼, S. E. ¼.
"	Mo. Lum. & Min. Co., Land No. 1	29 N.	1 E.	12	S. ½.
Wayne	Bear Mt. Bank	29 N.	3 E.	2	N. W. ¼.
"	Anderson, N. M., Mine	29 N.	3 E.	2	
"	Anderson, N. M., Bank	29 N.	3 E.	3	S. W. ¼.
"	Reported	29 N.	3 E.	4	W. ½ Lot 1, N. E. ¼. N. E. ¼, N. W. ¼. S. E. ¼. S. ½. S. E. ¼ and S. ½, S. W. ¼.
"	Daniel Mine	29 N.	3 E.	25	S. E. ¼.
"	Guest, W. S., Bank	29 N.	3 E.	35	N. E. ¼.
"	Guest, W. S., Land	29 N.	3 E.	36	N. E. ¼.
"	Clarks Mountain	29 N.	4 E.	5	W. ½, S. E. ¼.
"	Cheeney Bank	29 N.	4 E.	21	N. E. ¼, S. E. ¼.
"	Reported	29 N.	4 E.	25	S. E. ¼.
"	Reported	29 N.	5 E.	31	S. E. ¼.
"	Jennie Mine	29 N.	6 E.	5	S. W. ¼.
"	Reported (Cross, Wilson)	29 N.	6 E.	16	S. E. ¼, S. W. ¼.
"	White, R., Mine	29 N.	6 E.	19	N. E. ¼, S. W. ¼. N. W. ¼, S. E. ¼.
"	Talley, J. H., Land	29 N.	6 E.	20	S. W. ¼, N. E. ¼.
"	Myers Mine	29 N.	6 E.	20	E. ½, S. E. ¼.
"	White, W., Mine	29 N.	6 E.	26	S. ½, N. W. ¼.
"	Sneathen Co., Land No. 4	29 N.	6 E.	21	S. W. ¼, N. W. ¼.
"	Reported (Cross, Wilson)	29 N.	6 E.	21	S. E. ¼, N. W. ¼.
"	Burton Mine	29 N.	6 E.	21	W. ½, S. W. ¼.
"	Zippy, John, Mine	29 N.	6 E.	27	N. W. ¼, S. W. ¼.
"	Haggard Land	29 N.	6 E.	28	S. W. ¼, S. W. ¼.
"	White, W. E., Land	29 N.	6 E.	29	N. W. ¼, S. E. ¼.
"	Twidwell Bank	29 N.	6 E.	30	N. E. ¼, S. W. ¼. N. W. ¼, S. E. ¼.
"	Reported	29 N.	6 E.	32	
"	Reported	29 N.	7 E.	2	W. ½ Lot 2, N. W. ¼.
"	Speers Mt	29 N.	7 E.	3	W. ½ Lot 2, N. W. ¼.
"	Higgins Mine	29 N.	7 E.	5	S. W. ¼, S. E. ¼.
"	Lambert Mine	29 N.	7 E.	5	N. W. ¼, S. W. ¼.
"	Reported (Sneathen Estate)	29 N.	7 E.	7	S. W. ¼, S. E. ¼.
"	McKenzie No. 1 Bank	29 N.	7 E.	7	N. E. ¼, S. E. ¼.
"	McKenzie, Bank No. 2	29 N.	7 E.	7	S. W. ¼, N. E. ¼.
"	Wayne Iron & Lumber Co., Land No. 1	29 N.	7 E.	8	N. E. ¼, N. W. ¼.
"	Lilly Hollow Mine	29 N.	7 E.	9	S. W. ¼, S. E. ¼.
"	Long & Colby Bank	29 N.	7 E.	18	N. W. ¼, N. E. ¼.
"	Barker Bank	29 N.	7 E.	31	S. W. ¼, N. E. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Bollinger	Reported	29 N.	8 E.	25	N. W. ¼, N. W. ¼.
"	Howell, J. C., Land	29 N.	8 E.	26	N. W. ¼, N. E. ¼.
"	Reported (Wells, Sarah)	29 N.	9 E.	1	N. W. ¼, N. W. ¼.
"	Reported (Wells, Sarah)	29 N.	9 E.	1	N. E. ¼, N. E. ¼.
"	Reported	29 N.	9 E.	1	S. E. ¼, N. W. ¼.
"	Reported	29 N.	9 E.	2	N. W. ¼, N. E. ¼.
"	Reported	29 N.	9 E.	2	N. W. ¼.
"	Reported	29 N.	9 E.	2	N. E. ¼, N. E. ¼.
"	Reported (Cato, Peter)	29 N.	9 E.	3	S. W. ¼, N. E. ¼.
"	Reported	29 N.	9 E.	9	E. ½, S. E. ¼.
"	Shell, T. W., Bank	29 N.	9 E.	10	N. E. ¼, S. E. ¼.
"	Revelle Bank	29 N.	9 E.	10	N. E. ¼, S. W. ¼.
"	Reported	29 N.	9 E.	21	N. W. ¼, S. E. ¼.
"	Reported	29 N.	9 E.	23	
"	Reported (Golden, Peter)	29 N.	9 E.	27	S. W. ¼, S. W. ¼.
"	Reported (Davis, A.)	29 N.	9 E.	28	S. E. ¼, N. E. ¼.
"	Lemon, Thompson, Land	29 N.	9 E.	30	S. ½ Lot 3.
"	Bollinger, B. H., Land	29 N.	9 E.	31	S. E. ¼, N. E. ¼.
"	Reported	29 N.	9 E.	31	S. W. ¼, N. W. ¼.
"	Reported (Pioneer C. Co.)	29 N.	9 E.	34	S. W. ¼, S. E. ¼.
"	Boyer, A. F., Land	29 N.	9 E.	34	S. E. ¼, N. W. ¼.
"	Reported (Sarah Wells)	29 N.	9 E.	35	N. W. ¼, S. E. ¼.
"	Reported (Carelton, A. T.)	29 N.	9 E.	35	S. E. ¼, N. E. ¼.
"	Reported (Harris, S. E.)	29 N.	9 E.	35	S. E. ¼, S. E. ¼.
Shannon	Tripp, G. W., Land	29 N.	3 W.	31	N. E. ¼, S. E. ¼.
"	Reported (Carson & James)	29 N.	4 W.	15	S. E. ¼.
"	Chilton Bank	29 N.	4 W.	27	N. E. ¼, N. W. ¼.
"	West Eminence Bank	29 N.	4 W.	34	N. W. ¼.
"	Reported (Mo. Lum. & Min. Co.)	29 N.	5 W.	3	W. ½, S. W. ¼.
"	Mo. Lum. & Min. Co. No. 15.	29 N.	5 W.	9	S. E. ¼, N. W. ¼.
"	Reported	29 N.	5 W.	10	S. ½, S. W. ¼.
Texas	Government Land No. 6	29 N.	9 W.	6	E. ½ Lot 3, N. W. ¼.
Greene	Welsh Land	29 N.	23 W.	6	N. ½, N. W. ¼.
"	Noble Land	29 N.	24 W.	1	S. ½, N. E. ¼.
"	Helm, J. A., Mine	29 N.	24 W.	26	N. ½.
Reynolds	Mo. Lum. & Min. Co., Land No. 2	30 N.	1 E.	34	S. ½.
"	Laclede Lumber Co. Land	30 N.	2 E.	19	
Iron	Reported	30 N.	3 E.	2	S. E. ¼, S. E. ¼.
"	Graves, E. W	30 N.	3 E.	10	S. E. ¼, N. E. ¼.
Wayne	Yancy Mountain Bank	30 N.	4 E.	35	N. W. ¼, N. E. ¼.
"	Kister Bank	30 N.	4 E.	35	N. E. ¼, N. W. ¼.
"	Kinkad, Thomas, Land	30 N.	5 E.	13	S. W. ¼, S. E. ¼.
"	Kelly, Thomas, Land	30 N.	5 E.	24	W. ½, N. E. ¼.
Bollinger	Myers, W. C., Bank	30 N.	8 E.	32	S. E. ¼, N. E. ¼.
"	Reported	30 N.	9 E.	1	
"	Reported	30 N.	9 E.	2	N. W. ¼.
"	Reported (Eaker, G. S.)	30 N.	9 E.	10	E. ½.
"	Hahn, J., Mine	30 N.	9 E.	11	N. E. ¼, S. W. ¼.
"	Lutes (Jesse) Bank	30 N.	9 E.	11	N. E. ¼, N. W. ¼.
"	Reported	30 N.	9 E.	12	
"	Reported	30 N.	9 E.	13	
"	Glenn Emma Mine	30 N.	9 E.	16	N. E. ¼, N. W. ¼.
"	McGregor, H. P., Bank	30 N.	9 E.	16	S. W. ¼, N. W. ¼.
"	Murdock Bank	30 N.	9 E.	16	S. E. ¼, N. W. ¼.
"	Reported	30 N.	9 E.	18	N. E. ¼, N. E. ¼.
"	Lutes, Eli, Bank	30 N.	9 E.	25	S. W. ¼, S. E. ¼.
"	Gaines, Wm. E., Land	30 N.	9 E.	35	N. W. ¼, S. E. ¼.
"	Reported (Myers, J. W.)	30 N.	9 E.	35	N. E. ¼, S. W. ¼.
"	Reported (Levering, F. R.)	30 N.	9 E.	35	S. E. ¼, S. E. ¼.
"	Critts, G. W., Land	30 N.	9 E.	36	S. W. ¼, S. W. ¼.
"	Reported (Lutes, John)	30 N.	10 E.	7	
"	Reported	30 N.	10 E.	7	S. E. ¼.
"	Reported	30 N.	10 E.	16	N. W. ¼.
"	Reported	30 N.	10 E.	17	N. W. ¼.
Cape Girardeau	Reported	30 N.	12 E.	10	N. E. ¼.
Reynolds	Sutton, J. L., Land	30 N.	1 W.	34	S. W. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Shannon	Piatt, Sam	30 N.	4 W.	5	N. W. ¼, N. W. ¼.
"	Mo. Lum. & Min. Co. No. 34.	30 N.	5 W.	5	S. W. ¼.
"	Mo. Lum. & Min. Co. No. 33.	30 N.	5 W.	32	S. W. ¼, S. W. ¼.
"	Mo. Lum. & Min. Co. No. 32.	30 N.	6 W.	34	N. E. ¼, S. W. ¼.
Texas	Smith, N. W., Land	30 N.	9 W.	4	S. E. ¼, S. W. ¼.
"	Field Bank	30 N.	9 W.	11	
"	Sutton, T. G., Land	30 N.	9 W.	14	S. ½, N. E. ¼.
"	Duke, M. E., Land	30 N.	10 W.	1	
Greene	Pollack, C., Mine	30 N.	23 W.	4	S. E. ¼, S. E. ¼.
"	Jennings, R. H., Bank	30 N.	23 W.	9	N. W. ¼, N. E. ¼.
"	Clutter, J. W., Mine	30 N.	23 W.	23	N. E. ¼.
Dade	Compton, G. A., Mine	30 N.	25 W.	35	
Reynolds	Brooks, Wm., Land	31 N.	1 E.	6	Lot 2.
Madison	Reported	31 N.	5 E.	36	S. E. ¼, S. E ¼.
"	Reported	31 N.	7 E.	29	
Bollinger	Gilmore Mine	31 N.	8 E.	1	S. E. ¼, N. W ¼.
"	Whitener, G. C., Mine	31 N.	8 E.	2	N. W. ¼, S. W. ¼.
"	Richards, P., Mine	31 N.	8 E.	2	N. E. ¼, S. W. ¼.
"	Rogers Bank	31 N.	8 E.	11	N. E. ¼, S. W. ¼.
"	Rhodes Bank	31 N.	8 E.	14	S. W. ¼, S. W. ¼.
"	Robbins, Monroe, Bank	31 N.	9 E.	10	N. W. ¼, N. E. ¼.
"	Reported (McGregor)	31 N.	9 E.	29	N. W. ¼.
"	Reported	31 N.	10 E.	2	N. E. ¼.
"	Tibbs Bank	31 N.	10 E.	29	S. W. ¼.
"	Baker Bank	31 N.	10 E.	31	N. W. ¼, S. E. ¼.
"	Turkey Hill Bank	31 N.	10 E.	32	N. W. ¼.
"	Caldwell, J. G., Bank	31 N.	10 E.	32	S. W. ¼, S. W. ¼.
"	Reported	31 N.	10 E.	32	N. E. ¼.
Cape Girardeau	Reported	31 N.	13 E.	10	N. W. ¼.
Shannon	Reported (Biser, C. T.)	31 N.	3 W.	8	N. E. ¼.
"	Reported (Carson & James)	31 N.	3 W.	9	N. W. ¼.
"	Reported (Woodside, L. B.)	31 N.	3 W.	15	S. ½.
"	Reported	31 N.	4 W.	7	
"	Hurt, Samuel, Bank	31 N.	4 W.	17	N. ½, N. W. ¼.
"	Chrisco, Daniel, Bank	31 N.	4 W.	17	S. W. ¼.
"	Grandin Bank	31 N.	4 W.	19	S. W. ¼.
"	Woodside-Chrisco Bank	31 N.	4 W.	21	N. W. ¼.
"	Reported	31 N.	4 W.	24	N. ½.
"	Reported	31 N.	4 W.	27	N. W. ¼.
"	Carr Land	31 N.	4 W.	31	E. ½, N. E. ¼.
"	Reported	31 N.	4 W.	34	S. ½.
"	Reported (Organ & Swinney)	31 N.	5 W.	22	N. ½.
"	Reported (Organ & Swinney)	31 N.	5 W.	34	S. ½.
"	Reported	31 N.	6 W.	9	N. W. ¼.
"	Reported (Mo. Furnace Co.)	31 N.	6 W.	13	S. E. ¼, N. W. ¼.
"	Reported (Seay, A. J.)	31 N.	6 W.	16	
Texas	Reported (Ziegler, B.)	31 N.	9 W.	14	N. E. ¼, N. W. ¼.
"	Rodgers Mill Land	31 N.	9 W.	23	N. W. ¼, N. E. ¼.
Reynolds	Collins, E., Land No. 1	32 N.	2 E.	4	S. W. ¼, S. W. ¼.
"	Reported	32 N.	2 E.	5	N. W. ¼.
"	Kipp Land	32 N.	2 E.	5	S. E. ¼, N. E. ¼.
"	Collins, E., Land No. 2	32 N.	2 E.	8	N. E. ¼, N. E. ¼.
Madison	Mathews Mt. Bank	32 N.	6 E.	3	S. E. ¼, N. W. ¼.
Bollinger	Shrum Bank	32 N.	8 E.	11	N. W. ¼, S. E. ¼.
"	Fox, Daniel, Bank	32 N.	8 E.	23	N. W. ¼, S. E. ¼.
"	Lux, John, Bank	32 N.	8 E.	24	S. W. ¼, S. W ¼.
"	Pavlich, Joseph, Bank	32 N.	8 E.	26	S. W. ¼, S. W. ¼.
Cape Girardeau	Weiss, George, Bank	32 N.	13 E.	10	N. E. ¼.
Reynolds	Red Ore Bank	32 N.	2 W.	20	N. E. ¼.
Dent	Slater Bank	32 N.	3 W.	3	S. W. ¼, N. W. ¼.
"	Red Hill Mine	32 N.	3 W.	3	S. ½.
"	Bunker Bank	32 N.	3 W.	24	N. E. ¼.
"	Swinney, I. N., Land	32 N.	3 W.	33	S. E. ¼, S. E. ¼.
"	Reported	32 N.	4 W.	6	N. E. ¼.
"	Sligo Land	32 N.	6 W.	23	S. E. ¼.
"	Reported	32 N.	6 W.	30	N. E. ¼, S. E. ¼.
"	Reported	32 N.	6 W.	32	S. E. ¼, S. E. ¼.
Polk	Reported	32 N.	24 W.	27	S. E. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Polk	Henney Land	32 N.	24 W.	35	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
Iron	Russell Mt	33 N.	3 E.	3	S. E. $\frac{1}{4}$.
"	Shut-in-Mine	33 N.	4 E.	2	N. $\frac{1}{2}$.
"	Lewis Mt	33 N.	4 E.	6	S. $\frac{1}{2}$.
"	Cuthbertson's Hill	33 N.	4 E.	19	
Madison	Reported	33 N.	6 E.	6	Lot 3, N. W. $\frac{1}{4}$.
"	Reported	33 N.	6 E.	34	W. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
"	Parkin, F. J., Bank	33 N.	7 E.	14	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Foster Mine	33 N.	7 E.	16	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
"	Valle Bank	33 N.	7 E.	21	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
"	Clay, H., Mine	33 N.	7 E.	25	E. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
"	Ford Mine	33 N.	7 E.	25	S. $\frac{1}{2}$, N. E. $\frac{1}{4}$.
"	Forsyth, P. J., Bank	33 N.	7 E.	25	S. E. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Mine LaMotte Bank No. 2	33 N.	7 E.	35	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
Perry	Gerler, Frederick, Bank	33 N.	13 E.	1	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
Cape Girardeau	Shurbern & Burden Land	33 N.	13 E.	25	W. $\frac{1}{2}$.
Perry	Reported	33 N.	14 E.	6	S. $\frac{1}{2}$.
Reynolds	Reported	33 N.	1 W.	8	
Dent	Nova Scotia Mine	33 N.	4 W.	26	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
"	Riverside-Zegler Mine	33 N.	5 W.	2	
"	Stevens & Woodside Mine	33 N.	5 W.	4	E. $\frac{1}{2}$, S. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$. E. $\frac{1}{2}$, N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
"	Reported (Grogan Land)	33 N.	5 W.	18	S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
"	Jamison Mine	33 N.	6 W.	1	S. W. $\frac{1}{4}$.
"	Kerr Bank	33 N.	6 W.	4	W. $\frac{1}{2}$, N. W. $\frac{1}{4}$.
Polk	Akard, J. P., Land	33 N.	24 W.	5	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Iron	Reported	34 N.	1 E.	7 and 15.	
"	Cedar Hill Mine	34 N.	4 E.	19	S. W. $\frac{1}{4}$.
"	Pilot Knob	34 N.	4 E.	29	W. $\frac{1}{2}$.
"	Shepherd Mt	34 N.	4 E.	31	
St. Francois	Mine LaMotte Bank No. 1	34 N.	7 E.	17	Mine LaMotte Grant.
Perry	Reported	34 N.	13 E.	36	
"	Reported	34 N.	14 E.	19	
Iron	Reported	34 N.	1 W.	1, 12 and 27.	
"	Rogers Bank	34 N.	1 W.	2	
"	Burt Bank	34 N.	1 W.	2	
"	Reported	34 N.	1 W.	34	
"	Reported	34 N.	2 W.	1 and 14.	
"	Red Point Land	34 N.	2 W.	14 and 15.	
Dent	Howe Mill Bank	34 N.	3 W.	9	
"	Eddington Mine	34 N.	3 W.	19	S. $\frac{1}{2}$.
"	Hutchins Creek Mine	34 N.	4 W.	15	
"	Norris Mine	34 N.	5 W.	12	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Orchard Mine	34 N.	5 W.	19	N. W. $\frac{1}{4}$.
"	Hayes Mine	34 N.	5 W.	20	N. E. $\frac{1}{4}$.
"	Pomeroy Mine	34 N.	6 W.	10	N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$.
"	Ferguson Mine	34 N.	6 W.	13	
"	Lenox Mine	34 N.	6 W.	17	N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
"	Thomas Mine	34 N.	6 W.	17	S. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Simmons Mt	34 N.	6 W.	24	W. $\frac{1}{2}$.
"	Preston Mine	34 N.	6 W.	27	N. $\frac{1}{2}$.
"	Clark Mine	34 N.	7 W.	12	S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$.
"	Causey Mine	34 N.	7 W.	25	S. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Washington	Reported	35 N.	1 E.	7	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Reported	35 N.	1 E.	7	S. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Reported	35 N.	1 E.	7	S. W. $\frac{1}{4}$.
"	Reported	35 N.	1 E.	17	N. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
"	Reported	35 N.	1 E.	18	N. W. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
Iron	Reported	35 N.	1 E.	20 and 32.	
Washington	Adams Property	35 N.	2 E.	4	N. E. $\frac{1}{4}$.
"	Reported	35 N.	2 E.	13	
"	Reported	35 N.	2 E.	14	N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$.
"	Prewitt Mountain	35 N.	2 E.	16	
"	Reported	35 N.	3 E.	13	S. W. $\frac{1}{4}$, N. W. $\frac{1}{4}$.
Iron	Buford Mountain	35 N.	3 E.	34	
St. Francois	Iron Mountain	35 N.	4 E.	31	
Ste. Genevieve	Reported	35 N.	8 E.	7	

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Washington	Reported	35 N.	1 W.	16	S. W. ¼, N. E. ¼ and N. W. ¼, S. E. ¼.
Iron	Reported	35 N.	1 W.	35	
Dent	Sligo Mine	35 N.	4 W.	2	
"	Grover Mine	35 N.	4 W.	2 11	S. W. ¼. N. W. ¼.
"	Fitzwater Mine	35 N.	4 W.	33 34	N. E. ¼. N. W. ¼.
"	Arnold Mine	35 N.	5 W.	4	S. E. ¼.
"	Blair Mine	35 N.	6 W.	9	S. ½.
"	Hawkins Mine	35 N.	6 W.	11	Center of E. ½.
"	Reported (Graff-Blackwell)	35 N.	6 W.	12	Center of N. ½.
"	Williams Mine	35 N.	6 W.	16	N. ½.
"	Plank Mine	35 N.	6 W.	33	
"	Watkins Mine	35 N.	7 W.	12	N. W. ¼, N. E. ¼.
Phelps	Horse Hollow Bank	35 N.	9 W.	1	N. W. ¼.
"	Ozark Bank	35 N.	9 W.	3	N. W. ¼.
Dallas	Day, Walter, Land	35 N.	20 W.	1	S. ½.
"	Booth, Henry, Land	35 N.	20 W.	2	S. ½.
Washington	Reported	36 N.	1 E.	24	N. E. ¼, N. E. ¼.
"	Reported	36 N.	2 E.	27	N. E. ¼.
"	Desloge Property	36 N.	2 E.	30	N. E. ¼.
"	Nicholson, W. E., Bank	36 N.	2 E.	33	N. E. ¼.
"	Reported	36 N.	3 E.	16	S. W. ¼, S. E. ¼.
Crawford	Thompson Mine	36 N.	4 W.	26	
"	Rees Mine	36 N.	4 W.	27	E. ½.
"	McGary Mine	36 N.	4 W.	29	S. W. ¼, N. W. ¼.
"	Hibler Land	36 N.	4 W.	34	W. ½.
"	James Mine	36 N.	5 W.	12	Center.
"	Vaughn, F. E., Bank	36 N.	5 W.	13	N. E. ¼.
"	Craig Mine	36 N.	5 W.	24	S. E. ¼, N. W. ¼.
"	Benton Creek Mine	36 N.	5 W.	32	S. E. ¼.
Phelps	Kelley Mine No. 3	36 N.	6 W.	6	S. W. ¼.
"	Stimson Mine	36 N.	6 W.	10	S. W. ¼.
"	Winkler Bank	36 N.	6 W.	14	S. ½.
"	African Mine	36 N.	6 W.	22	S. E. ¼.
"	Clark Mine	36 N.	6 W.	23	
"	Reported (Chambers, J. A.)	36 N.	6 W.	26	N. E. ¼, S. W. ¼.
"	Clinton Mine	36 N.	6 W.	26	S. W. ¼, S. W. ¼.
"	Smith Mine	36 N.	6 W.	27	S. ½, S. W. ¼.
"	Brady Mine	36 N.	6 W.	27	S. E. ¼.
"	Burns Mine	36 N.	6 W.	34	
"	Lamb, J., Mine	36 N.	6 W.	35	N. W. ¼.
"	Hyer Mine	36 N.	7 W.	26	
"	Reported (Railroad Land)	36 N.	8 W.	4	N. W. ¼.
"	Kelley Mine No. 1	36 N.	8 W.	18	E. ½.
"	Moselle Mine No. 10	36 N.	8 W.	20	N. W. ¼, N. E. ¼.
"	Rep't'd (Moselle Land No. 2)	36 N.	8 W.	20	N. E. ¼.
"	Rep't'd (Southgate Land)	36 N.	8 W.	20	N. W. ¼.
"	Moselle Mine No. 1	36 N.	8 W.	26	S. E. ¼.
"	See Mine	36 N.	8 W.	36	S. E. ¼.
"	Little Piney No. 1	36 N.	9 W.	2	S. E. ¼, S. E. ¼.
"	Little Piney No. 2	36 N.	9 W.	11	N. E. ¼, N. E. ¼.
Pulaski	Reported	36 N.	11 W.	30	N. E. ¼.
Laclede	Reported	36 N.	14 W.	25	
Ste. Genevieve	Reported	37 N.	7 E.	12	
"	Naeger, Peter, Bank	37 N.	8 E.	11	S. E. ¼.
Crawford	Cherry Valley Mine No. 1	37 N.	3 W.	4	E. ½, S. W. ¼.
"	Cherry Valley Mine No. 2	37 N.	3 W.	4	W. ½, S. E. ¼.
"	Marsh Mine	37 N.	4 W.	5	N. E. ¼, N. E. ¼.
"	Steelville No. 2 Bank	37 N.	4 W.	5	E. ½, S. W. ¼.
"	Peetz Bank	37 N.	4 W.	9	S. E. ¼, N. W. ¼.
"	Ferguson Mine	37 N.	4 W.	21	
"	Buffum Mine	37 N.	4 W.	32	
"	Hart Mine	37 N.	5 W.	24	
Phelps	Meramec Mine	37 N.	6 W.	1	N. W. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Phelps	Cooper, Jerry, Bank	37 N.	6 W.	17	S. E. ¼, N. W. ¼.
"	Reported (McDole Land)	37 N.	6 W.	23	N. W. ¼.
"	Reported (Grand Union)	37 N.	6 W.	31	
"	Reed Mine	37 N.	6 W.	31	N. W. ¼, N. W. ¼.
"	DeCamp Mine	37 N.	6 W.	32	S. W. ¼, N. E. ¼.
"	Williford Mine	37 N.	6 W.	36	
"	Lenox Mine	37 N.	7 W.	36	
"	Taylor's Rolla Mine	37 N.	8 W.	15	S. W. ¼.
"	Buckland Mine	37 N.	8 W.	20	N. E. ¼, S. W. ¼.
"	Kelley Mine No. 2	37 N.	8 W.	21	N. E. ¼.
"	Hudgeons Mine	37 N.	8 W.	31	N. W. ¼.
"	Beaver Creek Mine	37 N.	8 W.	33	S. ½.
"	Strawhan Bank	37 N.	9 W.	2	N. W. ¼.
"	Ozark Branch	37 N.	9 W.	16	N. E. ¼, S. W. ¼.
"	Agricultural College Land	37 N.	10 W.	13	N. E. ¼, N. E. ¼.
Pulaski	Specular Bank	37 N.	12 W.	31	
St. Francois	Mar's Hill	38 N.	5 E.	23	S. W. ¼, N. E. ¼.
Washington	Reported	38 N.	1 W.	3	Lots 1 and 2, N.E.¼.
Crawford	Reported (Smith, G. L. W.)	38 N.	2 W.	4	Center.
"	Christy Bank	38 N.	2 W.	12	S. E. ¼, N. W. ¼.
"	Scotia Mine No. 1	38 N.	3 W.	1	E. ½, S. E. ¼.
"	Knox Bank	38 N.	3 W.	26	E. ½, S. E. ¼.
"	Zane Mine	38 N.	4 W.	13	N. W. ¼.
"	Griffith Mine	38 N.	4 W.	14	S. E. ¼, S. E. ¼.
"	Clark Mine	38 N.	4 W.	26	N. E. ¼, N. E. ¼.
"	Card Mine	38 N.	5 W.	13	S. E. ¼.
Phelps	South Mountain Mine	38 N.	6 W.	23	
"	Moselle & James Mine	38 N.	6 W.	29	S. ½, S. E. ¼.
"	Santee & Clark Mine	38 N.	6 W.	33	S. W. ¼.
"	Thornton-Dowling Mine	38 N.	6 W.	33	N. E. ¼.
"	Strahan	38 N.	9 W.	25	Center.
Maries	Reported	38 N.	9 W.	28	
"	Reported	38 N.	9 W.	30	
Miller	Reported	38 N.	12 W.	14	N. E. ¼.
"	Reported	38 N.	14 W.	11	S. ½.
St. Clair	Sheldon Land	38 N.	24 W.	8	N. E. ¼.
Washington	Reported	39 N.	1 E.	4	Lot 1, N. E. ¼.
"	Reported	39 N.	1 E.	33	S. E. ¼, N. W. ¼.
Jefferson	Prentiss Bank	39 N.	4 E.	4	N. E. ¼.
"	Reported	39 N.	6 E.	13	
Crawford	Scotia Mine No. 2	39 N.	2 W.	28	S. E. ¼.
"	Reported (Smith, G. L. W.)	39 N.	3 W.	13	E. ½, N. E. ¼.
"	Pinnel Mine	39 N.	5 W.	27	S. ½, S. W. ¼.
"	Iron Ridge Mine No. 1	39 N.	5 W.	29	N. E. ¼.
"	Iron Ridge Mine No. 2	39 N.	5 W.	33	
"	Varris Bank	39 N.	5 W.	33	S. W. ¼, S. E. ¼.
Maries	McNamara Mine	39 N.	8 W.	2	S. W. ¼, N. E. ¼.
"	Reported	39 N.	11 W.	5	
Miller	Reported	39 N.	12 W.	5	Lot 1.
"	Reported	39 N.	12 W.	7	N. W. ¼, N. E. ¼.
"	Bolin Creek Bank	39 N.	12 W.	15	S. W. ¼.
"	Reported	39 N.	12 W.	26	N. E. ¼.
"	Reported	39 N.	12 W.	31	N. E. ¼, N. W. ¼.
"	Bond Iron Banks	39 N.	13 W.	15	N. E. ¼.
"	Reported	39 N.	13 W.	12	S. W. ¼.
"	Reported	39 N.	15 W.	26	N. W. ¼.
Camden	Furnace Bank	39 N.	18 W.	4	Lot 3.
"	White Bank	39 N.	18 W.	7	S. E. ¼.
Benton	Richwoods Bank	39 N.	22 W.	3 and 4.	
St. Clair	Grover Bank	39 N.	24 W.	16	
"	Green, T. F., Bank	39 N.	24 W.	27	S. W. ¼.
"	Greenwell Bank	39 N.	25 W.	15	
"	Collins Bank	39 N.	25 W.	23	
"	Marmaduke Bank	39 N.	25 W.	23	
Franklin	Reported	40 N.	1 E.	11	W. ½.
"	Reported	40 N.	1 E.	12	S. E. ¼.
"	Silver Hollow Mine	40 N.	1 W.	8	N. E. ¼, N. W. ¼.
Washington	Blanton Limonite Mine	40 N.	1 W.	29	S. ½, S. W. ¼.

County.	*Name of Mine or Owner.*	*Twp.*	*R.*	*Sec.*	*Fractional.*
Washington	Blanton Specular Mine	40 N.	1 W.	29	N. ½, S. E. ¼.
"	Reported	40 N.	1 W.	31	S. W. ¼, N. W. ¼.
"	Primrose Hill Mine	40 N.	1 W.	32	S. W. ¼, N. W. ¼.
"	Reported	40 N.	1 W.	33	S. W. ¼, S. E. ¼.
Crawford	Copper Hill Mine	40 N.	2 W.	24	S. W. ¼, N. W. ¼.
"	Taylor Mine	40 N.	5 W.	33	S. ½, S. E. ¼.
Maries	Reported	40 N.	9 W.	2	
Miller	Reported	40 N.	12 W.	1	S. W. ¼, S. E. ¼.
"	Reported	40 N.	12 W.	2	N. E. ¼.
"	Reported	40 N.	12 W.	24	S. W. ¼.
"	Reported	40 N.	12 W.	25	N. E. ¼.
"	Reported	40 N.	12 W.	25	N. E. ¼, S. E. ¼.
"	Lambert Iron Bank	40 N.	13 W.	5	W. ½ Lot 1, N.W.¼.
"	Reported	40 N.	13 W.	6	N. W. ¼.
"	McDonald Bank No. 1	40 N.	13 W.	15	S. W. ¼.
"	Reported	40 N.	13 W.	17	S. W. ¼.
"	Reported	40 N.	13 W.	18	N. W. ¼.
"	Reported	40 N.	13 W.	18	S. E. ¼, S. W. ¼.
"	McDonald Bank No. 2	40 N.	13 W.	23	S. W. ¼.
"	Reported	40 N.	13 W.	33	S. W. ¼.
"	Reported	40 N.	14 W.	13	S. W. ¼.
"	Reported	40 N.	15 W.	32	N. W. ¼.
Morgan	Wigwam Bank	40 N.	19 W.	10	
"	Palm Bank	40 N.	19 W.	12	N. W. ¼.
"	Cout's Bank	40 N.	19 W.	14	
Benton	Gun Bank	40 N.	20 W.	33	
"	Carpenter Bank	40 N.	21 W.	12	
"	Grissam Land	40 N.	21 W.	28	
"	Miller (Chas.) Land	40 N.	23 W.	8	S. ½.
"	Smith Mine	40 N.	23 W.	16	E. ½.
Franklin	Bowlen Bank	41 N.	2 E.	5	N. W. ¼.
"	Hibbard Mine	41 N.	1 W.	3	S. E. ¼.
"	Reported (Anaconda Tract)	41 N.	1 W.	16	
"	Iron Hill Mine	41 N.	1 W.	17	
"	Thurmond Mine	41 N.	1 W.	19	N. ½, N. W. ¼.
"	Judith Spring Mine	41 N.	1 W.	18	N. W. ¼.
"	Booth Mine	41 N.	1 W.	27	N. E. ¼.
"	Stanton Hill Bank	41 N.	2 W.	36	S. W. ¼, N. E. ¼.
Osage	Reported	41 N.	7 W.	4 and 5.	
"	Reported	41 N.	11 W.	17	
Miller	Reported	41 N.	12 W.	29	N. E. ¼.
"	Reported	41 N.	12 W.	29	N. W. ¼.
"	Reported	41 N.	13 W.	31	S. W. ¼.
Morgan	Gravois Bank	41 N.	17 W.	27	N. W. ¼, S. W. ¼.
Benton	Walker Bank	41 N.	20 W.	36	
"	Sands Land	41 N.	22 W.	36	S. E. ¼.
Henry	Brownington Bank	41 N.	25 W.	20	
"	Clinton Deposit	41 N.	26 W.	in Clinton.	
Franklin	Iron Hill Bank	42 N.	1 E.	17	
"	Wildy, Isaac, Mine	42 N.	1 E.	17	S. W. ¼, S. W. ¼.
"	Bartle, J. H., Bank	42 N.	1 E.	20	N. E. ¼, N. W. ¼.
"	Drake, Wm. F., Bank	42 N.	2 E.	30	N. E. ¼, S. E. ¼.
"	St. Clair Mine	42 N.	1 W.	28	S. E. ¼.
"	Temme, Aug	42 N.	2 W.	1	N. E. ¼, N. W. ¼.
"	Kleinsorde, Hannah, Bank	42 N.	3 W.	8	S. W. ¼, N. E. ¼.
"	Leslie Mine	42 N.	3 W.	15	S. E. ¼, N. W. ¼.
Gasconade	Reported (Pletz, F.)	42 N.	5 W.	24	S. E. ¼, N. W. ¼.
"	Reported (Diestlecamp)	42 N.	5 W.	28	N. E. ¼, S. W. ¼.
Osage	Reported	42 N.	11 W.	20	
Cole	Gaty (E. W.) Land	42 N.	12 W.	21	
"	Lothian, B., Land	42 N.	12 W.	22	
Benton	Indian Creek Bank	42 N.	21 W.	26	
Franklin	Pletz, F., Bank	43 N.	3 W.	15	N. E. ¼, S. W. ¼.
"	Reported	43 N.	4 W.	23	N. ½.
Gasconade	Pehle, Adolph	43 N.	4 W.	28	N. E. ¼, S. E. ¼.
Franklin	Sickendick, Wm., Land	43 N.	4 W.	34	S. E. ¼, S. E. ¼.
"	Reported (Gordeke, Chas.)	43 N.	4 W.	35	N. E. ¼, S. E. ¼.
Osage	Reported	43 N.	7 W.	33	

County.	Name of Mine or Owner.	Twp.	R.	Sec.	Fractional.
Osage..........	Reported..................	43 N.	7 W.	34	S. E. ¼.
"	Reported..................	43 N.	8 W.	7	
"	Reported..................	43 N.	8 W.	34	
"	Reported..................	43 N.	9 W.	12	
Henry..........	Brown Bank...............	43 N.	25 W.	25	
Osage..........	Reported..................	44 N.	7 W.	15	
Callaway.......	Bartlett Land..............	45 N.	10 W.	4	N. E. ¼.
"	Shaft Hill.................	45 N.	10 W.	4	N. W. ¼.
"	Murphy's Hill.............	45 N.	10 W.	15	
"	Old Diggings...............	45 N.	10 W.	22	
"	Henderson Bank...........	45 N.	11 W.	12	
Warren.........	Sandmeyer, E., Land.......	46 N.	2 W.	21	W. ½.
Callaway.......	Knight Bank...............	46 N.	10 W.	2	
"	Dunn, Richard, Bank.......	46 N.	10 W.	21	
"	Dunn, Ralph, Bank.........	46 N.	10 W.	32	
Lincoln.........	Morris Bank...............	50 N.	1 W.	36	
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